Visveswaraya Technological University
Scheme and Syllabus
Effective from AY 2022-23

Visvesvaraya Technological University, Belagavi
Scheme of Teaching and Examinations-2022
Outcome-Based Education(OBE)and Choice Based Credit System(CBCS)
(Effective from the academic year 2022-23)

II Semester (Mechanical Engineering Stream) **(For the students who have attended 1semster under Chemistry Group)**

Sl. No	Course and Course Code		Course Title	TD/PSB	Teaching Hours/Week				Examination				Credits
					Theory Lecture L	Tutorial T	Practical/ Drawing P	SDA S	Duration in hours	CIE Marks	SEE Marks	Total Marks	
1	*ASC(IC)	BMATM201	Mathematics for ME Streams-II	Maths	3	0	2	0	03	50	50	100	04
2	#ASC(IC)	BPHYM202	Physics for ME Streams	PHY	2	2	2	0	03	50	50	100	04
3	ESC	BEME203	Elements of Mechanical Engineering	Mechanical	2	2	0	0	03	50	50	100	03
4	ESC-II	BESCK204x	Engineering Science Course-II	Respective Engg Dept	3	0	0	0	03	50	50	100	03
5	PLC-II	BPLCK205x	Programming Language Course-II	Any Dept	2	0	2	0	03	50	50	100	03
	OR												
	ETC-II	BETCK205x	Emerging Technology Course-II		3	0	0	0	03				
6	AEC	BPWSK206	Professional Writing Skills in English	Humanities	0	2	0	0	01	50	50	100	01
7	HSMC	BKSKK207 BKBKK207	Samskrutika Kannada/ Balake Kannada	Humanities	0	2	0	0	01	50	50	100	01
		OR											
		BICOK207	Indian Constitution										
8	AEC/SDC	BIDTK258	Innovation and Design Thinking	Any Dept	0	0	2	0	02	50	50	100	01
		OR											
		BSFHK258	Scientific Foundations of Health		1	0	0	0	01				
				TOTAL						**400**	**400**	**800**	**20**

SDA-Skill Development Activities, **TD/PSB**- Teaching Department / Paper Setting Board, **ASC**-Applied Science Course, **ESC**- Engineering Science Courses, **ETC**- Emerging

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(ESC-II) Engineering Science Courses-II				
Code	**Title**	**L**	**T**	**P**
BESCK204A	Introduction to Civil Engineering	3	0	0
BESCK204B	Introduction to Electrical Engineering	3	0	0
BESCK204C	Introduction to Electronics Engineering	3	0	0
BESCK204D	Introduction to Mechanical Engineering	3	0	0
BESCK204E	Introduction to C Programming	2	0	2

(ETC-II) Emerging Technology Courses-II				
Code	**Title**	**L**	**T**	**P**
BETCK205A	Smart materials and Systems	3	0	0
BETCK205B	Green Buildings	3	0	0
BETCK205C	Introduction to Nano Technology	3	0	0
BETCK205D	Introduction to Sustainable Engineering	3	0	0
BETCK205E	Renewable Energy Sources	3	0	0
BETCK205F	Waste Management	3	0	0
BETCK205G	Emerging Applications of Biosensors	3	0	0
BETCK205H	Introduction to Internet of Things(IoT)	3	0	0
BETCK205I	Introduction to Cyber Security	3	0	0
BETCK205J	**Introduction to Embedded System**	**3**	**0**	**0**

(PLC-II) Programming Language Courses-II				
Code	**Title**	**L**	**T**	**P**
BPLCK205A	Introduction to Web Programming	2	0	2
BPLCK205B	Introduction to Python Programming	2	0	2
BPLCK205C	Basics to JAVA programming	2	0	2
BPLCK205D	Introduction to C++ Programming	2	0	2

The course BESCK204E, **Introduction to C Programming, and all courses under PLC and ETC groups can be taught by faculty of ANY DEPARTMENT**

- The student has to select one course from the ESC-II group.
- Mechanical Engineering stream Students shall opt for any one of the courses from the ESC-II group **except,** BESCK204D **-Introduction to Mechanical Engineering**
- The students have to opt for the courses from ESC group without repeating the course in either 1st or 2nd semester
- The students must select one course from either ETC-II or PLC-II group.
- If students study the subject from ETC-I in 1st semester he/she has to select the course from PLC-II in the 2nd semester and vice-versa

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Visvesvaraya Technological University, Belagavi
Scheme of Teaching and Examinations-2022
Outcome-Based Education(OBE)and Choice Based Credit System(CBCS)
(Effective from the academic year 2022-23)

II Semester(Mechanical Engineering Stream) **(For the students who attend the 1st semester under Physics Group)**

Sl. No	Course and Course Code		Course Title	TD/PSB	Teaching Hours/Week				Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	SDA	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1	*ASC(IC)	BMATM201	Mathematics for MES-II	Maths	2	2	2	0	03	50	50	100	04
2	#ASC(IC)	BCHEM202	Chemistry for MES	Chemistry	2	2	2	0	03	50	50	100	04
3	ESC	BCEDK203	Computer-Aided Engineering Drawing	Civil/Mech Engg dept	2	0	2	0	03	50	50	100	03
4	ESC-II	BESCK204x	Engineering Science Course-II	Respective Engg Dept	3	0	0	0	03	50	50	100	03
5	PLC-II	BETCK205x	Programming Language Course-II	Any Dept	3	0	0	0	03	50	50	100	03
			OR										
	ETC-II	BETCK205x	Emerging Technology Course-II		3	0	0	0	03				
6	AEC	BPWSK206	Professional Writing Skills in English	Humanities	1	0	0	0	01	50	50	100	01
7	HSMS	BICOK207	Indian Constitution	Humanities	1	0	0	0	01	50	50	100	01
			OR										
		BKSKK207 BKBKK207	Samskrutika Kannada/ Balake Kannada										
8	AEC/SEC	BSFHK258	Scientific Foundations for Health	Any Dept	1	0	0	0	01	50	50	100	01
			OR										
		BIDTK258	Innovation and Design Thinking		1	0	0	0	01				
				TOTAL						**400**	**400**	**800**	**20**

SDA-Skill Development Activities, **TD/PSB**- Teaching Department / Paper Setting Board, **ASC**-Applied Science Course, **ESC**- Engineering Science Courses, **ETC**- Emerging Technology Course, **AEC**- Ability Enhancement Course, **HSMS**-Humanity and Social Science and management Course, **SDC**- Skill Development Course, **CIE** -Continuous

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Visvesvaraya Technological University, Belagavi

Scheme of Teaching and Examinations-2022

Outcome-Based Education(OBE)and Choice Based Credit System(CBCS)

(Effective from the academic year 2022-23)

I Semester (Mechanical Engineering Stream) **(For Chemistry Group)**

Sl. No	Course and Course Code		Course Title	TD/PSB	Teaching Hours/Week				Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	SDA	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1	*ASC(IC)	BMATM101	Mathematics for ME Streams-I	Maths	2	2	2	0	03	50	50	100	04
2	#ASC(IC)	BCHEM102	Chemistry for ME Streams	Chemistry	2	2	2	0	03	50	50	100	04
3	ESC	BCEDK103	Computer Aided Engineering Drawing	Civil/Mech Engg dept	2	0	2	0	03	50	50	100	03
4	ESC-I	BESCK104x	Engineering Science Course-I	Respective Engg Dept	3	0	0	0	03	50	50	100	03
5	ETC-I	BETCK105x	Emerging Technology Course-I/	Any Dept	3	0	0	0	03	50	50	100	03
	OR												
	PLC-I	BPLCK105x	Programming Language Course-I		2	0	2	0	03				
6	AEC	BENGK106	Communicative English	Humanities	1	0	0	0	01	50	50	100	01
7	HSMS	BICOK107	Indian Constitution	Humanities	1	0	0	0	01	50	50	100	01
		OR											
		BKSK0107 BKBKK107	Samskrutika Kannada/ Balake Kannada										
8	AEC/SEC	BSFHK158	Scientific Foundations for Health	Any Dept	1	0	0	0	01	50	50	100	01
		OR											
		BIDTK158	Innovation and Design Thinking		1	0	0	0	01				
				TOTAL						**400**	**400**	**800**	**20**

SDA-Skill Development Activities, **TD/PSB**- Teaching Department / Paper Setting Board, **ASC**-Applied Science Course, **ESC**- Engineering Science Courses, **ETC**- Emerging Technology Course, **AEC**- Ability Enhancement Course, **HSMS**-Humanity and Social Science and management Course, **SDC**- Skill Development Course, **CIE** -Continuous

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16.02.2023/V8 Tentative Scheme for EEE/ECE/ETC/EIE/BM/ML/IO

Visvesvaraya Technological University, Belagavi

Scheme of Teaching and Examinations-2022

Outcome-Based Education(OBE)and Choice Based Credit System(CBCS)

(Effective from the academic year 2022-23)

II Semester (Electrical & Electronics Engineering Stream) **(For students who attended 1st semester under Chemistry Group)**

Sl. No	Course and Course Code		Course Title	TD/PSB	Teaching Hours/Week				Examination				Credits
					Theory Lecture L	Tutorial T	Practical/ Drawing P	SDA S	Duration in hours	CIE Marks	SEE Marks	Total Marks	
1	*ASC(IC)	BMATE201	Mathematics for EES-II	Maths	2	2	2	0	03	50	50	100	04
2	#ASC(IC)	BPHYE202	Physics for EES	PHY	2	2	2	0	03	50	50	100	04
3	ESC	BEEE203	# Elements of Electrical Engineering	EEE/ECE/TCE	2	2	0	0	03	50	50	100	03
		OR											
		BBEE203	## Basic Electronics		3	0	0	0					
4	ESC-II	BESCK204x	Engineering Science Course-II	Respective Engg Dept.	3	0	0	0	03	50	50	100	03
5	PLC-II	BPLCK205x	Programming language Course-II	Any Dept	2	0	2	0	03	50	50	100	03
	OR												
	ETC-II	BETCK205x	Emerging Technology Course-II		3	0	0	0	03				
6	AEC	BPWSK206	Professional Writing Skills in English	Humanities	1	0	0	0	01	50	50	100	01
7	HSMC	BKSKK207/ BKBKK207	Samskrutika Kannada/ Balake Kannada	Humanities	1	0	0	0	01	50	50	100	01
		OR											
		BICOK207	Indian Constitution		1	0	0	0					
8	AEC/SDC	BIDTK258	Innovation and Design Thinking	Any Dept	1	0	0	0	01	50	50	100	01
		OR											
		BSFHK258	Scientific Foundations of Health		1	0	0	0	01				
				TOTAL						**400**	**400**	**800**	**20**

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(ESC-II) Engineering Science Courses-II					(ETC-II) Emerging Technology Courses-II				
Code	**Title**	**L**	**T**	**P**	**Code**	**Title**	**L**	**T**	**P**
BESCK204A	Introduction to Civil Engineering	3	0	0	BETCK205A	Smart materials and Systems	3	0	0
BESCK204B	Introduction to Electrical Engineering	3	0	0	BETCK205B	Green Buildings	3	0	0
BESCK204C	Introduction to Electronics Engineering	3	0	0	BETCK205C	Introduction to Nano Technology	3	0	0
BESCK204D	Introduction to Mechanical Engineering	3	0	0	BETCK205D	Introduction to Sustainable Engineering	3	0	0
BESCK204E	Introduction to C Programming	2	0	2	BETCK205E	Renewable Energy Sources	3	0	0
					BETCK205F	Waste Management	3	0	0
					BETCK205G	Emerging Applications of Biosensors	3	0	0
					BETCK205H	Introduction to Internet of Things(IoT)	3	0	0
					BETCK205I	Introduction to Cyber Security	3	0	0
					BETCK205J	Introduction to Embedded System	3	0	0
(PLC-II) Programming Language Courses-II									
Code	**Title**	**L**	**T**	**P**					
BPLCK205A	Introduction to Web Programming	2	0	2					
BPLCK205B	Introduction to Python Programming	2	0	2					
BPLCK205C	Basics of JAVA programming	2	0	2					
BPLCK205D	Introduction to C++ Programming	2	0	2					
The course BESCK204E, **Introduction to C Programming, and all courses under PLC and ETC groups can be taught by faculty of ANY DEPARTMENT**									

- The student has to select one course from the ESC-II group.
- **EEE** Students shall opt for any one of the courses from the ESC-I group **except,** BESCK204B-**Introduction to Electrical Engineering and ECE/ETC/BM/ML** students shall opt any one of the courses from ESC-I **except** BESCK204C **Introduction to Electronics** Engineering
- The students have to opt for the courses from ESC group without repeating the course in either 1st or 2nd semester
- The students must select one course from either ETC-II or PLC-II group.
- If students study the subject from ETC-I in 1st semester he/she has to select the course from PLC-II in the 2nd semester and vice-versa

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16.02.2023/V8 Tentative Scheme for EEE/ECE/ETC/EIE/BM/ML/IO

Visvesvaraya Technological University, Belagavi

Scheme of Teaching and Examinations-2022

Outcome-Based Education(OBE)and Choice Based Credit System(CBCS)

(Effective from the academic year 2022-23)

II Semester (Electrical & Electronics Engineering Stream) **(For the students who attended 1st semester under Physics Group)**

Sl. No	Course and Course Code		Course Title	TD/PSB	Teaching Hours/Week				Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	SDA	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1	*ASC(IC)	BMATE201	Mathematics for EES-II	Maths	2	2	2	0	03	50	50	100	04
2	#ASC(IC)	BCHEE202	Chemistry for EES	Chemistry	2	2	2	0	03	50	50	100	04
3	ESC	BCEDK203	Computer-Aided Engineering Drawing	Civil/Mech Engg dept	2	0	2	0	03	50	50	100	03
4	ESC-II	BESCK204x	Engineering Science Course-II	Respective Engg Dept	3	0	0	0	03	50	50	100	03
5	PLC-II	BPLCK205x	Programming Language Course-II	Any Dept	2	0	2	0	03	50	50	100	03
	OR												
	ETC-II	BPLCK205x	Emerging Technology Course-II		03	0	0	0	03				
6	AEC	BPWKS206	Professional Writing Skills in English	Humanities	1	0	0	0	01	50	50	100	01
7	HSMS	BICOK207	Indian Constitution	Humanities	1	0	0	0	01	50	50	100	01
			OR										
		BKSKK207/ BKBKK207	Samskrutika Kannada/ Balake Kannada										
8	HSMS	BSFHK258	Scientific Foundations of Health	Any Dept.	1	0	0	0	01	50	50	100	01
			OR										
		BIDTK258	Innovation and Design Thinking		1	0	0	0	01				
				TOTAL						**400**	**400**	**800**	**20**

SDA-Skill Development Activities, **TD/PSB**- Teaching Department / Paper Setting Board, **ASC**-Applied Science Course, **ESC**- Engineering Science Courses, **ETC**- Emerging Technology Course, **AEC**- Ability Enhancement Course, **HSMS**-Humanity and Social Science and Management Course, **SDC**- Skill Development Course, **CIE** -Continuous Internal Evaluation, **SEE**- Semester End Examination, **IC** – Integrated Course (Theory Course Integrated with Practical Course)

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*- BMATE201 Shall have the 03 hours of theory examination(SEE), however, practical sessions question shall be included in the theory question papers. ** **The mathematics subject should be taught by a single faculty member per division, with no sharing of the course(subject)module-wise by different faculty members.**

#- BCHEE202- SEE shall have the 03 hours of theory examination and 02-03 hours of practical examination

ESC or ETC of 03 credits Courses shall have only a theory component (L:T :P:S=3:0:0:0) or if the nature the of course required practical learning, syllabus shall be designed as an Integrated course (L:T:P:S= 2:0:2:0)

All 01 Credit- courses shall have the SEE of 01 hours duration and the pattern of the question paper shall be MCQ

(ESC-II) Engineering Science Courses-II					(ETC-II) Emerging Technology Courses-II				
Code	**Title**	**L**	**T**	**P**	**Code**	**Title**	**L**	**T**	**P**
BESCK201A	Introduction to Civil Engineering	3	0	0	BETCK205A	Smart materials and Systems	3	0	0
BESCK202B	Introduction to Electrical Engineering	3	0	0	BETCK205B	Green Buildings	3	0	0
BESCK203C	Introduction to Electronics Engineering	3	0	0	BETCK205C	Introduction to Nano Technology	3	0	0
BESCK204D	Introduction to Mechanical Engineering	3	0	0	BETCK205D	Introduction to Sustainable Engineering	3	0	0
BESCK205E	Introduction to C Programming	2	0	2	BETCK205E	Renewable Energy Sources	3	0	0
					BETCK205F	Waste Management	3	0	0
					BETCK205G	Emerging Applications of Biosensors	3	0	0
					BETCK205H	Introduction to Internet of Things(IoT)	3	0	0
					BETCK205I	Introduction to Cyber Security	3	0	0
					BETCK205J	Introduction to Embedded System	3	0	0
(PLC-II) Programming Language Courses-II									
Code	**Title**	**L**	**T**	**P**					
BPLCK205A	Introduction to Web Programming	2	0	2					
BPLCK205B	Introduction to Python Programming	2	0	2					
BPLCK205C	Basics of JAVA programming	2	0	2					
BPLCK205D	Introduction to C++ Programming	2	0	2					
The course BESCK205E **, Introduction to C Programming, and all courses under PLC and ETC groups can be taught by faculty of ANY DEPARTMENT**									

- The student has to select one course from the ESC-II group.
- **EEE** Students shall opt for any one of the courses from the ESC-I group **except,** BESCK202-**Introduction to Electrical Engineering and ECE/ETC/BM/ML** students shall opt any one of the courses from ESC-I **except** BESCK203 **Introduction to Electronics** Engineering
- The students have to opt for the courses from ESC group without repeating the course in either 1st or 2nd semester
- The students must select one course from either ETC-II or PLC-II group.
- If students study the subject from ETC-I in 1st semester he/she has to select the course from PLC-II in the 2nd semester and vice-versa

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20112022/V8 Tentative scheme for Computer Science and Engineering and allied branches (CSE/ISE and BT all allied branches of CSE)

Visvesvaraya Technological University, Belagavi

Scheme of Teaching and Examinations-2022

Outcome-Based Education(OBE)andChoiceBasedCreditSystem(CBCS)

(Effective from the academic year 2022-23)

II Semester (CSE Streams) **(For students who attended 1st semester under Chemistry Group)**

Sl. No	Course and Course Code		Course Title	TD/PSB	Teaching Hours/Week				Examination				Credits
					Theory Lecture L	Tutorial T	Practical/ Drawing P	SDA S	Duration in hours	CIE Marks	SEE Marks	Total Marks	
1	*ASC(IC)	**BMATS201**	Mathematics for CSEStream -II	Maths	2	2	2	0	03	50	50	100	04
2	#ASC(IC)	**BPHYS202**	Physics for CSE Stream	Physics	2	2	2	0	03	50	50	100	04
3	ESC	**BPOPS203**	Principles of Programming Using C	CSE	2	0	2	0	03	50	50	100	03
4	ESC-II	**BESCK204x**	Engineering Science Course-II	Respective Engg dept	3	0	0	0	03	50	50	100	03
5	ETC-II	**BETCK205x**	Programming Language Course-II	Any Dept	2	00	2	0	03	50	50	100	03
	OR												
	PLC-II	**BPLCK205x**	Emerging Technology Course-II		3	0	0	0	03				
6	AEC	**BPWSK206**	Professional Writing Skills in English	Humanities	1	0	0	0	01	50	50	100	01
7	HSMC	**BKSKK207** **BKBKK207**	Samskrutika Kannada/ Balake Kannada	Humanities	1	0	0	0	01	50	50	100	01
			OR										
		BICOK207	Indian Constitution										
8	AEC/SDC	**BIDTK258**	Innovation and Design Thinking	Any Dept	1	0	0	0	01	50	50	100	01
			OR										
		BSFHK258	Scientific Foundations of Health		1	0	0	0	01				
				TOTAL						**400**	**400**	**800**	**20**

SDA-Skill Development Activities, **TD/PSB**- Teaching Department / Paper Setting Board, **ASC**-Applied Science Course, **ESC**- Engineering Science Courses, **ETC**- Emerging Technology Course, **AEC**- Ability Enhancement Course, **HSMS**-Humanity and Social Science and management Course, **SDC**- Skill Development Course, **CIE**–Continuous Internal Evaluation, **SEE**- Semester End Examination, **IC** – Integrated Course (Theory Course Integrated with Practical Course)

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(ESC-II) Engineering Science Courses-II					(ETC-II) Emerging Technology Courses-II				
Code	**Title**	**L**	**T**	**P**	**Code**	**Title**	**L**	**T**	**P**
BESCK204A	Introduction to Civil Engineering	3	0	0	BETCK205A	Smart materials and Systems	3	0	0
BESCK204B	Introduction to Electrical Engineering	3	0	0	BETCK205B	Green Buildings	3	0	0
BESCK204C	Introduction to Electronics Engineering	3	0	0	BETCK205C	Introduction to Nano Technology	3	0	0
BESCK204D	Introduction to Mechanical Engineering	3	0	0	BETCK205D	Introduction to Sustainable Engineering	3	0	0
BESCK204E	Introduction to C Programming	2	0	2	BETCK205E	Renewable Energy Sources	3	0	0
					BETCK205F	Waste Management	3	0	0
					BETCK205G	Emerging Applications of Biosensors	3	0	0
					BETCK205H	Introduction to Internet of Things (IoT)	3	0	0
					BETCK205I	Introduction to Cyber Security	3	0	0
					BETCK205J	Introduction to Embedded System	3	0	0
(PLC-II) Programming Language Courses-II									
Code	**Title**	**L**	**T**	**P**					
BPLCK205A	Introduction to Web Programming	2	0	2					
BPLCK205B	Introduction to Python Programming	2	0	2					
BPLCK205C	Basics of JAVA programming	2	0	2					
BPLCK205D	Introduction to C++ Programming	2	0	2					
The course BESCK204E, **Introduction to C Programming, and all courses under PLC and ETC groups can be taught by ANY DEPARTMENT**									

- The student has to select one course from the ESC-II group.
- Civil Engineering Students shall opt for any one of the courses from the ESC-II group **except,** BESCK204E **-Introduction to C Programming**
- The students have to opt for the courses from ESC group without repeating the course in either 1st or 2nd semester
- The students must select one course from either ETC-II or PLC-II group.
- If students study the subject from ETC-I in 1st semester he/she has to select the course from PLC-II in the 2nd semester and vice-versa

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20112022/V8 Tentative scheme for Computer Science and Engineering and allied branches (CSE/ISE and BT all allied branches of CSE)

Visvesvaraya Technological University, Belagavi

Schemeof Teaching and Examinations-2022

Outcome-Based Education (OBE)and Choice Based Credit System(CBCS)

(Effective from the academic year 2022-23)

II Semester (CSE Stream) **(For students attended 1st semester under Physics Group)**

Sl. No	Course and Course Code		Course Title	TD/PSB	Teaching Hours/Week				Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	SDA	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1	*ASC(IC)	**BMATS201**	Mathematics for CSE Stream-II	Maths	2	2	2	0	03	50	50	100	04
2	#ASC(IC)	**BCHES202**	Chemistry for CSE Stream	Chemistry	2	2	2	0	03	50	50	100	04
3	ESC	**BCEDK203**	Computer-Aided Engineering Drawing	Civil/Mech Engg dept	2	0	2	0	03	50	50	100	03
4	ESC-II	**BESCK204x**	Engineering Science Course-II	Respective Engg. Dept	3	0	0	0	03	50	50	100	03
5	PLC-II	**BETCK205x**	Programming Language Course-II	Any Dept	2	00	2	0	03	50	50	100	03
	OR												
	ETC-II	**BPLCK205x**	Emerging Technology Course-II		3	0	0	0	03				
6	AEC	**BPWSK206**	Professional Writing Skills in English	Humanities	1	0	0	0	01	50	50	100	01
7	HSMS	**BICOK207**	Indian Constitution	Humanities	1	0	0	0	01	50	50	100	01
		OR											
		BKSKK207/ BKBKK207	Samskrutika Kannada/ Balake Kannada		1	0	0	0					
8	HSMS	**BSFHK258**	Scientific Foundations of Health	Any Dept	1	0	0	0	01	50	50	100	01
			OR										
		KIDTK258	Innovation and Design Thinking		1	0	0	0	01				
				TOTAL						**400**	**400**	**800**	**20**

SDA-Skill Development Activities, **TD/PSB**- Teaching Department / Paper Setting Board, **ASC**-Applied Science Course, **ESC**- Engineering Science Courses, **ETC**- Emerging Technology Course, **AEC**- Ability Enhancement Course, **HSMS**-Humanity and Social Science and management Course, **SDC**- Skill Development Course, **CIE**–Continuous

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20112022/V8 Tentative scheme for Computer Science and Engineering and allied branches (CSE/ISE and BT all allied branches of CSE)

(ESC-II) Engineering Science Courses-II					(ETC-II) Emerging Technology Courses-II				
Code	**Title**	**L**	**T**	**P**	**Code**	**Title**	**L**	**T**	**P**
BESCK204A	Introduction to Civil Engineering	3	0	0	BETCK205A	Smart materials and Systems	3	0	0
BESCK204B	Introduction to Electrical Engineering	3	0	0	BETCK205B	Green Buildings	3	0	0
BESCK204C	Introduction to Electronics Engineering	3	0	0	BETCK205C	Introduction to Nano Technology	3	0	0
BESCK204D	Introduction to Mechanical Engineering	3	0	0	BETCK205D	Introduction to Sustainable Engineering	3	0	0
BESCK204E	Introduction to C Programming	2	0	2	BETCK205E	Renewable Energy Sources	3	0	0
					BETCK205F	Waste Management	3	0	0
					BETCK205G	Emerging Applications of Biosensors	3	0	0
					BETCK205H	Introduction to Internet of Things(IoT)	3	0	0
					BETCK205I	Introduction to Cyber Security	3	0	0
					BETCK205J	Introduction to Embedded System	3	0	0
(PLC-II) Programming Language Courses-II									
Code	**Title**	**L**	**T**	**P**					
BPLCK205A	Introduction to Web Programming	2	0	2					
BPLCK205B	Introduction to Python Programming	2	0	2					
BPLCK205C	Basics of JAVA programming	2	0	2					
BPLCK205D	Introduction to C++ Programming	2	0	2					
The course BESCK204E, **Introduction to C Programming, and all courses under PLC and ETC groups can be taught by ANY DEPARTMENT**									

- The student has to select one course from the ESC-II group.
- CSE/ISE and allied branches Students shall opt for any one of the courses from the ESC-II group **except,** BESCK245E **-Introduction to C Programming**
- The students have to opt for the courses from ESC group without repeating the course in either 1st or 2nd semester
- The students must select one course from either ETC-II or PLC-II group.
- If students study the subject from ETC-I in 1st semester he/she has to select the course from PLC-II in the 2nd semester and vice-versa

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PRINCIPAL
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Visvesvaraya Technological University, Belagavi
Scheme of Teaching and Examinations-2022
Outcome-Based Education(OBE)and Choice Based Credit System(CBCS)
(Effective from the academic year 2022-23)

I Semester (Mechanical Engineering Stream) **(For Chemistry Group)**

Sl. No	Course and Course Code		Course Title	TD/PSB	Teaching Hours/Week				Examination				Credits
					Theory Lecture L	Tutorial T	Practical/ Drawing P	SDA S	Duration in hours	CIE Marks	SEE Marks	Total Marks	
1	*ASC(IC)	BMATM101	Mathematics for ME Streams-I	Maths	2	2	2	0	03	50	50	100	04
2	#ASC(IC)	BCHEM102	Chemistry for ME Streams	Chemistry	2	2	2	0	03	50	50	100	04
3	ESC	BCEDK103	Computer Aided Engineering Drawing	Civil/Mech Engg dept	2	0	2	0	03	50	50	100	03
4	ESC-I	BESCK104x	Engineering Science Course-I	Respective Engg Dept	3	0	0	0	03	50	50	100	03
5	ETC-I	BETCK105x	Emerging Technology Course-I/	Any Dept	3	0	0	0	03	50	50	100	03
	OR												
	PLC-I	BPLCK105x	Programming Language Course-I		2	0	2	0	03				
6	AEC	BENGK106	Communicative English	Humanities	1	0	0	0	01	50	50	100	01
7	HSMS	BICOK107	Indian Constitution	Humanities	1	0	0	0	01	50	50	100	01
		OR											
		BKSK0107 BKBKK107	Samskrutika Kannada/ Balake Kannada										
8	AEC/SEC	BSFHK158	Scientific Foundations for Health	Any Dept	1	0	0	0	01	50	50	100	01
		OR											
		BIDTK158	Innovation and Design Thinking		1	0	0	0	01				
				TOTAL						**400**	**400**	**800**	**20**

SDA-Skill Development Activities, **TD/PSB**- Teaching Department / Paper Setting Board, **ASC**-Applied Science Course, **ESC**- Engineering Science Courses, **ETC**- Emerging Technology Course, **AEC**- Ability Enhancement Course, **HSMS**-Humanity and Social Science and management Course, **SDC**- Skill Development Course, **CIE** -Continuous

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(ESC-I) Engineering Science Courses-I					(ETC-I) Emerging Technology Courses-I				
Code	**Title**	**L**	**T**	**P**	**Code**	**Title**	**L**	**T**	**P**
BESCK104A	Introduction to Civil Engineering	3	0	0	BETCK105A	Smart Materials and Systems	3	0	0
BESCK104B	Introduction to Electrical Engineering	3	0	0	BETCK105B	Green Buildings	3	0	0
BESCK104C	Introduction to Electronics Engineering	3	0	0	BETCK105C	Introduction to Nano Technology	3	0	0
BESCK104D	Introduction to Mechanical Engineering	3	0	0	BETCK105D	Introduction to Sustainable Engineering	3	0	0
BESCK104E	Introduction to C Programming	2	0	2	BETCK105E	Renewable Energy Sources	3	0	0
					BETCK105F	Waste Management	3	0	0
					BETCK105G	Emerging Applications of Biosensors	3	0	0
					BTC1K105H	Introduction to Internet of Things (IOT)	3	0	0
					BETCK105I	Introduction to Cyber Security	3	0	0
					BETCK105J	**Introduction to Embedded System**	**3**	**0**	**0**
(PLC-I) Programming Language Courses-I									
Code	**Title**	**L**	**T**	**P**					
BPLCK105A	Introduction to Web Programming	2	0	2					
BPLCK105B	Introduction to Python Programming	2	0	2					
BPLCK105C	Basics to JAVA programming	2	0	2					
BPLCK105D	Introduction to C++ Programming	2	0	2					
The course BESCK104E, **Introduction to C Programming, and all courses under PLC and ETC groups can be taught by faculty of ANY DEPARTMENT**									

- The student has to select one course from the ESC-I group.
- MES stream Students shall opt for any one of the courses from the ESC-I group **except,** BESCK104D **-Introduction to Mechanical Engineering**
- The students have to opt for the courses from ESC group without repeating the course in either 1st or 2nd semester
- The students must select one course from either ETC-I or PLC-I group.
- If students study the subject from ETC-I in 1st semester he/she has to select the course from PLC-II in the 2nd semester and vice-versa

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Visvesvaraya Technological University, Belagavi
Scheme of Teaching andExaminations-2022
Outcome-Based Education(OBE)and Choice Based Credit System(CBCS)
(Effective from the academic year 2022-23)

I Semester(Mechanical Engineering Stream) **(For Physics Group)**

Sl. No	Course andCourseCode		CourseTitle	TD/PSB	Teaching Hours/Week				Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	SDA	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1	*ASC(IC)	BMATM101	Mathematics for MES-I	Maths	2	2	2	0	03	50	50	100	04
2	#ASC(IC)	BPHYM102	Physics for MES	PHY	2	2	2	0	03	50	50	100	04
3	ESC	BEMEM103	Elements of Mechanical Engineering	Mechanical	2	2	0	0	03	50	50	100	03
4	ESC-I	BESCK104x	Engineering Science Course-I	Respective Engg Dept.	3	0	0	0	03	50	50	100	03
5	ETC-I	BETCK105x	Emerging Technology Course-I	Any Dept	3	0	0	0	03	50	50	100	03
	OR												
	PLC-I	BPLCK105x	Programming language Course-I		2	0	2	0	03				
6	AEC	BENGK106	Communicative English	Humanities	1	0	0	0	01	50	50	100	01
7	HSMC	BKSKK107/ BKBKK107	Samskrutika Kannada/ Balake Kannada	Humanities	1	0	0	0	01	50	50	100	01
		OR											
		BICOK107	Indian Constitution										
8	AEC/SDC	BIDTK158	Innovation and Design Thinking	Any Dept	1	0	0	0	01	50	50	100	01
		OR											
		BSFHK158	Scientific Foundations of Health		1	0	0	0	01				
				TOTAL						**400**	**400**	**800**	**20**

SDA-Skill Development Activities, **TD/PSB**- Teaching Department / Paper Setting Board, **ASC**-Applied Science Course, **ESC**- Engineering Science Courses, **ETC**-Emerging Technology Course, **AEC**- Ability Enhancement Course, **HSMS**-Humanity and Social Science and management Course, **SDC**- Skill Development Course, **CIE**–Continuous Internal Evaluation, **SEE**- Semester End Examination, **IC** – Integrated Course (Theory Course Integrated with Practical Course)

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(ESC-I) Engineering Science Courses-I					(ETC-I) Emerging Technology Courses-I				
Code	**Title**	**L**	**T**	**P**	**Code**	**Title**	**L**	**T**	**P**
BESCK104A	Introduction to Civil Engineering	3	0	0	BETCK105A	Smart Materials and Systems	3	0	0
BESCK104B	Introduction to Electrical Engineering	3	0	0	BETCK105B	Green Buildings	3	0	0
BESCK104C	Introduction to Electronics Engineering	3	0	0	BETCK105C	Introduction to Nano Technology	3	0	0
BESCK104D	Introduction to Mechanical Engineering	3	0	0	BETCK105D	Introduction to Sustainable Engineering	3	0	0
BSC1K104E	Introduction to C Programming	2	0	2	BETCK105E	Renewable Energy Sources	3	0	0
					BETCK105F	Waste Management	3	0	0
					BETCK105G	Emerging Applications of Biosensors	3	0	0
					BETCK105H	Introduction to Internet of Things (IOT)	3	0	0
					BETCK105I	Introduction to Cyber Security	3	0	0
(PLC-I) Programming Language Courses-I					**BETCK105J**	**Introduction to Embedded System**	**3**	**0**	**0**
Code	**Title**	**L**	**T**	**P**					
BPLCK105A	Introduction to Web Programming	2	0	2					
BPLCK105B	Introduction to Python Programming	2	0	2					
BPLCK105C	Basics to JAVA programming	2	0	2					
BPLCK105D	Introduction to C++ Programming	2	0	2					
The course BSC1K104E, **Introduction to C Programming, and all courses under PLC and ETC groups can be taught by faculty of ANY DEPARTMENT**									

- The student has to select one course from the ESC-I group.
- MES stream Students shall opt for any one of the courses from the ESC-I group **except, 22ESC144-Introduction to Mechanical Engineering**
- The students have to opt for the courses from ESC group without repeating the course in either 1st or 2nd semester
- The students must select one course from either ETC-I or PLC-I group.
- If students study the subject from ETC-I in 1st semester he/she has to select the course from PLC-II in the 2nd semester and vice-versa

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Visvesvaraya Technological University, Belagavi

Scheme of Teaching and Examinations-2022

Outcome-Based Education(OBE)and Choice Based Credit System(CBCS)

(Effective from the academic year 2022-23)

I Semester (Electrical & Electronics Engineering Stream) **(For Chemistry Group)**

Sl. No	Course and Course Code		Course Title	TD/PSB	Teaching Hours/Week				Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	SDA	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1	*ASC(IC)	BMATE101	Mathematics for EES-I	Maths	2	2	2	0	03	50	50	100	04
2	#ASC(IC)	BCHEE102	Chemistry for EES	Chemistry	2	2	2	0	03	50	50	100	04
3	ESC	BCEDK103	Computer-Aided Engineering Drawing	Mechanical	2	0	2	0	03	50	50	100	03
4	ESC-I	BESCK104x	Engineering Science Course-I	Respective Engg Dept	3	0	0	0	03	50	50	100	03
5	ETC-I	BETCK105x	Emerging Technology Course-I	Any Dept	3	0	0	0	03	50	50	100	03
	OR												
	PLC-I	BPLCK105x	Programming Language Course-I		2	0	2	0	03				
6	AEC	BENGK106	Communicative English	Humanities	1	0	0	0	01	50	50	100	01
7	HSMS	BICOK107	Indian Constitution	Humanities	1	0	0	0	01	50	50	100	01
			OR										
		BKSKK107/ BKBKK107	Samskrutika Kannada/ Balake Kannada										
8	HSMS	BSFHK158	Scientific Foundations of Health	Any Dept.	1	0	0	0	01	50	50	100	01
			OR										
		BIDTK158	Innovation and Design Thinking		1	0	0	0	01				
				TOTAL						**400**	**400**	**800**	**20**

SDA-Skill Development Activities, **TD/PSB**- Teaching Department / Paper Setting Board, **ASC**-Applied Science Course, **ESC**- Engineering Science Courses, **ETC**- Emerging Technology Course, **AEC**- Ability Enhancement Course, **HSMS**-Humanity and Social Science and Management Course, **SDC**- Skill Development Course, **CIE** -Continuous Internal

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16.02.2023/V8 Tentative Scheme for EEE/ECE/ETC/EIE/BM/ML/IO

(ESC-I) Engineering Science Courses-I					(ETC-I) Emerging Technology Courses-I				
Code	**Title**	**L**	**T**	**P**	**Code**	**Title**	**L**	**T**	**P**
BESCK104A	Introduction to Civil Engineering	3	0	0	BETCK105A	Smart Materials and Systems	3	0	0
BESCK104B	Introduction to Electrical Engineering	3	0	0	BETCK105B	Green Buildings	3	0	0
BESCK104C	Introduction to Electronics Engineering	3	0	0	BETCK105C	Introduction to Nano Technology	3	0	0
BESCK104D	Introduction to Mechanical Engineering	3	0	0	BETCK105D	Introduction to Sustainable Engineering	3	0	0
BESCK104E	Introduction to C Programming	2	0	2	BETCK105E	Renewable Energy Sources	3	0	0
					BETCK105F	Waste Management	3	0	0
					BETCK105G	Emerging Applications of Biosensors	3	0	0
					BETCK105H	Introduction to Internet of Things (IOT)	3	0	0
					BETCK105I	Introduction to Cyber Security	3	0	0
					BETCK105J	Introduction to Embedded System	3	0	0
(PLC-I) Programming Language Courses-I									
Code	**Title**	**L**	**T**	**P**					
BPLCK105A	Introduction to Web Programming	2	0	2					
BPLCK105B	Introduction to Python Programming	2	0	2					
BPLCK105C	Basics of JAVA programming	2	0	2					
BPLCK105D	Introduction to C++ Programming	2	0	2					
The course BESCK104E **Introduction to C Programming, and all courses under PLC and ETC groups can be taught by faculty of ANY DEPARTMENT**									

- The student has to select one course from the ESC-I group.
- **EEE** Students shall opt for any one of the courses from the ESC-I group **except,** BESCK104B **-Introduction to Electrical Engineering and ECE/ETC/BM/ML** students shall opt any one of the courses from ESC-I **except** BESCK104C **Introduction to Electronics** Engineering
- The students have to opt for the courses from ESC group without repeating the course in either 1st or 2nd semester
- The students must select one course from either ETC-I or PLC-I group.
- If students study the subject from ETC-I in 1st semester he/she has to select the course from PLC-II in the 2nd semester and vice-versa

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Visvesvaraya Technological University, Belagavi
Scheme of Teaching and Examinations-2022
Outcome-Based Education(OBE)and Choice Based Credit System(CBCS)
(Effective from the academic year 2022-23)

I Semester (Electrical & Electronics Engineering Stream) **(For Physics Group)**

Sl. No	Course and Course Code		Course Title	TD/PSB	Teaching Hours/Week				Examination				Credits
					Theory Lecture L	Tutorial T	Practical/ Drawing P	SDA S	Duration in hours	CIE Marks	SEE Marks	Total Marks	
1	*ASC(IC)	BMATE101	Mathematics for EEE Streams-I	Maths	2	2	2	0	03	50	50	100	04
2	#ASC(IC)	BPHYE102	Physics for EEE Stream	PHY	2	2	2	0	03	50	50	100	04
3	ESC	BEEE103	# Element of Electrical Engineering	EEE/ECE/TCE	2	2	0	0	03	50	50	100	03
		OR			OR								
		BBEE103	## Basic Electronics		3	0	0	0					
4	ESC-I	BESCK104x	Engineering Science Course-I	Respective Engg Dept	3	0	0	0	03	50	50	100	03
5	ETC-I	BETCK105x	Emerging Technology Course-I	Any Dept	3	0	0	0	03	50	50	100	03
	OR												
	PLC-I	BPLCK105x	Programming Language Course-I		2	0	2	0	03				
6	AEC	BENGK106	Communicative English	Humanities	1	0	0	0	01	50	50	100	01
7	HSMC	BKSKK107/ BKBKK107	Samskrutika Kannada/ Balake Kannada	Humanities	1	0	0	0	01	50	50	100	01
		OR											
		BICOK107	Indian Constitution		1	0	0	0					
8	AEC/SDC	BIDTK158	Innovation and Design Thinking	Any Dept	1	0	0	0	01	50	50	100	01
		OR											
		BSFHK158	Scientific Foundations of Health		1	0	0	0	01				
				TOTAL						400	400	800	20

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paper shall be MCQ

(ESC-I) Engineering Science Courses-I					(ETC-I) Emerging Technology Courses-I				
Code	**Title**	**L**	**T**	**P**	**Code**	**Title**	**L**	**T**	**P**
BESCK104A	Introduction to Civil Engineering	3	0	0	BETCK105A	Smart Materials and Systems	3	0	0
BESCK104B	Introduction to Electrical Engineering	3	0	0	BETCK105B	Green Buildings	3	0	0
BESCK104C	Introduction to Electronics Engineering	3	0	0	BETCK105C	Introduction to Nano Technology	3	0	0
BESCK104D	Introduction to Mechanical Engineering	3	0	0	BETCK105D	Introduction to Sustainable Engineering	3	0	0
BESCK104E	Introduction to C Programming	2	0	2	BETCK105E	Renewable Energy Sources	3	0	0
					BETCK105F	Waste Management	3	0	0
					BETCK105G	Emerging Applications of Biosensors	3	0	0
					BETCK105H	Introduction to Internet of Things (IOT)	3	0	0
					BETCK105I	Introduction to Cyber Security	3	0	0
					BETCK105J	Introduction to Embedded System	3	0	0
(PLC-I) Programming Language Courses-I									
Code	**Title**	**L**	**T**	**P**					
BPLCK105A	Introduction to Web Programming	2	0	2					
BPLCK105B	Introduction to Python Programming	2	0	2					
BPLCK105C	Basics of JAVA programming	2	0	2					
BPLCK105D	Introduction to C++ Programming	2	0	2					

The course BESCK104E, **Introduction to C Programming, and all courses under PLC and ETC groups can be taught by faculty of ANY DEPARTMENT**

- The student has to select one course from the ESC-I group.
- **EEE** Students shall opt for any one of the courses from the ESC-I group **except,** BESCK104B **-Introduction to Electrical Engineering** and **ECE/ETC/BM/ML** students shall opt any one of the courses from ESC-I **except** BESCK104C **Introduction to Electronics** Engineering
- The students have to opt for the courses from ESC group without repeating the course in either 1st or 2nd semester
- The students must select one course from either ETC-I or PLC-I group.
- If students study the subject from ETC-I in 1st semester he/she has to select the course from PLC-II in the 2nd semester and vice-versa

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Scheme of Teaching and Examinations-2022
Outcome-Based Education(OBE)and Choice Based Credit System(CBCS)
(Effective from the academic year 2022-23)

I Semester (CSE Stream) **(For Chemistry Group)**

Sl. No	Course and Course Code		Course Title	TD/PSB	Teaching Hours/Week				Examination				Credits
					Theory Lecture L	Tutorial T	Practical/ Drawing P	SDA S	Duration in hours	CIE Marks	SEE Marks	Total Marks	
1	*ASC(IC)	BMATS101	Mathematics for CSE Stream-I	Maths	2	2	2	0	03	50	50	100	04
2	#ASC(IC)	BCHES102	Chemistry for CSE Stream	Chemistry	2	2	2	0	03	50	50	100	04
3	ESC	BCEDK103	Computer-Aided Engineering Drawing	Civil/Mech Engg dept	2	0	2	0	03	50	50	100	03
4	ESC-I	BESCK104x	Engineering Science Course-I	Respective Engg Dept	3	0	0	0	03	50	50	100	03
5	ETC-I	BETCK105x	Emerging Technology Course-I	Any Dept	3	0	0	0	03	50	50	100	03
			OR										
	PLC-I	BPLCK105x	Programming Language Course-I		2	0	2	0	03				
6	AEC	BENGK106	Communicative English	Humanities	1	0	0	0	01	50	50	100	01
7	HSMS	BICOK107	Indian Constitution	Humanities	1	0	0	0	01	50	50	100	01
			OR										
		BKSKK107/ BKBKK107	Samskrutika Kannada/ Balake Kannada		1	0	0	0					
8	HSMS	BSFHK158	Scientific Foundations of Health	Any Dept	1	0	0	0	01	50	50	100	01
			OR										
		BIDTK158	Innovation and Design Thinking		1	0	0	0	02				
				TOTAL						**400**	**400**	**800**	**20**

SDA-Skill Development Activities, **TD/PSB**- Teaching Department / Paper Setting Board, **ASC**-Applied Science Course, **ESC**- Engineering Science Courses, **ETC**- Emerging

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(ESC-I) Engineering Science Courses-I					(ETC-I) Emerging Technology Courses-I				
Code	**Title**	**L**	**T**	**P**	**Code**	**Title**	**L**	**T**	**P**
BESCK104A	Introduction to Civil Engineering	3	0	0	BETCK105A	Smart Materials and Systems	3	0	0
BESCK104B	Introduction to Electrical Engineering	3	0	0	BETCK105B	Green Buildings	3	0	0
BESCK104C	Introduction to Electronics Engineering	3	0	0	BETCK105C	Introduction to Nano Technology	3	0	0
BESCK104D	Introduction to Mechanical Engineering	3	0	0	BETCK105D	Introduction to Sustainable Engineering	3	0	0
BESCK104E	Introduction to C Programming	2	0	2	BETCK105E	Renewable Energy Sources	3	0	0
					BETCK105F	Waste Management	3	0	0
					BETCK105G	Emerging Applications of Biosensors	3	0	0
					BETCK105H	Introduction to Internet of Things (IOT)	3	0	0
					BETCK105I	Introduction to Cyber Security	3	0	0
					BETCK105J	Introduction to Embedded System	3	0	0
(PLC-I) Programming Language Courses-I									
Code	**Title**	**L**	**T**	**P**					
BPLCK105A	Introduction to Web Programming	2	0	2					
BPLCK105B	Introduction to Python Programming	2	0	2					
BPLCK105C	Basics of JAVA programming	2	0	2					
BPLCK105D	Introduction to C++ Programming	2	0	2					
The course BESCK104E, **Introduction to C Programming, and all courses under PLC and ETC groups can be taught by ANY DEPARTMENT**									

- The student has to select one course from the ESC-I group.
- CSE/ISE & allied branch students shall opt for any one of the courses from the ESC-I group **except,** BESCK145E **-Introduction to C Programming**
- The students have to opt for the courses from ESC group without repeating the course in either 1st or 2nd semester
- The students must select one course from either ETC-I or PLC-I group.
- If students study the subject from ETC-I in 1st semester he/she has to select the course from PLC-II in the 2nd semester and vice-versa

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20112022/V8 Tentative scheme for Computer Science and Engineering and allied branches (CSE/ISE and BT all allied branches of CSE)

Visvesvaraya Technological University, Belagavi

Scheme of Teaching andExaminations-2022

Outcome-Based Education (OBE)and Choice Based Credit System(CBCS)

(Effective from the academic year 2022-23)

I Semester (CSE Stream) (Physics Group)

Sl. No	Course and course code		Course titlee	TD/PSB	Teaching Hours/Week				Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	SDA	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1	*ASC(IC)	BMATS101	Mathematics for CSE Stream-I	Maths	2	2	2	0	03	50	50	100	04
2	#ASC(IC)	BPHYS102	Physics for CSE stream	Physics	2	2	2	0	03	50	50	100	04
3	ESC	BPOPS103	Principles of Programming Using C	CSE	2	0	2	0	03	50	50	100	03
4	ESC-I	BESCK104x	Engineering Science Course-I	Respective Engg Dept	3	0	0	0	03	50	50	100	03
5	ETC-I	BETCK105x	Emerging Technology Course-I	Any Dept	3	0	0	0	03	50	50	100	03
			OR										
	PLC-I	BPLCK105x	Programming Languages Course-I		2	0	2	0	03				
6	AEC	BENGK106	Communicative English	Humanities	1	0	0	0	01	50	50	100	01
7	HSMC	BKSKK107 BKBKK107	Samskrutika Kannada/ Balake Kannada	Humanities	1	0	0	0	01	50	50	100	01
			OR										
		BICOK107	Indian Constitution										
8	AEC/SDC	BIDTK158	Innovation and Design Thinking	Any Dept	1	0	0	0	02	50	50	100	01
			OR										
		BSFHK158	Scientific Foundations of Health		1	0	0	0	01				
				TOTAL						**400**	**400**	**800**	**20**

SDA-Skill Development Activities, **TD/PSB**- Teaching Department / Paper Setting Board, **ASC**-Applied Science Course, **ESC**- Engineering Science Courses, **ETC**-Emerging Technology Course, **AEC**- Ability Enhancement Course, **HSMS**-Humanity and Social Science and management Course, **SDC**- Skill Development Course, **CIE**–Continuous Internal Evaluation, **SEE**- Semester End Examination, **IC** – Integrated Course (Theory Course Integrated with Practical Course)

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20112022/V8 Tentative scheme for Computer Science and Engineering and allied branches (CSE/ISE and BT all allied branches of CSE)

(ESC-I) Engineering Science Courses-I					(ETC-I) Emerging Technology Courses-I				
Code	**Title**	**L**	**T**	**P**	**Code**	**Title**	**L**	**T**	**P**
BESCK104A	Introduction to Civil Engineering	3	0	0	BETCK105A	Smart Materials and Systems	3	0	0
BESCK104B	Introduction to Electrical Engineering	3	0	0	BETCK105B	Green Buildings	3	0	0
BESCK104C	Introduction to Electronics Engineering	3	0	0	BETCK105C	Introduction to Nano Technology	3	0	0
BESCK104D	Introduction to Mechanical Engineering	3	0	0	BETCK105D	Introduction to Sustainable Engineering	3	0	0
BESCK104E	Introduction to C Programming	2	0	2	BETCK105E	Renewable Energy Sources	3	0	0
					BETCK105F	Waste Management	3	0	0
					BETCK105G	Emerging Applications of Biosensors	3	0	0
					BETCK105H	Introduction to Internet of Things (IOT)	3	0	0
					BETCK105I	Introduction to Cyber Security	3	0	0
					BETCK105J	Introduction to Embedded System	3	0	0
(PLC-I) Programming Language Courses-I									
Code	**Title**	**L**	**T**	**P**					
BPLCK105A	Introduction to Web Programming	2	0	2					
BPLCK105B	Introduction to Python Programming	2	0	2					
BPLCK105C	Basics of JAVA programming	2	0	2					
BPLCK105D	Introduction to C++ Programming	2	0	2					
The course 22ESC145/245, Introduction to C Programming, and all courses under PLC and ETC groups can be taught by ANY DEPARTMENT									

- The student has to select one course from the ESC-I group.
- CSE/ISE and allied branches Students shall opt for any one of the courses from the ESC-I group **except,** BESCK104E **-Introduction to C Programming**
- The students have to opt for the courses from ESC group without repeating the course in either 1st or 2nd semester
- The students must select one course from either ETC-I or PLC-I group.
- If students study the subject from ETC-I in 1st semester he/she has to select the course from PLC-II in the 2nd semester and vice-versa

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16-2-2023

I Semester

Course Title:	**Mathematics-I for Computer Science and Engineering stream**		
Course Code:	**BMATS101**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Integrated	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P: S)	2:2:2:0	Exam Hours	03
Total Hours of Pedagogy	40 hours Theory + 10 to12 Lab slots	Credits	04

Course objectives: The goal of the course**Mathematics-I for Computer Science and Engineering stream(22MATS11)** is to

- **Familiarize** the importance of calculus associated with one variable and multivariable for computer science and engineering.
- **Analyze**Computer science and engineering problems by applying Ordinary Differential Equations.
- **Apply** the knowledge of modular arithmetic to computer algorithms.
- **Develop** the knowledge of Linear Algebra to solve the system of equations.

Teaching-Learning Process

Pedagogy (General Instructions):

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. In addition to the traditional lecture method, different types of innovative teaching methods may be adopted so that the delivered lessons shall develop students' theoretical and applied mathematical skills.
2. State the need for Mathematics with Engineering Studies and Provide real-life examples.
3. Support and guide the students for self–study.
4. You will also be responsible for assigning homework, grading assignments and quizzes, and documenting students' progress.
5. Encourage the students to group learning to improve their creative and analytical skills.
6. Show short related video lectures in the following ways:
   - As an introduction to new topics (pre-lecture activity).
   - As a revision of topics (post-lecture activity).
   - As additional examples (post-lecture activity).
   - As an additional material of challenging topics (pre-and post-lecture activity).
   - As a model solution of some exercises (post-lecture activity).

Module-1:Calculus (8 hours)

Introduction to polar coordinates and curvature relating to Computer Science and Engineering.

Polar coordinates, Polar curves, angle between the radius vector and the tangent, angle between two curves. Pedal equations. Curvature and Radius of curvature - Cartesian, Parametric, Polar and Pedal forms. Problems.

Self-study: Center and circle of curvature, evolutes and involutes.

Applications: Computer graphics, Image processing.

(RBT Levels: L1, L2 and L3)

Module-2:Series Expansion and Multivariable Calculus (8 hours)

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Introduction of series expansion and partial differentiation in Computer Science & Engineering applications.

Taylor's and Maclaurin's series expansion for one variable (Statement only) – problems. Indeterminate forms - L'Hospital's rule-Problems.

Partial differentiation, total derivative - differentiation of composite functions. Jacobian and problems. Maxima and minima for a function of two variables. Problems.

Self-study: Euler's theorem and problems. Method of Lagrange's undetermined multipliers with single constraint.

Applications: Series expansion in computer programming, Computing errors and approximations.

(RBT Levels: L1, L2 and L3)

Module-3: Ordinary Differential Equations (ODEs) of First Order (8 hours)

Introduction to first-order ordinary differential equations pertaining to the applications for Computer Science & Engineering.

Linear and Bernoulli's differential equations. Exact and reducible to exact differential equations - Integrating factors on $\frac{1}{N}\left(\frac{\partial M}{\partial y}-\frac{\partial N}{\partial x}\right)$ and $\frac{1}{M}\left(\frac{\partial N}{\partial x}-\frac{\partial M}{\partial y}\right)$. Orthogonal trajectories, L-R & C-R circuits. Problems.

Non-linear differential equations: Introduction to general and singular solutions, Solvable for p only, Clairaut's equations,reducible to Clairaut's equations. Problems.

Self-Study: Applications of ODEs, Solvable for x and y.

Applications of ordinary differential equations: Rate of Growth or Decay, Conduction of heat.

(RBT Levels: L1, L2 and L3)

Module-4: Modular Arithmetic (8 hours)

Introduction of modular arithmetic and its applications in Computer Science and Engineering.

Introduction to Congruences, Linear Congruences, The Remainder theorem, Solving Polynomials, Linear Diophantine Equation, System of Linear Congruences, Euler's Theorem, Wilson Theorem and Fermat's little theorem. Applications of Congruences-RSA algorithm.

Self-Study: Divisibility, GCD, Properties of Prime Numbers, Fundamental theorem of Arithmetic.

Applications: Cryptography, encoding and decoding, RSA applications in public key encryption.

(RBT Levels: L1, L2 and L3)

Module-5: Linear Algebra (8 hours)

Introduction of linear algebra related to Computer Science &Engineering.

Elementary row transformationofa matrix, Rank of a matrix. Consistency and Solution of system of linear equations - Gauss-elimination method, Gauss-Jordan method and approximate solution by Gauss-Seidel method. Eigenvalues and Eigenvectors, Rayleigh's power method to find the dominant Eigenvalue and Eigenvector.

Self-Study: Solution of system of equations by Gauss-Jacobi iterative method. Inverse of a square matrix by Cayley- Hamilton theorem.

Applications: Boolean matrix, Network Analysis, Markov Analysis, Critical point of a network system. Optimum solution.

(RBT Levels: L1, L2 and L3).

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List of Laboratory experiments (2 hours/week per batch/ batch strength 15)
10 lab sessions + 1 repetition class + 1 Lab Assessment

1	2D plots for Cartesian and polar curves
2	Finding angle between polar curves, curvature and radius of curvature of a given curve
3	Finding partial derivatives and Jacobian
4	Applications to Maxima and Minima of two variables
5	Solution of first-order ordinary differential equation and plotting the solution curves
6	Finding GCD using Euclid's Algorithm
7	Solving linear congruences $ax \equiv b(mod\ m)$
8	Numerical solution of system of linear equations, test for consistency and graphical representation
9	Solution of system of linear equations using Gauss-Seidel iteration
10	Compute eigenvalues and eigenvectors and find the largest and smallest eigenvalue by Rayleigh power method.

Suggested software: Mathematica/MatLab/Python/Scilab

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

CO1	apply the knowledge of calculus to solve problems related to polar curves andlearn the notion of partial differentiation to compute rate of change of multivariate functions
CO2	analyze the solution of linear and nonlinear ordinary differential equations
CO3	get acquainted and to apply modular arithmetic to computer algorithms
CO4	make use of matrix theory for solving the system of linear equations and compute eigenvalues and eigenvectors
CO5	familiarize with modern mathematical tools namely MATHEMATICA/MATLAB/ PYTHON/ SCILAB

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). The minimum passing mark for the SEE is 35% of the maximum marks (18 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation(CIE):

The CIE marks for the theory component of the IC shall be **30 marks** and for the laboratory component **20 Marks**.

CIE for the theory component of the IC

- Three Tests each of 20 Marks; after the completion of the syllabus of 35-40%, 65-70%, and 90-100% respectively.
- Two Assignments/two quizzes/ seminars/one field survey and report presentation/one-course project totalling 20 marks.

Total Marks scored (test + assignments) out of 80 shall be scaled down to **30 marks**

CIE for the practical component of the IC

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- On completion of every experiment/program in the laboratory, the students shall be evaluated and marks shall be awarded on the same day. The **15 marks** are for conducting the experiment and preparation of the laboratory record, the other **05 marks shall be for the test** conducted at the end of the semester.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to 15 marks.
- The laboratory test **(duration 03 hours)** at the end of the 15th week of the semester/after completion of all the experiments (whichever is early) shall be conducted for 50 marks and scaled down to **05 marks.**

Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IC/IPCC for **20 marks**.

- The minimum marks to be secured in CIE to appear for SEE shall be 12 (40% of maximum marks) in the theory component and 08 (40% of maximum marks) in the practical component. The laboratory component of the IC/IPCC shall be for CIE only. However, in SEE, the questions from the laboratory component shall be included. The maximum of 05 questions is to be set from the practical component of IC/IPCC, the total marks of all questions should not be more than 25 marks.

The theory component of the IC shall be for both CIE and SEE.

Semester End Examination(SEE):

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours**)

- The question paper shall be set for 100 marks. The medium of the question paper shall be English/Kannada). The duration of SEE is 03 hours.
- The question paper will have 10 questions. Two questions per module. Each question is set for 20 marks. The students have to answer 5 full questions, selecting one full question from each module. The student has to answer for 100 marks and **marks scored out of 100 shall be proportionally reduced to 50 marks**.
- There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

Suggested Learning Resources:

Books (Title of the Book/Name of the author/Name of the publisher/Edition and Year)

Text Books

1. **B. S. Grewal**: "Higher Engineering Mathematics", Khanna Publishers, 44thEd., 2021.
2. **E. Kreyszig**: "Advanced Engineering Mathematics", John Wiley & Sons, 10thEd., 2018.
3. **David M Burton:** "Elementary Number Theory" Mc Graw Hill, 7th Ed.,2017.

Reference Books

4. **V. Ramana:** "Higher Engineering Mathematics" McGraw-Hill Education, 11th Ed., 2017
5. **Srimanta Pal & Subodh C.Bhunia**: "Engineering Mathematics" Oxford University Press, 3rd Ed., 2016.
6. **N.P Bali and Manish Goyal**: "A Textbook of Engineering Mathematics" Laxmi

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Publications, 10^{th} Ed., 2022.

7. **C. Ray Wylie, Louis C. Barrett:** "Advanced Engineering Mathematics" McGraw – Hill Book Co., New York, 6^{th} Ed., 2017.
8. **Gupta C.B, Sing S.R and Mukesh Kumar:** "Engineering Mathematic for Semester I and II", Mc-Graw Hill Education(India) Pvt. Ltd 2015.
9. **H. K. Dass and Er. Rajnish Verma:** "Higher Engineering Mathematics" S. Chand Publication, 3^{rd} Ed., 2014.
10. **James Stewart:** "Calculus" Cengage Publications, 7^{th}Ed., 2019.
11. **David C Lay:** "Linear Algebra and its Applications", Pearson Publishers, 4^{th} Ed., 2018.
12. **Gareth Williams:** "Linear Algebra with Applications", Jones Bartlett Publishers Inc., 6^{th} Ed., 2017.
13. **Gilbert Strang:** "Linear Algebra and its Applications", Cengage Publications, 4^{th} Ed. 2022.
14. **William Stallings:** "Cryptography and Network Security" Pearson Prentice Hall, 6^{th} Ed., 2013.
15. **Kenneth H Rosen:** "Discrete Mathematics and its Applications" McGraw-Hill, 8^{th} Ed. 2019.
16. **Ajay Kumar Chaudhuri:** "Introduction to Number Theory"NCBA Publications, 2^{nd} Ed., 2009.
17. **Thomas Koshy:** "Elementary Number Theory with Applications"Harcourt Academic Press, 2^{nd} Ed., 2008.

Web links and Video Lectures (e-Resources):

- http://nptel.ac.in/courses.php?disciplineID=111
- http://www.class-central.com/subject/math(MOOCs)
- http://academicearth.org/
- VTU e-Shikshana Program
- VTU EDUSAT Program

Activity Based Learning (Suggested Activities in Class)/ Practical Based Learning

- Quizzes
- Assignments
- Seminar

COs and POs Mapping (Individual teacher has to fill up)

COs	POs						
	1	2	3	4	5	6	7
CO1							
CO2							
CO3							
CO4							
CO5							

Level 3- Highly Mapped, Level 2-Moderately Mapped, Level 1-Low Mapped, Level 0- Not Mapped

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16-2-2022

II Semester

Course Title:	**Mathematics-II for Computer Science and Engineering stream**		
Course Code:	**BMATS201**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Integrated	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P: S)	2:2:2:0	Exam Hours	03
Total Hours of Pedagogy	40 hours Theory + 10 to 12 Lab slots	Credits	04

Course objectives: The goal of the course**Mathematics-II for Computer Science and Engineering stream(22MATS21)** is to

- **Familiarize** the importance of Integral calculus and Vector calculus.
- **Learn** vector spaces and linear transformations.
- **Develop** the knowledge of numerical methods and apply them to solvetranscendental and differential equations.

Teaching-Learning Process

Pedagogy (General Instructions):

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. In addition to the traditional lecture method, different types of innovative teaching methods may be adopted so that the delivered lessons shall develop students' theoretical and applied mathematical skills.
2. State the need for Mathematics with Engineering Studies and Provide real-life examples.
3. Support and guide the students for self–study.
4. You will also be responsible for assigning homework, grading assignments and quizzes, and documenting students' progress.
5. Encourage the students to group learning to improve their creative and analytical skills.
6. Show short related video lectures in the following ways:
   - As an introduction to new topics (pre-lecture activity).
   - As a revision of topics (post-lecture activity).
   - As additional examples (post-lecture activity).
   - As an additional material of challenging topics (pre-and post-lecture activity).
   - As a model solution of some exercises (post-lecture activity).

Module-1Integral Calculus (8 hours)

Introduction to Integral Calculus in Computer Science &Engineering.

Multiple Integrals: Evaluation of double and triple integrals, evaluation of double integrals by change of order of integration, changing into polar coordinates. Applications to find Area and Volume by double integral.Problems.

Beta and Gamma functions: Definitions, properties, relation between Beta and Gamma functions. Problems.

Self-Study: Center of gravity, Duplication formula.

Applications: Antenna and wave propagation, Calculation of optimum value in various geometries. Analysis of probabilistic models.

(RBT Levels: L1, L2 and L3)

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Module-2 Vector Calculus(8 hours)
Introduction to Vector Calculus in Computer Science & Engineering. Scalar and vector fields. Gradient, directional derivative, curl and divergence - physical interpretation, solenoidal and irrotational vector fields. Problems. **Curvilinear coordinates:**Scale factors, base vectors, Cylindrical polar coordinates, Spherical polar coordinates, transformation between cartesian and curvilinear systems, orthogonality. Problems. **Self-Study:** Vector integration and Vector line integral. **Applications:** Conservation of laws, Electrostatics, Analysis of streamlines.
Module-3Vector Space and Linear Transformations(8 hours)
Importance of Vector Space and Linear Transformations in the field of Computer Science & Engineering. **Vector spaces:** Definition and examples, subspace, linear span, Linearly independent and dependent sets, Basis and dimension. Problems. **Linear transformations**: Definition and examples, Algebra of transformations, Matrix of a linear transformation. Change of coordinates, Rank and nullity of a linear operator, rank-nullity theorem. Inner product spaces and orthogonality. Problems. **Self-study:** Angles and Projections.Rotation, Reflection, Contraction and Expansion. **Applications:** Image processing, AI & ML, Graphs and networks, Computer graphics. **(RBT Levels: L1, L2 and L3)**
Module-4Numerical Methods -1(8 hours)
Importance of numerical methods for discrete data in the field of computer science & engineering. Solution of algebraic and transcendental equations - Regula-Falsi and Newton-Raphson methods (only formulae). Problems. Finite differences, Interpolation using Newton's forward and backward difference formulae, Newton's divided difference formula and Lagrange's interpolation formula (All formulae without proof). Problems. **Numerical integration**: Trapezoidal, Simpson's $(1/3)^{rd}$ and $(3/8)^{th}$ rules(without proof). Problems. **Self-Study:** Bisection method, Lagrange's inverse Interpolation. **Applications:** Estimating the approximate roots, extremum values, Area, volume, and surface area. Errors in finite precision. **(RBT Levels: L1, L2 and L3)**
Module-5Numerical Methods -2(8 hours)
Introduction to various numerical techniques for handling Computer Science & Engineering applications. **Numerical Solution of Ordinary Differential Equations (ODE's):** Numerical solution of ordinary differential equations of first order and first degree - Taylor's series method, Modified Euler's method, Runge-Kutta method of fourth order and Milne's predictor-corrector formula (No derivations of formulae). Problems. **Self-Study:** Adam-Bashforth method. **Applications:** Estimating the approximate solutions of ODE. **(RBT Levels: L1, L2 and L3).**

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16-2-2022

List of Laboratory experiments (2 hours/week per batch/ batch strength 15)
10 lab sessions + 1 repetition class + 1 Lab Assessment

1	Program to compute area, surface area, volume and centre of gravity
2	Evaluation of improper integrals
3	Finding gradient, divergent, curl and their geometrical interpretation
4	Computation of basis and dimension for a vector space and Graphical representation of linear transformation
5	Computing the inner product and orthogonality
6	Solution of algebraic and transcendental equations by Ramanujan's, Regula-Falsi and Newton-Raphson method
7	Interpolation/Extrapolation using Newton's forward and backward difference formula
8	Computation of area under the curve using Trapezoidal, Simpson's $(1/3)^{rd}$ and $(3/8)^{th}$ rule
9	Solution of ODE of first order and first degree by Taylor's series and Modified Euler's method
10	Solution of ODE of first order and first degree by Runge-Kutta 4^{th} order and Milne's predictor-corrector method

Suggested software's: Mathematica/MatLab/Python/Scilab

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

CO1	Apply the concept of change of order of integration and variables to evaluate multiple integrals and their usage in computing area and volume.
CO2	Understand the applications of vector calculus refer to solenoidal, and irrotational vectors.Orthogonal curvilinear coordinates.
CO3	Demonstrate the idea of Linear dependence and independence of sets in the vector space, and linear transformation
CO4	Apply the knowledge of numerical methods in analysing the discrete data and solving the physical and engineering problems.
CO5	Get familiarize with modern mathematical tools namely MATHEMATICA/ MATLAB /PYTHON/ SCILAB

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). The minimum passing mark for the SEE is 35% of the maximum marks (18 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in thetotal of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation(CIE):

The CIE marks for the theory component of the IC shall be **30 marks** and for the laboratory component **20 Marks**.

CIE for the theory component of the IC

- Three Tests each of 20 Marks; after the completion of the syllabus of 35-40%, 65-70%, and 90-100% respectively.

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- Two Assignments/two quizzes/ seminars/one field survey and report presentation/one-course project totalling 20 marks.

Total Marks scored (test + assignments) out of 80 shall be scaled down to **30 marks**

CIE for the practical component of the IC

- On completion of every experiment/program in the laboratory, the students shall be evaluated and marks shall be awarded on the same day. The **15 marks** are for conducting the experiment and preparation of the laboratory record, the other **05 marks shall be for the test** conducted at the end of the semester.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to 15 marks.
- The laboratory test (**duration 03 hours**) at the end of the 15th week of the semester/after completion of all the experiments (whichever is early) shall be conducted for 50 marks and scaled down to **05 marks.**

Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IC/IPCC for **20 marks**.

- The minimum marks to be secured in CIE to appear for SEE shall be 12 (40% of maximum marks) in the theory component and 08 (40% of maximum marks) in the practical component. The laboratory component of the IC/IPCC shall be for CIE only. However, in SEE, the questions from the laboratory component shall be included. The maximum of 05 questions is to be set from the practical component of IC/IPCC, the total marks of all questions should not be more than 25 marks.

The theory component of the IC shall be for both CIE and SEE.

Semester End Examination(SEE):

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours**)

- The question paper shall be set for 100 marks. The medium of the question paper shall be English/Kannada). The duration of SEE is 03 hours.
- The question paper will have 10 questions. Two questions per module. Each question is set for 20 marks. The students have to answer 5 full questions, selecting one full question from each module. The student has to answer for 100 marks and **marks scored out of 100 shall be proportionally reduced to 50 marks**.
- There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

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Suggested Learning Resources:

Books (Title of the Book/Name of the author/Name of the publisher/Edition and Year)

Text Books

1. **B. S. Grewal**: "Higher Engineering Mathematics", Khanna Publishers, 44thEd., 2021.
2. **E. Kreyszig**: "Advanced Engineering Mathematics", John Wiley & Sons, 10thEd., 2018.

Reference Books

1. **V. Ramana:** "Higher Engineering Mathematics" McGraw-Hill Education, 11th Ed., 2017
2. **Srimanta Pal & Subodh C.Bhunia**: "Engineering Mathematics" Oxford University Press, 3rd Ed., 2016.
3. **N.P Bali and Manish Goyal**: "A Textbook of Engineering Mathematics" Laxmi Publications, 10th Ed., 2022.
4. **C. Ray Wylie, Louis C. Barrett:** "Advanced Engineering Mathematics" McGraw – Hill Book Co., New York, 6th Ed., 2017.
5. **Gupta C.B, Sing S.R and Mukesh Kumar:** "Engineering Mathematic for Semester I and II", Mc-Graw Hill Education(India) Pvt. Ltd 2015.
6. **H. K. Dass and Er. Rajnish Verma:** "Higher Engineering Mathematics" S. Chand Publication, 3rd Ed., 2014.
7. **James Stewart:** "Calculus" Cengage Publications, 7thEd., 2019.
8. **David C Lay:** "Linear Algebra and its Applications", Pearson Publishers, 4th Ed., 2018.
9. **Gareth Williams:** "Linear Algebra with applications", Jones Bartlett Publishers Inc., 6th Ed., 2017.
10. **Gilbert Strang:** "Linear Algebra and its Applications", Cengage Publications, 4th Ed., 2022.

Web links and Video Lectures (e-Resources):

- http://nptel.ac.in/courses.php?disciplineID=111
- http://www.class-central.com/subject/math(MOOCs)
- http://academicearth.org/
- VTU e-Shikshana Program
- VTU EDUSAT Program

Activity-Based Learning (Suggested Activities in Class)/ Practical-Based Learning

- Quizzes
- Assignments
- Seminar

COs and POs Mapping (Individual teacher has to fill up)

COs	POs						
	1	2	3	4	5	6	7
CO1							
CO2							
CO3							
CO4							
CO5							

Level 3- Highly Mapped, Level 2-Moderately Mapped, Level 1-Low Mapped, Level 0- Not Mapped

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Course Title:	**Applied Physics for CSE Stream**		
Course Code:	**BPHYS102/202**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Integrated	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P: S)	2:2:2:0	Exam Hours	03
Total Hours of Pedagogy	40 hours Theory + 10-12 Lab slots	Credits	04

Course objectives

- To study the essentials of photonics and its application in computer science.
- To study the principles of quantum mechanics and its application in quantum computing.
- To study the electrical properties of materials
- To study the essentials of physics for computational aspects like design and data analysis.

Teaching-Learning Process

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes and make Teaching –Learning more effective

1. Flipped Class
2. Chalk and Talk
3. Blended Mode of Teaching and Learning
4. Simulations, Interactive Simulations and Animations
5. NPTEL and Other Videos for theory topics
6. Smart Class Room
7. Lab Experiment Videos

Module-1 (8 Hours)

Laser and Optical Fibers:

LASER: Characteristic properties of a LASER beam, Interaction of Radiation with Matter, Einstein's A and B Coefficients and Expression for Energy Density (Derivation), Laser Action, Population Inversion, Metastable State, Requisites of a laser system, Semiconductor Diode Laser, Applications: Bar code scanner, Laser Printer, Laser Cooling(Qualitative), Numerical Problems.

Optical Fiber: Principle and Structure, Propagation of Light, Acceptance angle and Numerical Aperture (NA), Derivation of Expression for NA, Modes of Propagation, RI Profile, Classification of Optical Fibers, Attenuation and Fiber Losses, Applications: Fiber Optic networking, Fiber Optic Communication. Numerical Problems

Pre requisite:Properties of light

Self-learning: Total Internal Reflection

Module-2 (8 Hours)

Quantum Mechanics:

de Broglie Hypothesis and Matter Waves, de Broglie wavelength and derivation of expression by analogy, Phase Velocity and Group Velocity, Heisenberg's Uncertainty Principle and its application (Non existence of electron inside the nucleus - Non Relativistic), Principle of Complementarity, Wave Function, Time independent Schrödinger wave equation (Derivation), Physical Significance of a wave function and Born Interpretation, Expectation value, Eigen functions and Eigen Values, Particle inside one dimensional infinite potential well, Quantization of Energy States, Waveforms and Probabilities. Numerical Problems.

Pre requisite:Wave–Particle dualism

Self-learning: de Broglie Hypothesis

Module-3 (8 Hours)

Quantum Computing:

Principles of Quantum Information & Quantum Computing:

Introduction to Quantum Computing, Moore's law & its end, Differences between Classical & Quantum computing. Concept of qubit and its properties. Representation of qubit by Bloch sphere. Single and Two qubits. Extension to N qubits.

Dirac representation and matrix operations:

Matrix representation of 0 and 1 States, Identity Operator I, Applying I to $|0\rangle$ and $|1\rangle$ states, Pauli Matrices and its

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operations on $|0\rangle$and $|1\rangle$states, Explanation of i) Conjugate of a matrix and ii) Transpose of a matrix. Unitary matrix U, Examples: Row and Column Matrices and their multiplication (Inner Product), Probability, and Quantum Superposition, normalization rule. Orthogonality, Orthonormality. Numerical Problems

Quantum Gates:

Single Qubit Gates: Quantum Not Gate, Pauli – X, Y and Z Gates, Hadamard Gate, Phase Gate (or S Gate), T Gate

Multiple Qubit Gates: Controlled gate, CNOT Gate, (Discussion for 4 different input states). Representation of Swap gate, Controlled -Z gate, Toffoli gate.

Pre requisites: Matrices

Self-learning: Moore's law

Module-4 (8 Hours)

Electrical Properties of Materials and Applications

Electrical Conductivity in metals

Resistivity and Mobility, Concept of Phonon, Matheissen's rule, Failures of Classical Free Electron Theory, Assumptions of Quantum Free Electron Theory, Fermi Energy, Density of States, Fermi Factor, Variation of Fermi Factor With Temperature and Energy. Numerical Problems.

Superconductivity

Introduction to Super Conductors, Temperature dependence of resistivity, Meissner's Effect, Critical Field, Temperature dependence of Critical field, Types of Super Conductors, BCS theory (Qualitative), Quantum Tunnelling, High Temperature superconductivity, Josephson Junctions (Qualitative), DC and RF SQUIDs (Qualitative), Applications in Quantum Computing: Charge, Phase and Flux qubits, Numerical Problems.

Pre requisites:Basics of Electrical conductivity

Self-learning: Resistivity and Mobility

Module-5 (8 hours)

Applications of Physics in computing:

Physics of Animation:

Taxonomy of physics based animation methods, Frames, Frames per Second, Size and Scale, Weight and Strength, Motion and Timing in Animations, Constant Force and Acceleration, The Odd rule, Odd-rule Scenarios, Motion Graphs, Examples of Character Animation: Jumping, Parts of Jump, Jump Magnification, Stop Time, Walking: Strides and Steps, Walk Timing. Numerical Problems

Statistical Physics for Computing: Descriptive statistics and inferential statistics, Poisson distribution and modeling the probability of proton decay, Normal Distributions (Bell Curves), Monte Carlo Method: Determination of Value of π. Numerical Problems.

Pre requisites: Motion in one dimension, Probability

Self-learning: Frames, Frames per Second

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

CO1	**Describe** the principles of LASERS and Optical fibers and their relevant applications.
CO2	**Discuss** the basic principles of the Quantum Mechanics and its application in Quantum Computing.
CO3	**Summarize** the essential properties of superconductors and its applications in qubits.
CO4	**Illustrate** the application of physics in design and data analysis.
CO5	**Practice** working in groups to conduct experiments in physics and **perform** precise and honest measurements.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). The minimum passing mark for the SEE is 35% of the maximum marks (18 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

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Continuous Internal Evaluation(CIE):

The CIE marks for the theory component of the IC shall be **30 marks** and for the laboratory component **20 Marks**.

CIE for the theory component of the IC

- Three Tests each of 20 Marks; after the completion of the syllabus of 35-40%, 65-70%, and 90-100% respectively.
- Two Assignments/two quizzes/ seminars/one field survey and report presentation/one-course project totalling 20 marks.

Total Marks scored (test + assignments) out of 80 shall be scaled down to **30 marks**

CIE for the practical component of the IC

- On completion of every experiment/program in the laboratory, the students shall be evaluated and marks shall be awarded on the same day. The **15 marks** are for conducting the experiment and preparation of the laboratory record, the other **05 marks shall be for the test** conducted at the end of the semester.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to 15 marks.
- The laboratory test **(duration 03 hours)** at the end of the 15th week of the semester /after completion of all the experiments (whichever is early) shall be conducted for 50 marks and scaled down to **05 marks.**

Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IC/IPCC for **20 marks**.

- The minimum marks to be secured in CIE to appear for SEE shall be 12 (40% of maximum marks) in the theory component and 08 (40% of maximum marks) in the practical component. The laboratory component of the IC/IPCC shall be for CIE only. However, in SEE, the questions from the laboratory component shall be included. The maximum of 05 questions is to be set from the practical component of IC/IPCC, the total marks of all questions should not be more than 25 marks.

The theory component of the IC shall be for both CIE and SEE.

Semester End Examination(SEE):

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject **(duration 03 hours)**

- The question paper shall be set for 100 marks. The medium of the question paper shall be English/Kannada). The duration of SEE is 03 hours.
- The question paper will have 10 questions. Two questions per module. Each question is set for 20 marks. The students have to answer 5 full questions, selecting one full question from each module. The student has to answer for 100 marks and **marks scored out of 100 shall be proportionally reduced to 50 marks**.

There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

Suggested Learning Resources:

Books (Title of the Book/Name of the author/Name of the publisher/Edition and Year)

1. Solid State Physics, S O Pillai, New Age International Private Limited, 8th Edition, 2018.
2. Engineering Physics by Gupta and Gour, Dhanpat Rai Publications, 2016 (Reprint).
3. A Textbook of Engineering Physics- M.N. Avadhanulu and P.G. Kshirsagar, 10th revised Ed, S. Chand. & Company Ltd, New Delhi.
4. Concepts of Modern Physics, Aurthur Beiser, McGrawhill, 6th Edition, 2009.
5. Lasers and Non Linear Optics, B B Loud, New age international, 2011 edition.
6. A Textbook of Engineering Physics by M.N. Avadhanulu, P G. Kshirsagar and T V S Arun Murthy, Eleventh edition, S Chand and Company Ltd. New Delhi-110055.
7. Quantum Computation and Quantum Information, Michael A. Nielsen & Isaac L. Chuang, Cambridge Universities Press, 2010 Edition.

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8. Quantum Computing, Vishal Sahani, McGraw Hill Education, 2007 Edition.
9. Quantum Computing – A Beginner's Introduction, Parag K Lala, Indian Edition, Mc GrawHill, Reprint 2020.
10. Engineering Physics, S P Basavaraj, 2005 Edition, Subhash Stores.
11. Physics for Animators, Michele Bousquet with Alejandro Garcia, CRC Press, Taylor & Francis, 2016.
12. Quantum Computation and Logic: How Quantum Computers Have Inspired Logical Investigations,Maria Luisa Dalla Chiara, Roberto Giuntini, Roberto Leporini, Giuseppe Sergioli,TrendsinLogic, Volume 48, Springer.
13. Statistical Physics: Berkely Physics Course, Volume 5, F. Reif, McGraw Hill.
14. Introduction to Superconductivity, Michael Tinkham, McGraw Hill, INC, II Edition

Web links and Video Lectures (e-Resources):

LASER: https://www.youtube.com/watch?v=WgzynezPiyc

Superconductivity : https://www.youtube.com/watch?v=MT5Xl5ppn48

Optical Fiber : https://www.youtube.com/watch?v=N_kA8EpCUQo

Quantum Mechanics : https://www.youtube.com/watch?v=p7bzE1E5PMY&t=136s

Quantum Computing : https://www.youtube.com/watch?v=jHoEjvuPoB8

Quantum Computing :https://www.youtube.com/watch?v=ZuvCUU2jD30

Physics of Animation : https://www.youtube.com/watch?v=kj1kaA_8Fu4

Statistical Physics Simulation : https://phet.colorado.edu/sims/html/plinko-probability/latest/plinko-probability_en.html

NPTEL Supercoductivity:https://archive.nptel.ac.in/courses/115/103/115103108/

NPTEL Quantum Computing : https://archive.nptel.ac.in/courses/115/101/115101092

Virtual LAB :https://www.vlab.co.in/participating-institute-amrita-vishwa-vidyapeetham

Virtual LAB : https://vlab.amrita.edu/index.php?sub=1&brch=189&sim=343&cnt=1

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

http://nptel.ac.in

https://swayam.gov.in

https://virtuallabs.merlot.org/vl_physics.html

https://phet.colorado.edu

https://www.myphysicslab.com

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Laboratory Component:

Any Ten Experiments have to be completed from the list of experiments

Note: The experiments have to be classified into

a) Exercise
b) Demonstration
c) Structured Inquiry
d) Open Ended

Based on the convenience classify the following experiments into above categories. Select at least one simulation/spreadsheet activity.

List of Experiments

1. Determination of wavelength of LASER using Diffraction Grating.
2. Determination of acceptance angle and numerical aperture of the given Optical Fiber.
3. Determination of Magnetic Flux Density at any point along the axis of a circular coil.
4. Determination of resistivity of a semiconductor by Four Probe Method
5. Study the I-V Characteristics of the Given Bipolar Junction Transistor.
6. Determination of dielectric constant of the material of capacitor by Charging and Discharging method.
7. Study the Characteristics of a Photo-Diode and to determine the power responsivity / Verification of Inverse Square Law of Intensity of Light.
8. Study the frequency response of Series & Parallel LCR circuits.
9. Determination of Planck's Constant using LEDs.
10. Determination of Fermi Energy of Copper.
11. Identification of circuit elements in a Black Box and determination of values of the components.
12. Determination of Energy gap of the given Semiconductor.
13. Step Interactive Physical Simulations.
14. Study of motion using spread Sheets
15. Study of Application of Statistics using spread sheets
16. PHET Interactive Simulations(https://phet.colorado.edu/en/simulations/filter?subjects=physics&type=html,prototype)

COs and POs Mapping (Individual teacher has to fill up)

COs	POs											
	1	2	3	4	5	6	7	8	9	10	11	12
CO1	3	2	-	-	-	-	-	-	-	-	-	2
CO2	3	3	-	-	-	-	-	-	-	-	-	2
CO3	3	3	-	-	-	-	-	-	-	-	-	2
CO4	3	2	1	-	1	-	-	-	-	-	-	2
CO5	3	2	1	-	2	-	-	3	3	-	-	2

Level 3- Highly Mapped, Level 2-Moderately Mapped, Level 1-Low Mapped,

Note : The CO-PO mapping values are indicative. The course coordinator can alter the mapping using **Competency and Performance Indicators** mentioned in the **AICTE Exam reforms.**

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Computer Science and Engineering and allied branches(Chemistry group)

Course Title:	Applied Chemistry for Computer Science &Engineering stream		
Course Code:	**BCHES102/202**	CIEMarks	50
Course Type(Theory/Practical/Integrated)	Integrated	SEEMarks	50
		Total Marks	100
TeachingHours/Week(L:T:P:S)[1]	2:2:2:0	Exam Hours	03
TotalHoursofPedagogy	40hoursTheory+ 10to12Labslots	Credits	04

Courseobjectives

- Toenablestudentstoacquireknowledgeonprinciplesofchemistryforengineeringapplications.
- Todevelopanintuitiveunderstandingofchemistrybyemphasizingtherelatedbranchesofengineering.
- Toprovidestudentswithasolidfoundationinanalyticalreasoningrequiredtosolvesocietalproblems.

Teaching-LearningProcess

Thesearesamplestrategies,whichteachercanusetoacceleratetheattainmentofthevariouscourseoutcomesandmakeTeaching–Learningmoreeffective

- Tutorial&remedialclassesforneedystudents(notregularT/R)
- ConductingMakeupclasses/Bridgecourses forneedystudents
- Demonstrationofconceptseitherbybuildingmodelsorbyindustryvisit
- Experimentsinlaboratoriesshallbeexecutedinblendedmode(conventionalornon–conventionalmethods)
- UseofICT–Onlinevideos,onlinecourses
- Useofonlineplatformsforassignments/Notes/Quizzes(Ex.Googleclassroom)

MODULE1:SensorsandEnergySystems(8hr)

Sensors:Introduction,working,principleandapplicationsofConductometricsensors,Electrochemical sensors,Thermometricsensors (Flame photometry)andOpticalsensors (colorimetry).Sensorsforthemeasurement of dissolved oxygen (DO). Electrochemical sensors for the pharmaceuticals.ElectrochemicalgassensorsforSOxandNOx.Disposablesensorsin thedetectionofbiomoleculesandpesticides.

EnergySystems:Introductiontobatteries,construction,workingandapplicationsofLithiumionandSodiumionbatteries.QuantumDotSensitizedSolarCells(QDSSC's)-Principle, PropertiesandApplications.

Self-learning: Types of electrochemical sensor, Gas sensor - O_2 sensor, Biosensor - Glucosesensors.

MODULE2:MaterialsforMemoryandDisplaySystems(8hr)

Memory Devices: Introduction, Basic concepts of electronic memory, History of organic/polymerelectronicmemorydevices,Classificationofelectronicmemorydevices,

1.NOTE:Whereverthecontact hoursisnotsufficient,tutorialhourcanbeconvertedto theoryhours

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typesoforganicmemorydevices(organicmolecules,polymericmaterials,organic-inorganichybridmaterials).

DisplaySystems:Photoactiveandelectroactivematerials,Nanomaterialsandorganicmaterials used in optoelectronic devices. Liquid crystals (LC's) - Introduction, classification,properties and application in Liquid Crystal Displays (LCD's). Properties and application ofOrganic Light Emitting Diodes (OLED's) and Quantum Light Emitting Diodes (QLED's), Lightemittingelectrochemicalcells.

Self-learning: PropertiesandfunctionsofSilicon(Si),Germanium(Ge),Copper(Cu), Aluminium(Al),andBrominatedflameretardantsincomputers.

MODULE3:CorrosionandElectrodeSystem(8hr)

CorrosionChemistry: Introduction,electrochemicaltheoryofcorrosion,typesofcorrosion-differentialmetalanddifferentialaeration.Corrosioncontrol-galvanization,anodization and sacrificial anode method. Corrosion Penetration Rate (CPR) - Introductionandnumerical problem.

Electrode System: Introduction, types of electrodes. Ion selective electrode – definition,construction, working and applications of glass electrode. Determination of pH using glasselectrode. Reference electrode- Introduction, calomel electrode– construction, workingandapplicationsofcalomelelectrode.Concentrationcell–Definition,constructionandNumericalproblems.

Analytical Techniques: Introduction, principle and instrumentation of Conductometry; itsapplication in the estimation of weak acid. Potentiometry; its application in the estimationofiron.

Self-learning:IRandUV-Visiblespectroscopy.

MODULE4:PolymersandGreenFuels(8hr)

Polymers: Introduction,Molecularweight-Numberaverage,weightaverageandnumericalproblems.Preparation,properties,andcommercialapplicationsofkevlar. Conductingpolymers–synthesisandconductingmechanismofpolyacetyleneandcommercialapplications.

Green Fuels: Introduction, construction and working of solar photovoltaic cell, advantages,and disadvantages. Generation of energy (green hydrogen) by electrolysis of water and itsadvantages.

Self-learning: Regenerativefuelcells

MODULE5:E-WasteManagement(8hr)

E-Waste: Introduction, sources of e-waste, Composition, Characteristics, and Need of e-wastemanagement.Toxicmaterialsusedinmanufacturingelectronicandelectricalproducts, health hazards due to exposure to e-waste. Recycling and Recovery: Differentapproachesofrecycling(separation,thermaltreatments,hydrometallurgicalextraction,pyrometallurgical methods, direct recycling). Extraction of gold from E-waste. Role of stakeholders in environmental management of e-waste (producers, consumers, recyclers, andstatutorybodies).

Self-learning: Impactofheavymetalsonenvironmentandhumanhealth.

PRACTICALMODULE

A–Demonstration(anytwo)offline/virtual:

A1.ChemicalStructure drawingusingsoftware:ChemDraworACD/ChemSketch

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A2. Determination of strength of an acid in Pb-acid batteryA3:SynthesisofIron-oxideNanoparticles

A4.Electrolysisofwater

B–Exercise(compulsorilyany4tobeconducted):

B1.Conductometricestimationofacidmixture

B2.PotentiometricestimationofFASusing$K_2Cr_2O_7$

B3.DeterminationofpKaofvinegarusingpHsensor(Glasselectrode)

B4.DeterminationofrateofcorrosionofmildsteelbyweightlossmethodB5.

EstimationoftotalhardnessofwaterbyEDTAmethod

C–StructuredEnquiry (compulsorilyany4tobeconducted):

C1. Estimation of Copper present in electroplating effluent by optical sensor (colorimetry)C2.DeterminationofViscositycoefficientoflubricant(Ostwald'sviscometer)

C3. Estimation of iron in TMT bar by diphenyl amine/external indicator methodC4.EstimationofSodiumpresentinsoil/effluentsampleusingflamephotometry

C5.DeterminationofChemicalOxygenDemand(COD)ofindustrialwastewatersample

D–OpenEndedExperiments(anytwo):

D1:EvaluationofacidcontentinbeveragesbyusingpHsensorsandsimulation.D2.

Construction ofphotovoltaiccell.

D3.DesignanexperimenttoIdentifythepresenceofproteinsingivensample.

D4.SearchingsuitablePDBfileandtargetformoleculardocking

Courseoutcome(CourseSkillSet)

Attheendofthecourse thestudentwillbeableto:

CO1.	Identify the terms processes involved in scientific and engineering andapplications
CO2.	Explainthephenomenaofchemistrytodescribethemethodsofengineeringprocesses
CO3.	Solvetheproblemsinchemistrythatarepertinentinengineeringapplications
CO4.	Applythebasicconceptsofchemistrytoexplainthechemicalpropertiesandprocesses
CO5.	Analyzepropertiesandmultidi processes associated withchemical substances in sciplinarysituations

AssessmentDetails(bothCIEandSEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50).The minimum passing mark for the SEE is 35% of the maximum marks (18 marks out of 50). Astudentshallbedeemedtohavesatisfiedtheacademicrequirementsandearnedthecreditsallotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in thesemester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total oftheCIE(ContinuousInternalEvaluation)andSEE(SemesterEndExamination)takentogether.

ContinuousInternalEvaluation(CIE):

The CIE marks for the theory component of the IC shall be **30 marks** and for the laboratory component **20 Marks**.

CIE for the theory component of the IC

- Three Tests each of 20 Marks; after the completion of the syllabus of 35-40%, 65-70%, and 90-100% respectively.
- Two Assignments/two quizzes/ seminars/one field survey and report presentation/one-course project totalling 20 marks.

Total Marks scored (test + assignments) out of 80 shall be scaled down to **30 marks**

CIE for the practical component of the IC

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- On completion of every experiment/program in the laboratory, the students shall be evaluated and marks shall be awarded on the same day. The **15 marks** are for conducting the experiment and preparation of the laboratory record, the other **05 marks shall be for the test** conducted at the end of the semester.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to 15 marks.
- The laboratory test **(duration 03 hours)** at the end of the 15^{th} week of the semester /after completion of all the experiments (whichever is early) shall be conducted for 50 marks and scaled down to **05 marks.**

Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IC/IPCC for **20 marks**.

- The minimum marks to be secured in CIE to appear for SEE shall be 12 (40% of maximum marks) in the theory component and 08 (40% of maximum marks) in the practical component. The laboratory component of the IC/IPCC shall be for CIE only. However, in SEE, the questions from the laboratory component shall be included. The maximum of 05 questions is to be set from the practical component of IC/IPCC, the total marks of all questions should not be more than 25 marks.

The theory component of the IC shall be for both CIE and SEE.

Semester End Examination(SEE):

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject **(duration 03 hours)**

- The question paper shall be set for 100 marks. The medium of the question paper shall be English/Kannada). The duration of SEE is 03 hours.
- The question paper will have 10 questions. Two questions per module. Each question is set for 20 marks. The students have to answer 5 full questions, selecting one full question from each module. The student has to answer for 100 marks and **marks scored out of 100 shall be proportionally reduced to 50 marks**.

There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

SuggestedLearningResources:

Books(TitleoftheBook/Nameoftheauthor/Nameofthepublisher/EditionandYear)

1. WileyEngineeringChemistry,WileyIndiaPvt.Ltd.NewDelhi,2013-2ndEdition.
2. EngineeringChemistry,Satyaprakash&ManishaAgrawal,KhannaBookPublishing,Delhi
3. ATextBookofEngg.Chemistry,ShashiChawla,DhanpatRai&Co.(P)Ltd.
4. EssentialsofPhysicalChemistry,Bahl&Tuli,S.ChandPublishing
5. AppliedChemistry,SunitaRattan,Kataria5.EngineeringChemistry,Baskar,Wiley
6. EngineeringChemistry–I,D.GrourKrishana,VikasPublishing
7. ATextbookofEngineeringChemistry,SSDara&Dr.SSUmare,SChand&CompanyLtd.,12thEdition,2011.
8. ATextBookofEngineeringChemistry,R.V.GadagandNityanandaShetty,I.K.InternationalPublishinghouse. 2ndEdition,2016.
9. TextBookofPolymerScience,F.W.Billmeyer,JohnWiley&Sons,4thEdition,1999.
10. NanotechnologyAChemicalApproachtoNanomaterials,G.A.Ozin&A.C.Arsenault,RSCPublishing,2005
.
11. CorrosionEngineering,M.G.Fontana,N.D.Greene,McGrawHillPublications,NewYork,3rdEdition,1996.

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12. Linden'sHandbookofBatteries,KirbyW.Beard,FifthEdition,McGrawHill,2019.
13. OLEDDisplayFundamentalsandApplications,TakatoshiTsujimura,Wiley–Blackwell,2012
14. Supercapacitors:Materials,Systems,andApplications,MaxLu,FrancoisBeguin,ElzbietaFrackowiak,Wiley-VCH;1stedition,2013.
15. "HandbookonElectroplatingwithManufactureofElectrochemicals",ASIAPACIFICBUSINESSPRESS Inc., 2017. Dr.H. Panda,
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29. LaboratoryManualEngg.Chemistry,AnupmaRajput,DhanpatRai&Co.

WeblinksandVideoLectures(e-Resources):

- http://libgen.rs/
- https://nptel.ac.in/downloads/122101001/
- https://nptel.ac.in/courses/104/103/104103019/
- https://ndl.iitkgp.ac.in/
- https://www.youtube.com/watch?v=faESCxAWR9k
- https://www.youtube.com/watch?v=TBqXMWaxZYM&list=PLyhmwFtznRhuz8L1bb3X-9IbHrDMjHWWh
- https://www.youtube.com/watch?v=j5Hml6KN4TI
- https://www.youtube.com/watch?v=X9GHBdyYcyo
- https://www.youtube.com/watch?v=1xWBPZnEJk8
- https://www.youtube.com/watch?v=wRAo-M8xBHM

PRINCIPAL
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Kodigehalli, Doddaballapur - 561 203. Karnataka

16-2-2023

ActivityBasedLearning(SuggestedActivitiesinClass)/PracticalBasedlearning

- https://www.vlab.co.in/broad-area-chemical-sciences
- https://demonstrations.wolfram.com/topics.php
- https://interestingengineering.com/science

COsandPOsMapping(Individualteacherhastofillup)

	PO											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1				1					
CO2	3	1	1				1					
CO3	3	1	1				1					
CO4	3	1	1				1					
CO5	3	1	1				1					

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III SEMESTER

Sl. No	Course	Course Code	Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week: Theory Lecture (L)	Tutorial (T)	Practical/ Drawing (P)	SDA (S)	Examination: Duration in hours	CIE Marks	SEE Marks	Total Marks	Credits
1	PCC	BEC301	Maths for AV Communication	TD- Maths PSB - Maths	3	0	0		03	50	50	100	3
2	IPCC	BEC302	Analysis and Design of Digital Circuits	TD: ECE PSB: ECE	3	0	2		03	50	50	100	4
3	IPCC	BEC303	Analog Electronic Circuits	TD: ECE PSB: ECE	3	0	2		03	50	50	100	4
4	PCC	BEC304	Network Analysis	TD: ECE PSB: ECE	3	0	0		03	50	50	100	3
5	PCCL	BECL305	Analog and Digital Electronics Laboratory	TD: ECE PSB: ECE	0	0	2		03	50	50	100	1
6	ESC	BXX306x	ESC/ETC/PLC	TD: PSB:	3	0	0		03	50	50	100	3
7	UHV	BSCK307	**Social Connect and Responsibility**	Any Department	0	0	2		01	100	---	100	1
8	AEC/ SEC	BXX358x	Ability Enhancement Course/Skill Enhancement Course - III		If the course is a Theory				01	50	50	100	1
					1	0	0						
					If a course is a laboratory				02				
					0	0	2						
9	MC	BNSK359	National Service Scheme (NSS)	NSS coordinator	0	0	2			100	---	100	0
		BPEK359	Physical Education (PE) (Sports and Athletics)	Physical Education Director									
		BYOK359	Yoga	Yoga Teacher									
									Total	**550**	**350**	**900**	**20**

PCC: Professional Core Course, **PCCL**: Professional Core Course laboratory, **UHV**: Universal Human Value Course, **MC**: Mandatory Course (Non-credit), **AEC**: Ability Enhancement Course, **SEC**: Skill Enhancement Course, **L:** Lecture, **T**: Tutorial, **P**: Practical **S= SDA**: Skill Development Activity, **CIE**: Continuous Internal Evaluation, **SEE**: Semester End Evaluation. K : This letter in the course code indicates common to all the stream of engineering. ESC: Engineering Science Course, ETC: Emerging

Technology Course, PLC: Programming Language Course

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Engineering Science Course (ESC/ETC/PLC)			
BEC306A	Digital System Design using Verilog	BEC306C	Computer Organization and Architecture
BEC306B	Sensors and Instrumentation	BEC306D	Applied Numerical methods
Ability Enhancement Course – III			
BEC358A	LICs Lab using PSPICE	BEC358C	Digital Engineering Course (NASSCOM)
BEC358B	Simulink Programming Basics	BEC358D	IOT for Smart Infrastructure

Professional Core Course (IPCC): Refers to Professional Core Course Theory Integrated with practicals of the same course. Credit for IPCC can be 04 and its Teaching–Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from the practical part of IPCC shall be included in the SEE question paper. For more details, the regulation governing the Degree of Bachelor of Engineering /Technology (B.E./B.Tech.) 2022-23 may please be refered.

National Service Scheme /Physical Education/Yoga: All students have to register for any one of the courses namely National Service Scheme (NSS), Physical Education (PE)(Sports and Athletics), and Yoga(YOG) with the concerned coordinator of the course during the first week of III semesters. Activities shall be carried out between III semester to the VI semester (for 4 semesters). Successful completion of the registered course and requisite CIE score is mandatory for the award of the degree. The events shall be appropriately scheduled by the colleges and the same shall be reflected in the calendar prepared for the NSS, PE, and Yoga activities. These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the course is mandatory for the award of degree.

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IV SEMESTER

Sl. No	**Course and Course Code**		**Course Title**	**Teaching Department (TD) and Question Paper Setting Board (PSB)**	**Teaching Hours /Week**				**Examination**				**Credits**
					Theory Lecture	**Tutorial**	**Practical/ Drawing**	**Self -Study**	**Duration in hours**	**CIE Marks**	**SEE Marks**	**Total Marks**	
					L	**T**	**P**	**S**					
1	PCC	BEC401	Engineering Electromagnetics	ECE	3	0	0		03	50	50	100	3
2	IPCC	BEC402	Principles of Communication Systems	ECE	3	0	2		03	50	50	100	4
3	IPCC	BEC403	Modern Control systems	ECE	4	0	0		03	50	50	100	4
4	PCCL	BECL404	Communication laboratory	ECE	0	0	2		03	50	50	100	1
5	ESC	BEC405x	ESC/ETC/PLC	ECE	3	0	0		03	50	50	100	3
6	AEC/ SEC	BXX456x	Ability Enhancement Course/Skill Enhancement Course- IV	TD and PSB: Concerned department	If the course is Theory				01	50	50	100	1
					1	0	0						
					If the course is a lab				02				
					0	0	2						
4	BSC	BBOK407	Biology For Engineers	TD / PSB: BT, CHE,	3	0	0		03	50	50	100	3
7	UHV	BUHK408	Universal human values course	Any Department	1	0	0		01	50	50	100	1
9	MC	BNSK459	National Service Scheme (NSS)	NSS coordinator	0	0	2			100	---	100	0
		BPEK459	Physical Education (PE) (Sports and Athletics)	Physical Education Director									
		BYOK459	Yoga	Yoga Teacher									
									Total	**500**	**400**	**900**	**20**

PCC: Professional Core Course, **PCCL**: Professional Core Course laboratory, **UHV**: Universal Human Value Course, **MC**: Mandatory Course (Non-credit), **AEC**: Ability Enhancement Course, **SEC**: Skill Enhancement Course, **L:** Lecture, **T**: Tutorial, **P**: Practical **S= SDA**: Skill Development Activity, **CIE**: Continuous Internal Evaluation, **SEE**: Semester End Evaluation. K : This letter in the course code indicates common to all the stream of engineering.

Ability Enhancement Course / Skill Enhancement Course - IV			
BEC456A	Electronic Devices	BEC456C	LabVIEW Programming
BEC456B	PCB Design	BEC456D	Risk Management in IOT Implementation
Engineering Science Course (ESC/ETC/PLC)			
BEC405A	8051 Microcontroller	BEC405C	Operating Systems
BEC405B	Industrial Electronics	BEC405D	Engineering Statistics and Linear Algebra

Professional Core Course (IPCC): Refers to Professional Core Course Theory Integrated with practical of the same course. Credit for IPCC can be 04 and its Teaching–Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from the practical part of IPCC shall be included in the SEE question paper. For more details, the regulation governing the Degree of Bachelor of Engineering /Technology (B.E./B.Tech.) 2022-23

National Service Scheme /Physical Education/Yoga: All students have to register for any one of the courses namely National Service Scheme (NSS), Physical Education (PE)(Sports and Athletics), and Yoga(YOG) with the concerned coordinator of the course during the first week of III semesters. Activities shall be carried out between III semester to the VI semester (for 4 semesters). Successful completion of the registered course and requisite CIE score is mandatory for the award of the degree. The events shall be appropriately scheduled by the colleges and the same shall be reflected in the calendar prepared for the NSS, PE, and Yoga activities. These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the courses is mandatory for the award of degree.

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V SEMESTER

Sl. No	Course and Course Code		Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	Self -Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1	HSMS	BXX501	This course must be pertaining to economics and management of the concerned degree program. The course syllabus should have both economics and management topics and the course title should bear the word Management.		3	0	0		03	50	50	100	3
2	IPCC	BEC502	Digital Communication Systems		3	0	2		03	50	50	100	4
3	PCC	BEC503	Signal Processing		4	0	0		03	50	50	100	4
4	PCCL	BECL504	Signal Processing Laboratory		0	0	2		03	50	50	100	1
5	PEC	BEC515x	Professional Elective Course		3	0	0		03	50	50	100	3
6	PROJ	BEC586	Mini Project		0	0	4		03	100		100	2
7	AEC	BRMK557	Research Methodology and IPR		2	2	0		02	50	50	100	3
8	MC	BESK508	Environmental Studies		2	0	0		02	50	50	100	2
9	MC	BNSK559	National Service Scheme (NSS)	NSS coordinator	0	0	2			100		100	0
		BPEK559	Physical Education (PE) (Sports and Athletics)	Physical Education Director									
		BYOK559	Yoga	Yoga Teacher									
									Total	**500**	**300**	**800**	**22**

Professional Elective Course

BEC515A	Data Structures using C++	BEC515C	Artificial Neural Networks
BEC515B	Cryptography	BEC515D	Cloud Computing and IOT Analytics

PCC: Professional Core Course, **PCCL**: Professional Core Course laboratory, **UHV**: Universal Human Value Course, **MC**: Mandatory Course (Non-credit), **AEC**: Ability Enhancement Course, **SEC**: Skill Enhancement Course, **L:** Lecture, **T**: Tutorial, **P**: Practical **S= SDA**: Skill Development Activity, **CIE**: Continuous Internal Evaluation, **SEE**: Semester End Evaluation. **K :** The letter in the course code indicates common to al the stream of engineering. **PROJ**: Project /Mini Project. **PEC**: Professional Elective

Course
Professional Core Course (IPCC): Refers to Professional Core Course Theory Integrated with practicals of the same course. Credit for IPCC can be 04 and its Teaching–Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from the practical part of IPCC shall be included in the SEE question paper. For more details, the regulation governing the Degree of Bachelor of Engineering /Technology (B.E./B.Tech.) 2022-23 **National Service Scheme /Physical Education/Yoga:** All students have to register for any one of the courses namely National Service Scheme (NSS), Physical Education (PE)(Sports and Athletics), and Yoga(YOG) with the concerned coordinator of the course during the first week of III semesters. Activities shall be carried out between III semester to the VI semester (for 4 semesters). Successful completion of the registered course and requisite CIE score is mandatory for the award of the degree. The events shall be appropriately scheduled by the colleges and the same shall be reflected in the calendar prepared for the NSS, PE, and Yoga activities. These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the course is mandatory for the award of degree.
Mini-project work: Mini Project is a laboratory-oriented/hands on course that will provide a platform to students to enhance their practical knowledge and skills by the development of small systems/applications etc. Based on the ability/abilities of the student/s and recommendations of the mentor, a single discipline or a multidisciplinary Mini- project can be assigned to an individual student or to a group having not more than 4 students. **CIE procedure for Mini-project:** **(i) Single discipline:** The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two faculty members of the Department, one of them being the Guide. The CIE marks awarded for the Mini-project work shall be based on the evaluation of the project report, project presentation skill, and question and answer session in the ratio of 50:25:25. The marks awarded for the project report shall be the same for all the batches mates. **(ii) Interdisciplinary:** Continuous Internal Evaluation shall be group-wise at the college level with the participation of all the guides of the project. The CIE marks awarded for the Mini-project, shall be based on the evaluation of the project report, project presentation skill, and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates. **No SEE component for Mini-Project.**
Professional Elective Courses (PEC): A professional elective (PEC) course is intended to enhance the depth and breadth of educational experience in the Engineering and Technology curriculum. Multidisciplinary courses that are added supplement the latest trend and advanced technology in the selected stream of engineering. Each group will provide an option to select one course. The minimum number of students’ strengths for offering a professional elective is 10. However, this conditional shall not be applicable to cases where the admission to the program is less than 10.

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(Effective from the academic year 2023-24)

VI SEMESTER

Sl. No	Course and Course Code		Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	Self -Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1	IPCC	BEC601	ARM Microcontroller		3	0	2		03	50	50	100	4
2	PCC	BEC602	VLSI Design and Testing		4	0	0		03	50	50	100	4
3	PEC	BEC613x	Professional Elective Course		3	0	0		03	50	50	100	3
4	OEC	BEC654x	Open Elective Course		3	0	0		03	50	50	100	3
5	PROJ	BEC685	Project Phase I		0	0	4		03	100	--	100	2
6	PCCL	BECL606	VLSI Laboratory		0	0	2		03	50	50	100	1
7	AEC/SDC	BEE657x	Ability Enhancement Course/Skill Development Course V		If the course is offered as a Theory				01	50	50	100	1
					1	0	0						
					If course is offered as a practical								
					0	0	2						
8	MC	BNSK658	National Service Scheme (NSS)	NSS coordinator	0	0	2			100	---	100	0
		BPEK658	Physical Education (PE) (Sports and Athletics)	Physical Education Director									
		BYOK658	Yoga	Yoga Teacher									
									Total	**500**	**300**	**800**	**18**

Professional Elective Course

BEC613A	Satellite Communication	BEC613C	Machine Learning
BEC613B	Networks and Cyber Security	BEC613D	Digital Image Processing

Open Elective Course

BEE654A		BEE654C	
BEE654B		BEE654D	

Ability Enhancement Course / Skill Enhancement Course-V			
BEE657A	Automotive Electronics	BEE657C	Introduction to Quantum Computing
BEE657B	Introduction to E-Vehicles	BEE657D	Soft Computing

PCC: Professional Core Course, **PCCL**: Professional Core Course laboratory, **UHV**: Universal Human Value Course, **MC**: Mandatory Course (Non-credit), **AEC**: Ability Enhancement Course, **SEC**: Skill Enhancement Course, **L:** Lecture, **T**: Tutorial, **P**: Practical **S= SDA**: Skill Development Activity, **CIE**: Continuous Internal Evaluation, **SEE**: Semester End Evaluation. **K :** The letter in the course code indicates common to al the stream of engineering. **PROJ**: Project /Mini Project. **PEC**: Professional Elective Course. **PROJ**: Project Phase -I, **OEC**: Open Elective Course

Professional Core Course (IPCC): Refers to Professional Core Course Theory Integrated with practicals of the same course. Credit for IPCC can be 04 and its Teaching–Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from the practical part of IPCC shall be included in the SEE question paper. For more details, the regulation governing the Degree of Bachelor of Engineering /Technology (B.E./B.Tech.) 2022-23

National Service Scheme /Physical Education/Yoga: All students have to register for any one of the courses namely National Service Scheme (NSS), Physical Education (PE)(Sports and Athletics), and Yoga(YOG) with the concerned coordinator of the course during the first week of III semesters. Activities shall be carried out between III semester to the VI semester (for 4 semesters). Successful completion of the registered course and requisite CIE score is mandatory for the award of the degree. The events shall be appropriately scheduled by the colleges and the same shall be reflected in the calendar prepared for the NSS, PE, and Yoga activities. These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the course is mandatory for the award of degree.

Professional Elective Courses (PEC): A professional elective (PEC) course is intended to enhance the depth and breadth of educational experience in the Engineering and Technology curriculum. Multidisciplinary courses that are added supplement the latest trend and advanced technology in the selected stream of engineering. Each group will provide an option to select one course. The minimum number of students' strengths for offering professional electives is 10. However, this conditional shall not be applicable to cases where the admission to the program is less than 10.

Open Elective Courses:

Students belonging to a particular stream of Engineering and Technology are not entitled to the open electives offered by their parent Department. However, they can opt for an elective offered by other Departments, provided they satisfy the prerequisite condition if any. Registration to open electives shall be documented under the guidance of the Program Coordinator/ Advisor/Mentor. The minimum numbers of students' strength for offering Open Elective Course is 10. However, this condition shall not be applicable to class where the admission to the program is less than 10.

Project Phase-I : Students have to discuss with the mentor /guide and with their helphe/she has to complete the literature survey and prepare the report and finally define the problem statement for the project work.

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VII SEMESTER (Swappable VII and VIII SEMESTER)

Sl. No	Course and Course Code		Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	Self -Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1	IPCC	BEC701	Communication Networks	ECE	3	0	2		03	50	50	100	4
2	IPCC	BEC702	Antenna and Wave Propagation	ECE	3	0	2		03	50	50	100	4
3	PCC	BEC703	Wireless Cellular and LTE 4G Broadband	ECE	4	0	0		03	50	50	100	4
4	PEC	BEC714x	**Professional Elective Course**		3	0	0		03	50	50	100	3
5	OEC	BEC755x	**Open Elective Course**		3	0	0		01	50	50	100	3
6	PROJ	BEC786	**Major Project Phase-II**		0	0	12		03	100	100	200	6
										400	**300**	**700**	**24**

Professional Elective Course

BEC714A	Wireless Sensor Networks	BEC714C	Advanced VLSI
BEC714B	5G Fundamentals and Architecture	BEC714D	Soft Computing Techniques

Open Elective Course

BEE755A		BEE755C	
BEE755B		BEE755D	

PCC: Professional Core Course, **PCCL**: Professional Core Course laboratory, **PEC**: Professional Elective Course, **OEC**: Open Elective Course PR: Project Work, **L:** Lecture, **T**: Tutorial, **P**: Practical **S= SDA**: Skill Development Activity, **CIE**: Continuous Internal Evaluation, **SEE**: Semester End Evaluation. **TD-** Teaching Department, **PSB**: Paper Setting department, **OEC**: Open Elective Course, **PEC**: Professional Elective Course. **PROJ**: Project work

Note: VII and VIII semesters of IV years of the program

(1) Institutions can swap the VII and VIII Semester Schemes of Teaching and Examinations to accommodate research internships/ industry internships after the VI semester**.**

(2) Credits earned for the courses of VII and VIII Semester Scheme of Teaching and Examinations shall be counted against the corresponding semesters whether the VII or VIII semesters is completed during the beginning of the IV year or the later part of IV years of the program.

Professional Elective Courses (PEC): A professional elective (PEC) course is intended to enhance the depth and breadth of educational experience in the Engineering and

Technology curriculum. Multidisciplinary courses that are added supplement the latest trend and advanced technology in the selected stream of engineering. Each group will provide an option to select one course. The minimum number of students' strengths for offering professional electives is 10. However, this conditional shall not be applicable to cases where the admission to the program is less than 10.

Open Elective Courses:

Students belonging to a particular stream of Engineering and Technology are not entitled to the open electives offered by their parent Department. However, they can opt for an elective offered by other Departments, provided they satisfy the prerequisite condition if any. Registration to open electives shall be documented under the guidance of the Program Coordinator/ Advisor/Mentor. The minimum numbers of students' strength for offering Open Elective Course is 10. However, this condition shall not be applicable to class where the admission to the program is less than 10.

PROJECT WORK (21XXP75): The objective of the Project work is

(i) To encourage independent learning and the innovative attitude of the students.

(ii) To develop interactive attitude, communication skills, organization, time management, and presentation skills.

(iii) To impart flexibility and adaptability.

(iv) To inspire team working.

(v) To expand intellectual capacity, credibility, judgment and intuition.

(vi) To adhere to punctuality, setting and meeting deadlines.

(vii) To install responsibilities to oneself and others.

(viii) To train students to present the topic of project work in a seminar without any fear, face the audience confidently, enhance communication skills, involve in group discussion to present and exchange ideas.

CIE procedure for Project Work:

(1) Single discipline: The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two senior faculty members of the Department, one of whom shall be the Guide.

The CIE marks awarded for the project work, shall be based on the evaluation of the project work Report, project presentation skill, and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.

(2) Interdisciplinary: Continuous Internal Evaluation shall be group-wise at the college level with the participation of all guides of the college. Participation of external guide/s, if any, is desirable. The CIE marks awarded for the project work, shall be based on the evaluation of project work Report, project presentation skill, and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.

SEE procedure for Project Work: SEE for project work will be conducted by the two examiners appointed by the University. The SEE marks awarded for the project work shall be based on the evaluation of project work Report, project presentation skill, and question and answer session in the ratio 50:25:25.

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VIIISEMESTER (Swappable VII and VIII SEMESTER)

Sl. No	Course and Course Code		Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	Self -Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1	PEC	BEE801x	**Professional Elective (Online Courses)**		3	0	0		03	50	50	100	3
2	OEC	BEE802x	**Open Elective (Online Courses)**		0	2	0		01	50	50	100	3
3	INT	BEE803	**Internship (Industry/Research) (14 - 20 weeks)**		0	0	12		03	100	100	200	10
										200	**200**	**400**	**16**

Professional Elective Course (Online courses)

BEE801A		BEE801C	
BEE801B		BEE801D	

Open Elective Courses (Online Courses)

BEE802A		BEE802C	
BEE802B		BEE802D	

L: Lecture, **T**: Tutorial, **P**: Practical **S= SDA**: Skill Development Activity, **CIE**: Continuous Internal Evaluation, **SEE**: Semester End Evaluation. **TD-** Teaching Department, **PSB**: Paper Setting department, **OEC**: Open Elective Course, **PEC**: Professional Elective Course. **PROJ**: Project work, **INT**: Industry Internship / Research Internship / Rural Internship

Note: VII and VIII semesters of IV years of the program

Swapping Facility

- Institutions can swap VII and VIII Semester Scheme of Teaching and Examinations to accommodate **research internships/ industry internships/Rural Internship** after the VI semester**.**
- Credits earned for the courses of VII and VIII Semester Scheme of Teaching and Examinations shall be counted against the corresponding semesters whether VII or VIII semester is completed during the beginning of IV year or later part of IV year of the program.

Elucidation:

At the beginning of IV years of the program i.e., after VI semester, VII semester classwork and VIII semester **Research Internship /Industrial Internship / Rural Internship** shall be permitted to be operated simultaneously by the University so that students have ample opportunity for an internship. In other words, a good percentage of the class shall attend VII semester classwork and a similar percentage of others shall attend to Research Internship or Industrial Internship or Rural Internship.

Research/Industrial /Rural Internship shall be carried out at an Industry, NGO, MSME, Innovation center, Incubation center, Start-up, center of Excellence (CoE), Study Centre established in the parent institute and /or at reputed research organizations/institutes.

The mandatory Research internship /Industry internship / Rural Internship is for 14 to 20 weeks. The internship shall be considered as a head of passing and shall be considered for the award of a degree. Those, who do not take up/complete the internship shall be declared to fail and shall have to complete it during the subsequent University examination after satisfying the internship requirements.

Research internship: A research internship is intended to offer the flavor of current research going on in the research field. It helps students get familiarized with the field and imparts the skill required for carrying out research.

Industry internship: Is an extended period of work experience undertaken by students to supplement their degree for professional development. It also helps them learn to overcome unexpected obstacles and successfully navigate organizations, perspectives, and cultures. Dealing with contingencies helps students recognize, appreciate, and adapt to organizational realities by tempering their knowledge with practical constraints.

Rural Internship: Rural development internship is an initiative of Unnat Bharat Abhiyan Cell, RGIT in association with AICTE to involve students of all departments studying in different academic years for exploring various opportunities in techno-social fields, to connect and work with Rural India for their upliftment.

The faculty coordinator or mentor has to monitor the student's internship progress and interact with them to guide for the successful completion of the internship.

The students are permitted to carry out the internship anywhere in India or abroad. University shall not bear any expenses incurred in respect of the internship.

With the consent of the internal guide and Principal of the Institution, students shall be allowed to carry out the internship at their hometown (**within or outside the state or abroad**), provided favorable facilities are available for the internship and the student remains regularly in contact with the internal guide. **University shall not bear any cost involved in carrying out the internship by students.** However, students can receive any financial assistance extended by the organization.

Professional Elective /Open Elective Course: These are ONLINE courses suggested by the respective Board of Studies. Details of these courses shall be made available for students on the VTU web portal.

Please note: If any clarifications / suggestions please email to **sbhvtuso@yahoo.com**

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI

B.E. in Artificial Intelligence and Machine Learning

Scheme of Teaching and Examinations 2022

Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

(Effective from the academic year 2023-24)

III SEMESTER

<table>
<tr><th rowspan="3">Sl. No</th><th rowspan="3">Course</th><th rowspan="3">Course Code</th><th rowspan="3">Course Title</th><th rowspan="3">Teaching Department (TD) and Question Paper Setting Board (PSB)</th><th colspan="4">Teaching Hours /Week</th><th colspan="4">Examination</th><th rowspan="3">Credits</th></tr>
<tr><th>Theory Lecture</th><th>Tutorial</th><th>Practical / Drawing</th><th>SDA</th><th rowspan="2">Duration in hours</th><th rowspan="2">CIE Marks</th><th rowspan="2">SEE Marks</th><th rowspan="2">Total Marks</th></tr>
<tr><th>L</th><th>T</th><th>P</th><th>S</th></tr>
<tr><td>1</td><td>PCC/BSC</td><td>BCS301</td><td>Mathematics for Computer Science</td><td>TD : Maths
PSB : Maths</td><td>3</td><td>2</td><td>0</td><td></td><td>03</td><td>50</td><td>50</td><td>100</td><td>4</td></tr>
<tr><td>2</td><td>IPCC</td><td>BCS302</td><td>Digital Design & Computer Organization</td><td>TD : AI
PSB : CS</td><td>3</td><td>0</td><td>2</td><td></td><td>03</td><td>50</td><td>50</td><td>100</td><td>4</td></tr>
<tr><td>3</td><td>IPCC</td><td>BCS303</td><td>Operating Systems</td><td>TD : AI
PSB : CS</td><td>3</td><td>0</td><td>2</td><td></td><td>03</td><td>50</td><td>50</td><td>100</td><td>4</td></tr>
<tr><td>4</td><td>PCC</td><td>BCS304</td><td>Data Structures and Applications</td><td>TD : AI
PSB : CS</td><td>3</td><td>0</td><td>0</td><td></td><td>03</td><td>50</td><td>50</td><td>100</td><td>3</td></tr>
<tr><td>5</td><td>PCCL</td><td>BCSL305</td><td>Data Structures Lab</td><td>TD : AI
PSB : CS</td><td>0</td><td>0</td><td>2</td><td></td><td>03</td><td>50</td><td>50</td><td>100</td><td>1</td></tr>
<tr><td>6</td><td>ESC</td><td>BXX306x</td><td>ESC/ETC/PLC</td><td>TD : AI
PSB : CS</td><td>2</td><td>0</td><td>2</td><td></td><td>03</td><td>50</td><td>50</td><td>100</td><td>3</td></tr>
<tr><td>7</td><td>UHV</td><td>BSCK307</td><td>Social Connect and Responsibility</td><td>Any Department</td><td>0</td><td>0</td><td>2</td><td></td><td>01</td><td>100</td><td>---</td><td>100</td><td>1</td></tr>
<tr><td rowspan="4">8</td><td rowspan="4">AEC/ SEC</td><td rowspan="4">BXX358x</td><td rowspan="4">Ability Enhancement Course/Skill Enhancement Course – III</td><td rowspan="4">TD and PSB: Concerned department</td><td colspan="4">If the course is a Theory</td><td rowspan="2">01</td><td rowspan="4">50</td><td rowspan="4">50</td><td rowspan="4">100</td><td rowspan="4">1</td></tr>
<tr><td>1</td><td>0</td><td>0</td><td></td></tr>
<tr><td colspan="4">If a course is a laboratory</td><td rowspan="2">02</td></tr>
<tr><td>0</td><td>0</td><td>2</td><td></td></tr>
<tr><td rowspan="3">9</td><td rowspan="3">MC</td><td>BNSK359</td><td>National Service Scheme (NSS)</td><td>NSS coordinator</td><td rowspan="3">0</td><td rowspan="3">0</td><td rowspan="3">2</td><td rowspan="3"></td><td rowspan="3"></td><td rowspan="3">100</td><td rowspan="3">---</td><td rowspan="3">100</td><td rowspan="3">0</td></tr>
<tr><td>BPEK359</td><td>Physical Education (PE) (Sports and Athletics)</td><td>Physical Education Director</td></tr>
<tr><td>BYOK359</td><td>Yoga</td><td>Yoga Teacher</td></tr>
<tr><td colspan="10" align="right">Total</td><td>550</td><td>350</td><td>900</td><td>21</td></tr>
</table>

PCC: Professional Core Course, **PCCL**: Professional Core Course laboratory, **UHV**: Universal Human Value Course, **MC**: Mandatory Course (Non-credit), **AEC**: Ability Enhancement Course, **SEC**: Skill Enhancement Course, **L:** Lecture, **T**: Tutorial, **P**: Practical **S= SDA**: Skill Development Activity, **CIE**: Continuous Internal Evaluation, **SEE**: Semester End Evaluation.K :This letter in the course code indicates common to all the stream of engineering. ESC: Engineering Science Course, ETC: Emerging Technology Course, PLC: Programming Language Course

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Engineering Science Course (ESC/ETC/PLC) (Note- Student should opt for the course which should not be similar to the course opted in 1st Year)			
BCS306A	Object Oriented Programming with Java	BDS306C	Data Analytics with R
BDS306B	Python Programming for Data Science	BAI306D	
Ability Enhancement Course – III			
BCS358A	Data Analytics with Excel	BCS358C	Project Management with Git
BAI358B	Ethics and Public Policy for AI	BAI358D	PHP Programming

Professional Core Course (IPCC): Refers to Professional Core Course Theory Integrated with practicals of the same course. Credit for IPCC can be 04 and its Teaching–Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from the practical part of IPCC shall be included in the SEE question paper. For more details, the regulation governing the Degree of Bachelor of Engineering /Technology (B.E./B.Tech.) 2022-23 may please be refered.

National Service Scheme /Physical Education/Yoga: All students have to register for any one of the courses namely National Service Scheme (NSS), Physical Education (PE)(Sports and Athletics), and Yoga(YOG) with the concerned coordinator of the course during the first week of III semesters. Activities shall be carried out between III semester to the VI semester (for 4 semesters). Successful completion of the registered course and requisite CIE score is mandatory for the award of the degree. The events shall be appropriately scheduled by the colleges and the same shall be reflected in the calendar prepared for the NSS, PE, and Yoga activities. These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the course is mandatory for the award of degree.

VARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI

B.E. in Artificial Intelligence and Machine Learning

Scheme of Teaching and Examinations2022

Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

(Effective from the academic year 2023-24)

IV SEMESTER

Sl. No	Course and Course Code		Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	Self - Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1	PCC/BSC	BCS401	Analysis & Design of Algorithms	TD : AI PSB : CS	3	0	0		03	50	50	100	3
2	IPCC	BAI402	Artificial Intelligence	TD : AI PSB : CS	3	0	2		03	50	50	100	4
3	IPCC	BCS403	Database Management Systems	TD : AI PSB : CS	3	0	2		03	50	50	100	4
4	PCCL	BCSL404	Analysis & Design of Algorithms Lab	TD : AI PSB : CS	0	0	2		03	50	50	100	1
5	ESC	BXX405x	ESC/ETC/PLC	TD: AI/Maths PSB : CS/Maths	2	2	0		03	50	50	100	3
6	AEC/ SEC	BDS456x	Ability Enhancement Course/Skill Enhancement Course- IV	TD : AI PSB : CS	If the course is Theory				01	50	50	100	1
					1	0	0						
					If the course is a lab				02				
					0	0	2						
4	BSC	BBOK407	Biology For Engineers	TD / PSB: BT, CHE,	2	0	0		03	50	50	100	2
7	UHV	BUHK408	Universal human values course	Any Department	1	0	0		01	50	50	100	1
9	MC	BNSK459	National Service Scheme (NSS)	NSS coordinator	0	0	2			100	---	100	0
		BPEK459	Physical Education (PE) (Sports and Athletics)	Physical Education Director									
		BYOK459	Yoga	Yoga Teacher									
									Total	**500**	**400**	**900**	**19**

PCC: Professional Core Course, **PCCL**: Professional Core Course laboratory, **UHV**: Universal Human Value Course, **MC**: Mandatory Course (Non-credit), **AEC**: Ability Enhancement Course, **SEC**: Skill Enhancement Course, **L:** Lecture, **T**: Tutorial, **P**: Practical **S= SDA**: Skill Development Activity, **CIE**: Continuous Internal Evaluation, **SEE**: Semester End Evaluation. K :This letter in the course code indicates common to all the stream of engineering.			
Ability Enhancement Course / Skill Enhancement Course – IV			
BDS456A	Scala	BDS456C	MERN
BDS456B	MangoDB	BDS456D	Julia
Engineering Science Course (ESC/ETC/PLC)			
BCS405A	Discrete Mathematical Structures	BAI405C	Optimization for Machine Learning
BAI405B	Metric Spaces	BAI405D	Algorithmic Game Theory

Professional Core Course (IPCC): Refers to Professional Core Course Theory Integrated with practical of the same course. Credit for IPCC can be 04 and its Teaching–Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from the practical part of IPCC shall be included in the SEE question paper. For more details, the regulation governing the Degree of Bachelor of Engineering /Technology (B.E./B.Tech.) 2022-23

National Service Scheme /Physical Education/Yoga: All students have to register for any one of the courses namely National Service Scheme (NSS), Physical Education (PE)(Sports and Athletics), and Yoga(YOG) with the concerned coordinator of the course during the first week of III semesters. Activities shall be carried out between III semester to the VI semester (for 4 semesters). Successful completion of the registered course and requisite CIE score is mandatory for the award of the degree. The events shall be appropriately scheduled by the colleges and the same shall be reflected in the calendar prepared for the NSS, PE, and Yoga activities. These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the courses is mandatory for the award of degree.

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI

B.E. in Artificial Intelligence and Machine Learning

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(Effective from the academic year 2023-24)

V SEMESTER

Sl. No	Course and Course Code		Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
					Theory Lecture	Tutorial	Practical / Drawing	SDA	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1	HSMS	BAI501	Software Engineering & Project Management (This course must be pertaining to economics and management of the concerned degree program. The course syllabus should have both economics and management topics and the course title should bear the word Management.)	TD : AI PSB : AI	3	0	0		03	50	50	100	3
2	IPCC	BAI502	Computer Networks	TD : AI PSB : AI	3	0	2		03	50	50	100	4
3	PCC	BAI503	Theory of Computation	TD : AI PSB : AI	3	2	0		03	50	50	100	4
4	PCCL	BAIL504	Data Visualization Lab	TD : AI PSB : AI	0	0	2		03	50	50	100	1
5	PEC	BAI515x	Professional Elective Course	TD : AI PSB : AI	3	0	0		03	50	50	100	3
6	PROJ	BAI586	Mini Project	TD : AI PSB : AI	0	0	4		03	100		100	2
7	AEC	BRMK557	Research Methodology and IPR	TD: HSM PSB : HSM	2	2	0		02	50	50	100	3
8	MC	BESK508	Environmental Studies	TD: HSM PSB : HSM	2	0	0		02	50	50	100	2
9	MC	BNSK559	National Service Scheme (NSS)	NSS coordinator	0	0	2			100		100	0
		BPEK559	Physical Education (PE) (Sports and Athletics)	Physical Education Director									
		BYOK559	Yoga	Yoga Teacher									

			Total	**500**	**300**	**800**	**22**

Professional Elective Course

BAI515A	Computer Vision	BAI515C	Nonlinear Control Techniques
BAI515B	Information Theory and Coding	BAI515D	Distributed Systems

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Professional Core Course (IPCC): Refers to Professional Core Course Theory Integrated with practicals of the same course. Credit for IPCC can be 04 and its Teaching–Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from the practical part of IPCC shall be included in the SEE question paper. For more details, the regulation governing the Degree of Bachelor of Engineering /Technology (B.E./B.Tech.) 2022-23

National Service Scheme /Physical Education/Yoga: All students have to register for any one of the courses namely National Service Scheme (NSS), Physical Education (PE)(Sports and Athletics), and Yoga(YOG) with the concerned coordinator of the course during the first week of III semesters. Activities shall be carried out between III semester to the VI semester (for 4 semesters). Successful completion of the registered course and requisite CIE score is mandatory for the award of the degree. The events shall be appropriately scheduled by the colleges and the same shall be reflected in the calendar prepared for the NSS, PE, and Yoga activities. These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the course is mandatory for the award of degree.

Mini-project work: Mini Project is a laboratory-oriented/hands on course that will provide a platform to students to enhance their practical knowledge and skills by the development of small systems/applications etc. Based on the ability/abilities of the student/s and recommendations of the mentor, a single discipline or a multidisciplinary Mini- project can be assigned to an individual student or to a group having not more than 4 students.

CIE procedure for Mini-project:

(i) Single discipline: The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two faculty members of the Department, one of them being the Guide. The CIE marks awarded for the Mini-project work shall be based on the evaluation of the project report, project presentation skill, and question and answer session in the ratio of 50:25:25. The marks awarded for the project report shall be the same for all the batches mates.

(ii) Interdisciplinary: Continuous Internal Evaluation shall be group-wise at the college level with the participation of all the guides of the project.

The CIE marks awarded for the Mini-project, shall be based on the evaluation of the project report, project presentation skill, and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.

No SEE component for Mini-Project.

Professional Elective Courses (PEC): A professional elective (PEC) course is intended to enhance the depth and breadth of educational experience in the Engineering and Technology curriculum. Multidisciplinary courses that are added supplement the latest trend and advanced technology in the selected stream of engineering. Each group will provide an option to select one course. The minimum number of students' strengths for offering a professional elective is 10. However, this conditional shall not be applicable to cases where the admission to the program is less than 10.

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI

B.E. in Artificial Intelligence and Machine Learning

Scheme of Teaching and Examinations2022

Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

(Effective from the academic year 2023-24)

VI SEMESTER

Sl. No	Course and Course Code		Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
					Theory Lecture	Tutorial	Practical / Drawing	SDA	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1	IPCC	BAI601	Natural Language Processing	TD : AI PSB : AI	3	0	2		03	50	50	100	4
2	PCC	BAI602	Machine Learning -I	TD : AI PSB : AI	4	0	0		03	50	50	100	4
3	PEC	BAI613x	Professional Elective Course	TD : AI PSB : AI	3	0	0		03	50	50	100	3
4	OEC	BAI654x	Open Elective Course	TD : AI PSB : AI	3	0	0		03	50	50	100	3
5	PROJ	BAI685	Project Phase I	TD : AI PSB : AI	0	0	4		03	100	--	100	2
6	PCCL	BAIL606	Machine Learning lab	TD : AI PSB : AI	0	0	2		03	50	50	100	1
7	AEC/SDC	BAI657x	Ability Enhancement Course/Skill Development Course V	TD and PSB: Concerned department	If the course is offered as a Theory 1 / 0 / 0 If course is offered as a practical 0 / 0 / 2				01	50	50	100	1
8	MC	BNSK658	National Service Scheme (NSS)	NSS coordinator	0	0	2			100	---	100	0
		BPEK658	Physical Education (PE) (Sports and Athletics)	Physical Education Director									
		BYOK658	Yoga	Yoga Teacher									
									Total	**500**	**300**	**800**	**18**

Professional Elective Course

BAI613A	Human-Centred AI	BAI613C	Blockchain Technology
BAI613B	Cloud Computing	BAI613D	Time Series Analysis

Open Elective Course

BAI654A	Introduction to Data Structures	BAI654C	Mobile Application Development
BAI654B	Fundamentals of Operating Systems	BAI654D	
Ability Enhancement Course / Skill Enhancement Course-V			
BAI657A	Explainable AI	BAI657C	Generative AI
BAI657B	PyTorch	BAI657D	Devops

PCC: Professional Core Course, **PCCL**: Professional Core Course laboratory, **UHV**: Universal Human Value Course, **MC**: Mandatory Course (Non-credit), **AEC**: Ability Enhancement Course, **SEC**: Skill Enhancement Course, **L:** Lecture, **T**: Tutorial, **P**: Practical **S= SDA**: Skill Development Activity, **CIE**: Continuous Internal Evaluation, **SEE**: Semester End Evaluation. **K :** The letter in the course code indicates common to al the stream of engineering. **PROJ**: Project /Mini Project. **PEC**: Professional Elective Course. **PROJ**: Project Phase -I, **OEC**: Open Elective Course

Professional Core Course (IPCC): Refers to Professional Core Course Theory Integrated with practicals of the same course. Credit for IPCC can be 04 and its Teaching–Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from the practical part of IPCC shall be included in the SEE question paper. For more details, the regulation governing the Degree of Bachelor of Engineering /Technology (B.E./B.Tech.) 2022-23

National Service Scheme /Physical Education/Yoga: All students have to register for any one of the courses namely National Service Scheme (NSS), Physical Education (PE)(Sports and Athletics), and Yoga(YOG) with the concerned coordinator of the course during the first week of III semesters. Activities shall be carried out between III semester to the VI semester (for 4 semesters). Successful completion of the registered course and requisite CIE score is mandatory for the award of the degree. The events shall be appropriately scheduled by the colleges and the same shall be reflected in the calendar prepared for the NSS, PE, and Yoga activities. These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the course is mandatory for the award of degree.

Professional Elective Courses (PEC): A professional elective (PEC) course is intended to enhance the depth and breadth of educational experience in the Engineering and Technology curriculum. Multidisciplinary courses that are added supplement the latest trend and advanced technology in the selected stream of engineering. Each group will provide an option to select one course. The minimum number of students' strengths for offering professional electives is 10. However, this conditional shall not be applicable to cases where the admission to the program is less than 10.

Open Elective Courses:

Students belonging to a particular stream of Engineering and Technology are not entitled to the open electives offered by their parent Department. However, they can opt for an elective offered by other Departments, provided they satisfy the prerequisite condition if any. Registration to open electives shall be documented under the guidance of the Program Coordinator/ Advisor/Mentor. The minimum numbers of students' strength for offering Open Elective Course is 10. However, this condition shall not be applicable to class where the admission to the program is less than 10.

Project Phase-I : Students have to discuss with the mentor /guide and with their helphe/she has to complete the literature survey and prepare the report and finally

define the problem statement for the project work.

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI

B.E. in Artificial Intelligence and Machine Learning

Scheme of Teaching and Examinations2022

Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

(Effective from the academic year 2023-24)

VIISEMESTER (Swappable VII and VIII SEMESTER)

Sl. No	Course and Course Code		Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
					Theory Lecture	Tutorial	Practical / Drawing	SDA	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1	IPCC	BAI701	Deep Learning & Reinforcement Learning	TD : AI PSB : AI	3	0	2		03	50	50	100	4
2	IPCC	BAI702	Machine Learning -II	TD : AI PSB : AI	3	0	2		03	50	50	100	4
3	PCC	BAI703	Data Security & Privacy	TD : AI PSB : AI	4	0	0		03	50	50	100	4
4	PEC	BAI714x	**Professional Elective Course**	TD : AI PSB : AI	3	0	0		03	50	50	100	3
5	OEC	BAI755x	**Open Elective Course**	TD : AI PSB : AI	3	0	0		01	50	50	100	3
6	PROJ	BAI786	**Major Project Phase-II**	TD : AI PSB : AI	0	0	12		03	100	100	200	6
										400	**300**	**700**	**24**

Professional Elective Course

BAI714A	IOT Analytics	BAI714C	Data Engineering & MLOps
BAI714B	Business Analytics	BAI714D	Big Data Analytics

Open Elective Course

BAI755A	Introduction to DBMS	BAI755C	Software Engineering
BAI755B	Introduction to Algorithms	BAI755D	

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Setting department, **OEC**: Open Elective Course, **PEC**: Professional Elective Course. **PROJ**: Project work

Note: VII and VIII semesters of IV years of the program

(1) Institutions can swap the VII and VIII Semester Schemes of Teaching and Examinations to accommodate research internships/ industry internships after the VI semester**.**

(2) Credits earned for the courses of VII and VIII Semester Scheme of Teaching and Examinations shall be counted against the corresponding semesters whether the VII or VIII semesters is completed during the beginning of the IV year or the later part of IV years of the program.

Professional Elective Courses (PEC): A professional elective (PEC) course is intended to enhance the depth and breadth of educational experience in the Engineering and Technology curriculum. Multidisciplinary courses that are added supplement the latest trend and advanced technology in the selected stream of engineering. Each group will provide an option to select one course. The minimum number of students' strengths for offering professional electives is 10. However, this conditional shall not be applicable to cases where the admission to the program is less than 10.

Open Elective Courses:

Students belonging to a particular stream of Engineering and Technology are not entitled to the open electives offered by their parent Department. However, they can opt for an elective offered by other Departments, provided they satisfy the prerequisite condition if any. Registration to open electives shall be documented under the guidance of the Program Coordinator/ Advisor/Mentor. The minimum numbers of students' strength for offering Open Elective Course is 10. However, this condition shall not be applicable to class where the admission to the program is less than 10.

PROJECT WORK (21AIP75): The objective of the Project work is

(i) To encourage independent learning and the innovative attitude of the students.

(ii) To develop interactive attitude, communication skills, organization, time management, and presentation skills.

(iii) To impart flexibility and adaptability.

(iv) To inspire team working.

(v) To expand intellectual capacity, credibility, judgment and intuition.

(vi) To adhere to punctuality, setting and meeting deadlines.

(vii) To install responsibilities to oneself and others.

(viii) To train students to present the topic of project work in a seminar without any fear, face the audience confidently, enhance communication skills, involve in group discussion to present and exchange ideas.

CIE procedure for Project Work:

(1) Single discipline: The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two senior faculty members of the Department, one of whom shall be the Guide.

The CIE marks awarded for the project work, shall be based on the evaluation of the project work Report, project presentation skill, and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.

(2) Interdisciplinary: Continuous Internal Evaluation shall be group-wise at the college level with the participation of all guides of the college. Participation of external guide/s, if any, is desirable. The CIE marks awarded for the project work, shall be based on the evaluation of project work Report, project presentation skill, and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.

SEE procedure for Project Work: SEE for project work will be conducted by the two examiners appointed by the University. The SEE marks awarded for the project work shall be based on the evaluation of project work Report, project presentation skill, and question and answer session in the ratio 50:25:25.

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI

B.E. in Artificial Intelligence and Machine Learning

Scheme of Teaching and Examinations2022

Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

(Effective from the academic year 2023-24)

VIII SEMESTER (Swappable VII and VIII SEMESTER)

Sl. No	Course and Course Code		Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
					Theory Lecture	Tutorial	Practical / Drawing	SDA	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1	PEC	BAI801x	**Professional Elective (Online Courses) Only through NPTEL**	PSB : AI	3	0	0		03	50	50	100	3
2	OEC	BAI802x	**Open Elective (Online Courses) Only through NPTEL**	PSB : AI	3	0	0		01	50	50	100	3
3	INT	BAI803	**Internship (Industry/Research) (14 - 20 weeks)**		0	0	12		03	100	100	200	10
										200	**200**	**400**	**16**

Professional Elective Course (Online courses)

BAI801A	BOS will publish courses based on the availability	BAI801C	
BAI801B		BAI801D	

Open Elective Courses (Online Courses)

BAI802A	BOS will publish courses based on the availability	BAI802C	
BAI802B		BAI802D	

L: Lecture, **T**: Tutorial, **P**: Practical **S= SDA**: Skill Development Activity, **CIE**: Continuous Internal Evaluation, **SEE**: Semester End Evaluation. **TD-** Teaching Department, **PSB**: Paper Setting department, **OEC**: Open Elective Course, **PEC**: Professional Elective Course. **PROJ**: Project work, **INT**: Industry Internship / Research Internship / Rural Internship

Note: VII and VIII semesters of IV years of the program

Swapping Facility

- Institutions can swap VII and VIII Semester Scheme of Teaching and Examinations to accommodate **research internships/ industry internships/Rural Internship** after the VI semester**.**
- Credits earned for the courses of VII and VIII Semester Scheme of Teaching and Examinations shall be counted against the corresponding semesters whether VII or VIII semester is completed during the beginning of IV year or later part of IV year of the program.
- Note: For BAI801x and BAI802x courses BOS will announce list of courses in 6^{th} , 7^{th} & 8^{th} Sem . Students can register in any of the semester to earn the credits in 8^{th} Sem.

Elucidation:

At the beginning of IV years of the program i.e., after VI semester, VII semester classwork and VIII semester **Research Internship /Industrial Internship / Rural Internship** shall be permitted to be operated simultaneously by the University so that students have ample opportunity for an internship. In other words, a good percentage of the class shall attend VII semester classwork and a similar percentage of others shall attend to Research Internship or Industrial Internship or Rural Internship.

Research/Industrial /Rural Internship shall be carried out at an Industry, NGO, MSME, Innovation center, Incubation center, Start-up, center of Excellence (CoE), Study Centre established in the parent institute and /or at reputed research organizations/institutes.

The mandatory Research internship /Industry internship / Rural Internship is for 14 to 20 weeks. The internship shall be considered as a head of passing and shall be considered for the award of a degree. Those, who do not take up/complete the internship shall be declared to fail and shall have to complete it during the subsequent University examination after satisfying the internship requirements.

Research internship: A research internship is intended to offer the flavor of current research going on in the research field. It helps students get familiarized with the field and imparts the skill required for carrying out research.

Industry internship: Is an extended period of work experience undertaken by students to supplement their degree for professional development. It also helps them learn to overcome unexpected obstacles and successfully navigate organizations, perspectives, and cultures. Dealing with contingencies helps students recognize, appreciate, and adapt to organizational realities by tempering their knowledge with practical constraints.

Rural Internship: Rural development internship is an initiative of Unnat Bharat Abhiyan Cell, RGIT in association with AICTE to involve students of all departments studying in different academic years for exploring various opportunities in techno-social fields, to connect and work with Rural India for their upliftment.

The faculty coordinator or mentor has to monitor the student’s internship progress and interact with them to guide for the successful completion of the internship.

The students are permitted to carry out the internship anywhere in India or abroad. University shall not bear any expenses incurred in respect of the internship.

With the consent of the internal guide and Principal of the Institution, students shall be allowed to carry out the internship at their hometown (**within or outside the state or abroad**), provided favorable facilities are available for the internship and the student remains regularly in contact with the internal guide. **University shall not bear any cost involved in carrying out the internship by students.** However, students can receive any financial assistance extended by the organization.
Professional Elective /Open Elective Course: These are ONLINE courses suggested by the respective Board of Studies. Details of these courses shall be made available for students on the VTU web portal.

Please note: If any clarifications / suggestions please email to **sbhvtuso@yahoo.com**

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI

B.E. in Computer Science and Engineering

Scheme of Teaching and Examinations 2022

Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

(Effective from the academic year 2023-24)

III SEMESTER

Sl. No	Course	Course Code	Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
					Theory Lecture	Tutorial	Practical / Drawing	SDA	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1	PCC/BSC	BCS301	Mathematics for Computer Science	TD: Maths PSB: Maths/CS	3	2	0		03	50	50	100	4
2	IPCC	BCS302	Digital Design & Computer Organization	TD: CS PSB : CS	3	0	2		03	50	50	100	4
3	IPCC	BCS303	Operating Systems	TD: CS PSB : CS	3	0	2		03	50	50	100	4
4	PCC	BCS304	Data Structures and Applications	TD: CS PSB : CS	3	0	0		03	50	50	100	3
5	PCCL	BCSL305	Data Structures Lab	TD: CS PSB : CS	0	0	2		03	50	50	100	1
6	ESC	BCS306x	ESC/ETC/PLC	TD: CS PSB : CS	2	0	2		03	50	50	100	3
7	UHV	BSCK307	**Social Connect and Responsibility**	Any Department	0	0	2		01	100	---	100	1
8	AEC/ SEC	BCS358x	Ability Enhancement Course/Skill Enhancement Course - III	TD: Concerned department PSB:CS	If the course is a Theory					50	50	100	1
					1	0	0		01				
					If a course is a laboratory								
					0	0	2		02				
9	MC	BNSK359	National Service Scheme (NSS)	NSS coordinator	0	0	2			100	---	100	0
		BPEK359	Physical Education (PE) (Sports and Athletics)	Physical Education Director									
		BYOK359	Yoga	Yoga Teacher									
									Total	**550**	**350**	**900**	**21**

PCC: Professional Core Course, **PCCL**: Professional Core Course laboratory, **UHV**: Universal Human Value Course, **MC**: Mandatory Course (Non-credit), **AEC**: Ability Enhancement Course, **SEC**: Skill Enhancement Course, **L:** Lecture, **T**: Tutorial, **P**: Practical **S= SDA**: Skill Development Activity, **CIE**: Continuous Internal Evaluation, **SEE**: Semester End Evaluation.K :This letter in the course code indicates common to all the stream of engineering. ESC: Engineering Science Course, ETC: Emerging Technology Course, PLC: Programming Language Course

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Engineering Science Course (ESC/ETC/PLC) (Note- Student should opt for the course which should not be similar to the course opted in 1st Year)			
BCS306A	Object Oriented Programming with Java		
BCS306B	Object Oriented Programming with C++		
Ability Enhancement Course – III			
BCS358A	Data analytics with Excel	BCS358C	Project Management with Git
BCS358B	R Programming	BCS358D	Data Visualization with Python

Professional Core Course (IPCC): Refers to Professional Core Course Theory Integrated with practicals of the same course. Credit for IPCC can be 04 and its Teaching–Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from the practical part of IPCC shall be included in the SEE question paper. For more details, the regulation governing the Degree of Bachelor of Engineering /Technology (B.E./B.Tech.) 2022-23 may please be refered.

National Service Scheme /Physical Education/Yoga: All students have to register for any one of the courses namely National Service Scheme (NSS), Physical Education (PE)(Sports and Athletics), and Yoga(YOG) with the concerned coordinator of the course during the first week of III semesters. Activities shall be carried out between III semester to the VI semester (for 4 semesters). Successful completion of the registered course and requisite CIE score is mandatory for the award of the degree. The events shall be appropriately scheduled by the colleges and the same shall be reflected in the calendar prepared for the NSS, PE, and Yoga activities. These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the course is mandatory for the award of degree.

VARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI

B.E. in Computer Science and Engineering

Scheme of Teaching and Examinations2022

Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

(Effective from the academic year 2023-24)

IV SEMESTER

Sl. No	Course and Course Code		Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
					Theory Lecture	Tutorial	Practical / Drawing	Self - Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1	PCC/BSC	BCS401	Analysis & Design of Algorithms	TD: CS PSB : CS	3	0	0		03	50	50	100	3
2	IPCC	BCS402	Microcontrollers	TD: CS PSB : CS	3	0	2		03	50	50	100	4
3	IPCC	BCS403	Database Management Systems	TD: CS PSB : CS	3	0	2		03	50	50	100	4
4	PCCL	BCSL404	Analysis & Design of Algorithms Lab	TD: CS PSB : CS	0	0	2		03	50	50	100	1
5	ESC	BCS405x	ESC/ETC/PLC	TD: CS/Maths PSB : CS/Maths	2	2	0		03	50	50	100	3
6	AEC/ SEC	BCS456x	Ability Enhancement Course/Skill Enhancement Course- IV	TD: Concerned department PSB:CS	If the course is Theory				01	50	50	100	1
					1	0	0						
					If the course is a lab				02				
					0	0	2						
4	BSC	BBOK407	Biology For Engineers	TD / PSB: BT, CHE,	2	0	0		03	50	50	100	2
7	UHV	BUHK408	Universal human values course	Any Department	1	0	0		01	50	50	100	1
9	MC	BNSK459	National Service Scheme (NSS)	NSS coordinator	0	0	2			100	---	100	0
		BPEK459	Physical Education (PE) (Sports and Athletics)	Physical Education Director									
		BYOK459	Yoga	Yoga Teacher									

Total	**500**	**400**	**900**	**19**

PCC: Professional Core Course, **PCCL**: Professional Core Course laboratory, **UHV**: Universal Human Value Course, **MC**: Mandatory Course (Non-credit), **AEC**: Ability Enhancement Course, **SEC**: Skill Enhancement Course, **L:** Lecture, **T**: Tutorial, **P**: Practical **S= SDA**: Skill Development Activity, **CIE**: Continuous Internal Evaluation, **SEE**: Semester End Evaluation. K :This letter in the course code indicates common to all the stream of engineering.

Ability Enhancement Course / Skill Enhancement Course – IV			
BCS456A	Green IT and Sustainability	BCS456C	UI/UX (Lab)
BCS456B	Capacity Planning for IT	BCS456D	Technical writing using LATEX (Lab)
Engineering Science Course (ESC/ETC/PLC)			
BCS405A	Discrete Mathematical Structures	BCS405C	Optimization Technique
BCS405B	Graph Theory	BCS405D	Linear Algebra

Professional Core Course (IPCC): Refers to Professional Core Course Theory Integrated with practical of the same course. Credit for IPCC can be 04 and its Teaching–Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from the practical part of IPCC shall be included in the SEE question paper. For more details, the regulation governing the Degree of Bachelor of Engineering /Technology (B.E./B.Tech.) 2022-23

National Service Scheme /Physical Education/Yoga: All students have to register for any one of the courses namely National Service Scheme (NSS), Physical Education (PE)(Sports and Athletics), and Yoga(YOG) with the concerned coordinator of the course during the first week of III semesters. Activities shall be carried out between III semester to the VI semester (for 4 semesters). Successful completion of the registered course and requisite CIE score is mandatory for the award of the degree. The events shall be appropriately scheduled by the colleges and the same shall be reflected in the calendar prepared for the NSS, PE, and Yoga activities. These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the courses is mandatory for the award of degree.

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI

B.E. in Computer Science and Engineering

B.E. in the title of the program

Scheme of Teaching and Examinations2022

Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

(Effective from the academic year 2023-24)

V SEMESTER

Sl. No	Course and Course Code		Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
					Theory Lecture	Tutorial	Practical / Drawing	SDA	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1	HSMS	BCS501	Software Engineering & Project Management (This course must be pertaining to economics and management of the concerned degree program. The course syllabus should have both economics and management topics and the course title should bear the word Management.)	TD: CS PSB : CS	3	0	0		03	50	50	100	3
2	IPCC	BCS502	Computer Networks	TD: CS PSB : CS	3	0	2		03	50	50	100	4
3	PCC	BCS503	Theory of Computation	TD: CS PSB : CS	3	2	0		03	50	50	100	4
4	PCCL	BCSL504	Web Technology Lab	TD: CS PSB : CS	0	0	2		03	50	50	100	1
5	PEC	BCS515x	Professional Elective Course	TD: CS PSB : CS	3	0	0		03	50	50	100	3
6	PROJ	BCS586	Mini Project	TD: CS PSB : CS	0	0	4		03	100		100	2
7	AEC	BRMK557	Research Methodology and IPR	TD: HSM PSB : HSM	2	2	0		02	50	50	100	3
8	MC	BESK508	Environmental Studies	TD: HSM PSB : HSM	2	0	0		02	50	50	100	2
9	MC	BNSK559	National Service Scheme (NSS)	NSS coordinator	0	0	2			100		100	0
		BPEK559	Physical Education (PE) (Sports and Athletics)	Physical Education Director									

		BYOK559	Yoga	Yoga Teacher									
									Total	**500**	**300**	**800**	**22**

Professional Elective Course			
BCS515A	Computer Graphics	BCS515C	Unix System Programming
BCS515B	Artificial Intelligence	BCS515D	Distributed Systems

PCC: Professional Core Course, **PCCL**: Professional Core Course laboratory, **UHV**: Universal Human Value Course, **MC**: Mandatory Course (Non-credit), **AEC**: Ability Enhancement Course, **SEC**: Skill Enhancement Course, **L:** Lecture, **T**: Tutorial, **P**: Practical **S= SDA**: Skill Development Activity, **CIE**: Continuous Internal Evaluation, **SCS**: Semester End Evaluation. **K :** The letter in the course code indicates common to al the stream of engineering. **PROJ**: Project /Mini Project. **PEC**: Professional Elective Course

Professional Core Course (IPCC): Refers to Professional Core Course Theory Integrated with practicals of the same course. Credit for IPCC can be 04 and its Teaching–Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from the practical part of IPCC shall be included in the SEE question paper. For more details, the regulation governing the Degree of Bachelor of Engineering /Technology (B.E./B.Tech.) 2022-23

National Service Scheme /Physical Education/Yoga: All students have to register for any one of the courses namely National Service Scheme (NSS), Physical Education (PE)(Sports and Athletics), and Yoga(YOG) with the concerned coordinator of the course during the first week of III semesters. Activities shall be carried out between III semester to the VI semester (for 4 semesters). Successful completion of the registered course and requisite CIE score is mandatory for the award of the degree. The events shall be appropriately scheduled by the colleges and the same shall be reflected in the calendar prepared for the NSS, PE, and Yoga activities. These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the course is mandatory for the award of degree.

Mini-project work: Mini Project is a laboratory-oriented/hands on course that will provide a platform to students to enhance their practical knowledge and skills by the development of small systems/applications etc. Based on the ability/abilities of the student/s and recommendations of the mentor, a single discipline or a multidisciplinary Mini- project can be assigned to an individual student or to a group having not more than 4 students.

CIE procedure for Mini-project:

(i) Single discipline: The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two faculty members of the Department, one of them being the Guide. The CIE marks awarded for the Mini-project work shall be based on the evaluation of the project report, project presentation skill, and question and answer session in the ratio of 50:25:25. The marks awarded for the project report shall be the same for all the batches mates.

(ii) Interdisciplinary: Continuous Internal Evaluation shall be group-wise at the college level with the participation of all the guides of the project.

The CIE marks awarded for the Mini-project, shall be based on the evaluation of the project report, project presentation skill, and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.

No SEE component for Mini-Project.

Professional Elective Courses (PEC): A professional elective (PEC) course is intended to enhance the depth and breadth of educational experience in the Engineering and Technology curriculum. Multidisciplinary courses that are added supplement the latest trend and advanced technology in the selected stream of engineering. Each group will provide an option to select one course. The minimum number of students' strengths for offering a professional elective is 10. However, this conditional shall not be applicable to cases where the admission to the program is less than 10.

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI

B.E. in Computer Science and Engineering

Scheme of Teaching and Examinations2022

Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

(Effective from the academic year 2023-24)

VI SEMESTER

Sl. No	Course and Course Code		Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
					Theory Lecture	Tutorial	Practical / Drawing	SDA	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1	IPCC	BCS601	Cloud Computing (Open Stack /Google)	TD: CS PSB : CS	3	0	2		03	50	50	100	4
2	PCC	BCS602	Machine Learning	TD: CS PSB : CS	4	0	0		03	50	50	100	4
3	PEC	BCS613x	Professional Elective Course	TD: CS PSB : CS	3	0	0		03	50	50	100	3
4	OEC	BCS654x	Open Elective Course	TD: CS PSB : CS	3	0	0		03	50	50	100	3
5	PROJ	BCS685	Project Phase I	TD: CS PSB : CS	0	0	4		03	100	--	100	2
6	PCCL	BCSL606	Machine Learning lab	TD: CS PSB : CS	0	0	2		03	50	50	100	1
7	AEC/SDC	BCS657x	Ability Enhancement Course/Skill Development Course V	TD and PSB: Concerned department	If the course is offered as a Theory				01	50	50	100	1
					1	0	0						
					If course is offered as a practical								
					0	0	2						
8	MC	BNSK658	National Service Scheme (NSS)	NSS coordinator	0	0	2			100	---	100	0
		BPEK658	Physical Education (PE) (Sports and Athletics)	Physical Education Director									
		BYOK658	Yoga	Yoga Teacher									
									Total	**500**	**300**	**800**	**18**

Professional Elective Course

BCS613A	Blockchain Technology	BCS613C	Compiler Design
BCS613B	Computer Vision	BCS613D	Advanced Java

Open Elective Course			
BCS654A	Introduction to Data Structures	BCS654C	Mobile Application Development
BCS654B	Fundamentals of Operating Systems	BCS654D	Introduction to AI

Ability Enhancement Course / Skill Enhancement Course-V			
BCS657A	Progressive App Development	BCS657C	Agile
BCS657B	Tosca – *Automated* Software Testing	BCS657D	Devops

PCC: Professional Core Course, **PCCL**: Professional Core Course laboratory, **UHV**: Universal Human Value Course, **MC**: Mandatory Course (Non-credit), **AEC**: Ability Enhancement Course, **SEC**: Skill Enhancement Course, **L:** Lecture, **T**: Tutorial, **P**: Practical **S= SDA**: Skill Development Activity, **CIE**: Continuous Internal Evaluation, **SEE**: Semester End Evaluation. **K :** The letter in the course code indicates common to al the stream of engineering. **PROJ**: Project /Mini Project. **PEC**: Professional Elective Course. **PROJ**: Project Phase -I, **OEC**: Open Elective Course

Professional Core Course (IPCC): Refers to Professional Core Course Theory Integrated with practicals of the same course. Credit for IPCC can be 04 and its Teaching–Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from the practical part of IPCC shall be included in the SEE question paper. For more details, the regulation governing the Degree of Bachelor of Engineering /Technology (B.E./B.Tech.) 2022-23

National Service Scheme /Physical Education/Yoga: All students have to register for any one of the courses namely National Service Scheme (NSS), Physical Education (PE)(Sports and Athletics), and Yoga(YOG) with the concerned coordinator of the course during the first week of III semesters. Activities shall be carried out between III semester to the VI semester (for 4 semesters). Successful completion of the registered course and requisite CIE score is mandatory for the award of the degree. The events shall be appropriately scheduled by the colleges and the same shall be reflected in the calendar prepared for the NSS, PE, and Yoga activities. These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the course is mandatory for the award of degree.

Professional Elective Courses (PEC): A professional elective (PEC) course is intended to enhance the depth and breadth of educational experience in the Engineering and Technology curriculum. Multidisciplinary courses that are added supplement the latest trend and advanced technology in the selected stream of engineering. Each group will provide an option to select one course. The minimum number of students' strengths for offering professional electives is 10. However, this conditional shall not be applicable to cases where the admission to the program is less than 10.

Open Elective Courses:

Students belonging to a particular stream of Engineering and Technology are not entitled to the open electives offered by their parent Department. However, they can opt for an elective offered by other Departments, provided they satisfy the prerequisite condition if any. Registration to open electives shall be documented under the guidance of the Program Coordinator/ Advisor/Mentor. The minimum numbers of students' strength for offering Open Elective Course is 10. However, this condition shall not be applicable to class where the admission to the program is less than 10.

Project Phase-I : Students have to discuss with the mentor /guide and with their helphe/she has to complete the literature survey and prepare the report and finally

define the problem statement for the project work.

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI

B.E. in Computer Science and Engineering

Scheme of Teaching and Examinations2022

Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

(Effective from the academic year 2023-24)

VIISEMESTER (Swappable VII and VIII SEMESTER)

Sl. No	Course and Course Code		Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
					Theory Lecture	Tutorial	Practical / Drawing	SDA	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1	IPCC	BCS701	Internet of Things	TD: CS PSB : CS	3	0	2		03	50	50	100	4
2	IPCC	BCS702	Parallel Computing	TD: CS PSB : CS	3	0	2		03	50	50	100	4
3	PCC	BCS703	Cryptography & Network Security	TD: CS PSB : CS	4	0	0		03	50	50	100	4
4	PEC	BCS714x	**Professional Elective Course**	TD: CS PSB : CS	3	0	0		03	50	50	100	3
5	OEC	BCS755x	**Open Elective Course**	TD: CS PSB : CS	3	0	0		01	50	50	100	3
6	PROJ	BCS786	**Major Project Phase-II**	TD: CS PSB : CS	0	0	12		03	100	100	200	6
										400	**300**	**700**	**24**

Professional Elective Course

BCS714A	Deep Learning	BCS714C	Enterprise Data Warehousing
BCS714B	Natural Language Processing	BCS714D	Big Data Analytics

Open Elective Course

BCS755A	Introduction to DBMS	BCS755C	Software Engineering
BCS755B	Introduction to Algorithms	BCS755D	

PCC: Professional Core Course, **PCCL**: Professional Core Course laboratory, **PEC**: Professional Elective Course, **OEC**: Open Elective Course PR: Project Work, **L:** Lecture, **T**: Tutorial, **P**: Practical **S= SDA**: Skill Development Activity, **CIE**: Continuous Internal Evaluation, **SEE**: Semester End Evaluation. **TD-** Teaching Department, **PSB**: Paper Setting department, **OEC**: Open Elective Course, **PEC**: Professional Elective Course. **PROJ**: Project work

Note: VII and VIII semesters of IV years of the program

(1) Institutions can swap the VII and VIII Semester Schemes of Teaching and Examinations to accommodate research internships/ industry internships after the VI semester**.** **(2)** Credits earned for the courses of VII and VIII Semester Scheme of Teaching and Examinations shall be counted against the corresponding semesters whether the VII or VIII semesters is completed during the beginning of the IV year or the later part of IV years of the program.
Professional Elective Courses (PEC): A professional elective (PEC) course is intended to enhance the depth and breadth of educational experience in the Engineering and Technology curriculum. Multidisciplinary courses that are added supplement the latest trend and advanced technology in the selected stream of engineering. Each group will provide an option to select one course. The minimum number of students' strengths for offering professional electives is 10. However, this conditional shall not be applicable to cases where the admission to the program is less than 10.
Open Elective Courses: Students belonging to a particular stream of Engineering and Technology are not entitled to the open electives offered by their parent Department. However, they can opt for an elective offered by other Departments, provided they satisfy the prerequisite condition if any. Registration to open electives shall be documented under the guidance of the Program Coordinator/ Advisor/Mentor. The minimum numbers of students' strength for offering Open Elective Course is 10. However, this condition shall not be applicable to class where the admission to the program is less than 10.
PROJECT WORK (21CSP75): The objective of the Project work is **(i)** To encourage independent learning and the innovative attitude of the students. **(ii)** To develop interactive attitude, communication skills, organization, time management, and presentation skills. **(iii)** To impart flexibility and adaptability. **(iv)** To inspire team working. **(v)** To expand intellectual capacity, credibility, judgment and intuition. **(vi)** To adhere to punctuality, setting and meeting deadlines. **(vii)** To install responsibilities to oneself and others. **(viii)**To train students to present the topic of project work in a seminar without any fear, face the audience confidently, enhance communication skills, involve in group discussion to present and exchange ideas. **CIE procedure for Project Work:** **(1) Single discipline:** The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two senior faculty members of the Department, one of whom shall be the Guide. The CIE marks awarded for the project work, shall be based on the evaluation of the project work Report, project presentation skill, and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates. **(2) Interdisciplinary:** Continuous Internal Evaluation shall be group-wise at the college level with the participation of all guides of the college. Participation of external

guide/s, if any, is desirable. The CIE marks awarded for the project work, shall be based on the evaluation of project work Report, project presentation skill, and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.

SEE procedure for Project Work: SEE for project work will be conducted by the two examiners appointed by the University. The SEE marks awarded for the project work shall be based on the evaluation of project work Report, project presentation skill, and question and answer session in the ratio 50:25:25.

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI

B.E. in Computer Science and Engineering

Scheme of Teaching and Examinations2022

Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

(Effective from the academic year 2023-24)

VIII SEMESTER (Swappable VII and VIII SEMESTER)

Sl. No	Course and Course Code		Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
					Theory Lecture	Tutorial	Practical / Drawing	SDA	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1	PEC	BCS801x	**Professional Elective (Online Courses) Only through NPTEL**	PSB : CS	3	0	0		03	50	50	100	3
2	OEC	BCS802x	**Open Elective (Online Courses) Only through NPTEL**	PSB : CS	3	0	0		01	50	50	100	3
3	INT	BCS803	**Internship (Industry/Research) (14 - 20 weeks)**		0	0	12		03	100	100	200	10
										200	**200**	**400**	**16**

Professional Elective Course (Online courses)

BCS801A	BOS will publish courses based on the availability	BCS801C	
BCS801B		BCS801D	

Open Elective Courses (Online Courses)

BCS802A	BOS will publish courses based on the availability	BCS802C	
BCS802B		BCS802D	

L: Lecture, **T**: Tutorial, **P**: Practical **S= SDA**: Skill Development Activity, **CIE**: Continuous Internal Evaluation, **SEE**: Semester End Evaluation. **TD-** Teaching Department, **PSB**: Paper Setting department, **OEC**: Open Elective Course, **PEC**: Professional Elective Course. **PROJ**: Project work, **INT**: Industry Internship / Research Internship / Rural Internship

Note: VII and VIII semesters of IV years of the program

Swapping Facility

- Institutions can swap VII and VIII Semester Scheme of Teaching and Examinations to accommodate **research internships/ industry internships/Rural Internship** after the VI semester**.**
- Credits earned for the courses of VII and VIII Semester Scheme of Teaching and Examinations shall be counted against the corresponding semesters whether VII or VIII semester is completed during the beginning of IV year or later part of IV year of the program.
- Note: For BCS801x and BCS802x courses BOS will announce the list of courses in 6th , 7th & 8th Sem . Students can register in any of the semesters to earn the credits in 8th Sem.

Elucidation:

At the beginning of IV years of the program i.e., after VI semester, VII semester classwork and VIII semester **Research Internship /Industrial Internship / Rural Internship** shall be permitted to be operated simultaneously by the University so that students have ample opportunity for an internship. In other words, a good percentage of the class shall attend VII semester classwork and a similar percentage of others shall attend to Research Internship or Industrial Internship or Rural Internship.

Research/Industrial /Rural Internship shall be carried out at an Industry, NGO, MSME, Innovation center, Incubation center, Start-up, center of Excellence (CoE), Study Centre established in the parent institute and /or at reputed research organizations/institutes.

The mandatory Research internship /Industry internship / Rural Internship is for 14 to 20 weeks. The internship shall be considered as a head of passing and shall be considered for the award of a degree. Those, who do not take up/complete the internship shall be declared to fail and shall have to complete it during the subsequent University examination after satisfying the internship requirements.

Research internship: A research internship is intended to offer the flavor of current research going on in the research field. It helps students get familiarized with the field and imparts the skill required for carrying out research.

Industry internship: Is an extended period of work experience undertaken by students to supplement their degree for professional development. It also helps them learn to overcome unexpected obstacles and successfully navigate organizations, perspectives, and cultures. Dealing with contingencies helps students recognize, appreciate, and adapt to organizational realities by tempering their knowledge with practical constraints.

Rural Internship: Rural development internship is an initiative of Unnat Bharat Abhiyan Cell, RGIT in association with AICTE to involve students of all departments studying in different academic years for exploring various opportunities in techno-social fields, to connect and work with Rural India for their upliftment.

The faculty coordinator or mentor has to monitor the student's internship progress and interact with them to guide for the successful completion of the internship.

The students are permitted to carry out the internship anywhere in India or abroad. University shall not bear any expenses incurred in respect of the internship.

With the consent of the internal guide and Principal of the Institution, students shall be allowed to carry out the internship at their hometown (**within or outside the state or abroad**), provided favorable facilities are available for the internship and the student remains regularly in contact with the internal guide. **University shall not bear any cost involved in carrying out the internship by students.** However, students can receive any financial assistance extended by the organization.

Professional Elective /Open Elective Course: These are ONLINE courses suggested by the respective Board of Studies. Details of these courses shall be made available for students on the VTU web portal.

Please note: If any clarifications / suggestions please email to **sbhvtuso@yahoo.com**

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI

B.E. in Data Science

Scheme of Teaching and Examinations 2022

Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

(Effective from the academic year 2023-24)

III SEMESTER

Sl. No	Course	Course Code	Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
					Theory Lecture	Tutorial	Practical / Drawing	SDA	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1	PCC/BSC	BDS301	Mathematics for Data Science	TD: Maths PSB: Maths	3	2	0		03	50	50	100	4
2	IPCC	BCS302	Digital Design & Computer Organization	TD: DS PSB: CS	3	0	2		03	50	50	100	4
3	IPCC	BCS303	Operating Systems	TD: DS PSB: CS	3	0	2		03	50	50	100	4
4	PCC	BCS304	Data Structures and Applications	TD: DS PSB: CS	3	0	0		03	50	50	100	3
5	PCCL	BCSL305	Data Structures Lab	TD: DS PSB: CS	0	0	2		03	50	50	100	1
6	ESC	BXX306x	ESC/ETC/PLC	TD: DS PSB: CS	2	0	2		03	50	50	100	3
7	UHV	BSCK307	**Social Connect and Responsibility**	Any Department	0	0	2		01	100	---	100	1
8	AEC/SEC	BXX358x	Ability Enhancement Course/Skill Enhancement Course – III	TD : Concerned department PSB: CS	If the course is a Theory				01	50	50	100	1
					1	0	0						
					If a course is a laboratory				02				
					0	0	2						
9	MC	BNSK359	National Service Scheme (NSS)	NSS coordinator	0	0	2			100	---	100	0
		BPEK359	Physical Education (PE) (Sports and Athletics)	Physical Education Director									
		BYOK359	Yoga	Yoga Teacher									
									Total	**550**	**350**	**900**	**21**

PCC: Professional Core Course, **PCCL**: Professional Core Course laboratory, **UHV**: Universal Human Value Course, **MC**: Mandatory Course (Non-credit), **AEC**: Ability Enhancement Course, **SEC**: Skill Enhancement Course, **L:** Lecture, **T**: Tutorial, **P**: Practical **S= SDA**: Skill Development Activity, **CIE**: Continuous Internal Evaluation, **SEE**: Semester End Evaluation.K :This letter in the course code indicates common to all the stream of engineering. ESC: Engineering Science Course, ETC: Emerging Technology Course, PLC: Programming Language Course			
.			
Engineering Science Course (ESC/ETC/PLC) (Note- Student should opt for the course which should not be similar to the course opted in 1st Year)			
BCS306A	Object Oriented Programming with Java	BDS306C	Data Analytics with R
BDS306B	Python Programming for Data Science		
Ability Enhancement Course – III			
BCS358A	Data Analytics with Excel	BCS358C	Project Management with Git
BAI358B	Ethics and Public Policy for AI	BCS358D	Data Visualization with Python
Professional Core Course (IPCC): Refers to Professional Core Course Theory Integrated with practicals of the same course. Credit for IPCC can be 04 and its Teaching–Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from the practical part of IPCC shall be included in the SEE question paper. For more details, the regulation governing the Degree of Bachelor of Engineering /Technology (B.E./B.Tech.) 2022-23 may please be refered. **National Service Scheme /Physical Education/Yoga:** All students have to register for any one of the courses namely National Service Scheme (NSS), Physical Education (PE)(Sports and Athletics), and Yoga(YOG) with the concerned coordinator of the course during the first week of III semesters. Activities shall be carried out between III semester to the VI semester (for 4 semesters). Successful completion of the registered course and requisite CIE score is mandatory for the award of the degree. The events shall be appropriately scheduled by the colleges and the same shall be reflected in the calendar prepared for the NSS, PE, and Yoga activities. These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the course is mandatory for the award of degree.			

VARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI

B.E. in Data Science

Scheme of Teaching and Examinations2022

Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

(Effective from the academic year 2023-24)

IV SEMESTER

Sl. No	Course and Course Code		Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
					Theory Lecture	Tutorial	Practical / Drawing	Self - Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1	PCC/BSC	BCS401	Analysis & Design of Algorithms	TD: DS PSB: CS	3	0	0		03	50	50	100	3
2	IPCC	BDS402	Computer Networks (NS-2/3)	TD: DS PSB: CS	3	0	2		03	50	50	100	4
3	IPCC	BCS403	Database Management Systems	TD: DS PSB: CS	3	0	2		03	50	50	100	4
4	PCCL	BCSL404	Analysis & Design of Algorithms Lab	TD: DS PSB: CS	0	0	2		03	50	50	100	1
5	ESC	BXX405x	ESC/ETC/PLC	TD: DS PSB: CS	2	2	0		03	50	50	100	3
6	AEC/ SEC	BDS456x	Ability Enhancement Course/Skill Enhancement Course- IV	TD: Concerned department PSB: CS	If the course is Theory 1	0	0		01	50	50	100	1
					If the course is a lab 0	0	2		02				
4	BSC	BBOK407	Biology For Engineers	TD / PSB: BT, CHE,	2	0	0		03	50	50	100	2
7	UHV	BUHK408	Universal human values course	Any Department	1	0	0		01	50	50	100	1
9	MC	BNSK459	National Service Scheme (NSS)	NSS coordinator	0	0	2			100	---	100	0
		BPEK459	Physical Education (PE) (Sports and Athletics)	Physical Education Director									
		BYOK459	Yoga	Yoga Teacher									
									Total	**500**	**400**	**900**	**19**

PCC: Professional Core Course, **PCCL**: Professional Core Course laboratory, **UHV**: Universal Human Value Course, **MC**: Mandatory Course (Non-credit), **AEC**: Ability Enhancement Course, **SEC**: Skill Enhancement Course, **L:** Lecture, **T**: Tutorial, **P**: Practical **S= SDA**: Skill Development Activity, **CIE**: Continuous Internal Evaluation, **SEE**: Semester End Evaluation. K :This letter in the course code indicates common to all the stream of engineering.

Ability Enhancement Course / Skill Enhancement Course – IV			
BDS456A	Scala	BDS456C	MERN
BDS456B	MangoDB	BDS456D	Julia
Engineering Science Course (ESC/ETC/PLC)			
BCS405A	Discrete Mathematical Structures	BAI405C	Optimization for Machine Learning
BAI405B	Metric Spaces	BAI405D	Algorithmic Game Theory

Professional Core Course (IPCC): Refers to Professional Core Course Theory Integrated with practical of the same course. Credit for IPCC can be 04 and its Teaching–Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from the practical part of IPCC shall be included in the SEE question paper. For more details, the regulation governing the Degree of Bachelor of Engineering /Technology (B.E./B.Tech.) 2022-23

National Service Scheme /Physical Education/Yoga: All students have to register for any one of the courses namely National Service Scheme (NSS), Physical Education (PE)(Sports and Athletics), and Yoga(YOG) with the concerned coordinator of the course during the first week of III semesters. Activities shall be carried out between III semester to the VI semester (for 4 semesters). Successful completion of the registered course and requisite CIE score is mandatory for the award of the degree. The events shall be appropriately scheduled by the colleges and the same shall be reflected in the calendar prepared for the NSS, PE, and Yoga activities. These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the courses is mandatory for the award of degree.

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI

B.E. in Data Science

Scheme of Teaching and Examinations2022

Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

(Effective from the academic year 2023-24)

V SEMESTER

Sl. No	Course and Course Code		Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
					Theory Lecture	Tutorial	Practical / Drawing	SDA	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1	HSMS	BDS501	Software Engineering & Project Management (This course must be pertaining to economics and management of the concerned degree program. The course syllabus should have both economics and management topics and the course title should bear the word Management.)	TD: DS PSB: DS	3	0	0		03	50	50	100	3
2	IPCC	BDS502	NoSQL Databases	TD: DS PSB: DS	3	0	2		03	50	50	100	4
3	PCC	BDS503	Theory of Computation	TD: DS PSB: DS	3	2	0		03	50	50	100	4
4	PCCL	BDSL504	Data Visualization Lab	TD: DS PSB: DS	0	0	2		03	50	50	100	1
5	PEC	BDS515x	Professional Elective Course	TD: DS PSB: DS	3	0	0		03	50	50	100	3
6	PROJ	BDS586	Mini Project	TD: DS PSB: DS	0	0	4		03	100		100	2
7	AEC	BRMK557	Research Methodology and IPR	TD: DS PSB: DS	2	2	0		02	50	50	100	3
8	MC	BESK508	Environmental Studies	TD: DS PSB: DS	2	0	0		02	50	50	100	2
9	MC	BNSK559	National Service Scheme (NSS)	NSS coordinator	0	0	2			100		100	0
		BPEK559	Physical Education (PE) (Sports and Athletics)	Physical Education Director									
		BYOK559	Yoga	Yoga Teacher									

			Total	**500**	**300**	**800**	**22**
Professional Elective Course							
BDS515A	Computer Vision	BDS515C	Distributed File Systems				
BDS515B	Data Warehousing	BDS515D	Predictive Analytics				

PCC: Professional Core Course, **PCCL**: Professional Core Course laboratory, **UHV**: Universal Human Value Course, **MC**: Mandatory Course (Non-credit), **AEC**: Ability Enhancement Course, **SEC**: Skill Enhancement Course, **L:** Lecture, **T**: Tutorial, **P**: Practical **S= SDA**: Skill Development Activity, **CIE**: Continuous Internal Evaluation, **SXX**: Semester End Evaluation. **K :** The letter in the course code indicates common to al the stream of engineering. **PROJ**: Project /Mini Project. **PEC**: Professional Elective Course

Professional Core Course (IPCC): Refers to Professional Core Course Theory Integrated with practicals of the same course. Credit for IPCC can be 04 and its Teaching–Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from the practical part of IPCC shall be included in the SEE question paper. For more details, the regulation governing the Degree of Bachelor of Engineering /Technology (B.E./B.Tech.) 2022-23

National Service Scheme /Physical Education/Yoga: All students have to register for any one of the courses namely National Service Scheme (NSS), Physical Education (PE)(Sports and Athletics), and Yoga(YOG) with the concerned coordinator of the course during the first week of III semesters. Activities shall be carried out between III semester to the VI semester (for 4 semesters). Successful completion of the registered course and requisite CIE score is mandatory for the award of the degree. The events shall be appropriately scheduled by the colleges and the same shall be reflected in the calendar prepared for the NSS, PE, and Yoga activities. These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the course is mandatory for the award of degree.

Mini-project work: Mini Project is a laboratory-oriented/hands on course that will provide a platform to students to enhance their practical knowledge and skills by the development of small systems/applications etc. Based on the ability/abilities of the student/s and recommendations of the mentor, a single discipline or a multidisciplinary Mini- project can be assigned to an individual student or to a group having not more than 4 students.

CIE procedure for Mini-project:

(i) Single discipline: The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two faculty members of the Department, one of them being the Guide. The CIE marks awarded for the Mini-project work shall be based on the evaluation of the project report, project presentation skill, and question and answer session in the ratio of 50:25:25. The marks awarded for the project report shall be the same for all the batches mates.

(ii) Interdisciplinary: Continuous Internal Evaluation shall be group-wise at the college level with the participation of all the guides of the project.

The CIE marks awarded for the Mini-project, shall be based on the evaluation of the project report, project presentation skill, and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.

No SEE component for Mini-Project.

Professional Elective Courses (PEC): A professional elective (PEC) course is intended to enhance the depth and breadth of educational experience in the Engineering and Technology curriculum. Multidisciplinary courses that are added supplement the latest trend and advanced technology in the selected stream of engineering. Each group will provide an option to select one course. The minimum number of students' strengths for offering a professional elective is 10. However, this conditional shall not be applicable to cases where the admission to the program is less than 10.

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI

B.E. in Data Science

Scheme of Teaching and Examinations2022

Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

(Effective from the academic year 2023-24)

VI SEMESTER

Sl. No	Course and Course Code		Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
					Theory Lecture	Tutorial	Practical / Drawing	SDA	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1	IPCC	BDS601	Big Data Analytics	TD: DS PSB: DS	3	0	2		03	50	50	100	4
2	PCC	BDS602	Artificial Intelligence & Machine Learning	TD: DS PSB: DS	4	0	0		03	50	50	100	4
3	PEC	BDS613x	Professional Elective Course	TD: DS PSB: DS	3	0	0		03	50	50	100	3
4	OEC	BDS654x	Open Elective Course	TD: DS PSB: DS	3	0	0		03	50	50	100	3
5	PROJ	BDS685	Project Phase I	TD: DS PSB: DS	0	0	4		03	100	--	100	2
6	PCCL	BDSL606	Machine Learning lab	TD: DS PSB: DS	0	0	2		03	50	50	100	1
7	AEC/SDC	BDS657x	Ability Enhancement Course/Skill Development Course V	TD: DS PSB: DS	If the course is offered as a Theory				01	50	50	100	1
					1	0	0						
					If course is offered as a practical								
					0	0	2						
8	MC	BNSK658	National Service Scheme (NSS)	NSS coordinator	0	0	2			100	---	100	0
		BPEK658	Physical Education (PE) (Sports and Athletics)	Physical Education Director									
		BYOK658	Yoga	Yoga Teacher									
									Total	**500**	**300**	**800**	**18**

Professional Elective Course

BDS613A	Natural Language Processing	BDS613C	Blockchain Technology
BDS613B	Exploratory Data Analysis	BDS613D	Time Series Analysis

Open Elective Course

BDS654A	Introduction to Data Structures	BDS654C	Mobile Application Development
BDS654B	Fundamentals of Operating Systems	BDS654D	Introduction to AI
Ability Enhancement Course / Skill Enhancement Course-V			
BDS657A	Explainable AI	BDS657C	Generative AI
BDS657B	PyTorch	BDS657D	Devops

PCC: Professional Core Course, **PCCL**: Professional Core Course laboratory, **UHV**: Universal Human Value Course, **MC**: Mandatory Course (Non-credit), **AEC**: Ability Enhancement Course, **SEC**: Skill Enhancement Course, **L:** Lecture, **T**: Tutorial, **P**: Practical **S= SDA**: Skill Development Activity, **CIE**: Continuous Internal Evaluation, **SEE**: Semester End Evaluation. **K :** The letter in the course code indicates common to al the stream of engineering. **PROJ**: Project /Mini Project. **PEC**: Professional Elective Course. **PROJ**: Project Phase -I, **OEC**: Open Elective Course

Professional Core Course (IPCC): Refers to Professional Core Course Theory Integrated with practicals of the same course. Credit for IPCC can be 04 and its Teaching–Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from the practical part of IPCC shall be included in the SEE question paper. For more details, the regulation governing the Degree of Bachelor of Engineering /Technology (B.E./B.Tech.) 2022-23

National Service Scheme /Physical Education/Yoga: All students have to register for any one of the courses namely National Service Scheme (NSS), Physical Education (PE)(Sports and Athletics), and Yoga(YOG) with the concerned coordinator of the course during the first week of III semesters. Activities shall be carried out between III semester to the VI semester (for 4 semesters). Successful completion of the registered course and requisite CIE score is mandatory for the award of the degree. The events shall be appropriately scheduled by the colleges and the same shall be reflected in the calendar prepared for the NSS, PE, and Yoga activities. These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the course is mandatory for the award of degree.

Professional Elective Courses (PEC): A professional elective (PEC) course is intended to enhance the depth and breadth of educational experience in the Engineering and Technology curriculum. Multidisciplinary courses that are added supplement the latest trend and advanced technology in the selected stream of engineering. Each group will provide an option to select one course. The minimum number of students' strengths for offering professional electives is 10. However, this conditional shall not be applicable to cases where the admission to the program is less than 10.

Open Elective Courses:

Students belonging to a particular stream of Engineering and Technology are not entitled to the open electives offered by their parent Department. However, they can opt for an elective offered by other Departments, provided they satisfy the prerequisite condition if any. Registration to open electives shall be documented under the guidance of the Program Coordinator/ Advisor/Mentor. The minimum numbers of students' strength for offering Open Elective Course is 10. However, this condition shall not be applicable to class where the admission to the program is less than 10.

Project Phase-I : Students have to discuss with the mentor /guide and with their helphe/she has to complete the literature survey and prepare the report and finally

define the problem statement for the project work.

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI

B.E. in Data Science

Scheme of Teaching and Examinations2022

Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

(Effective from the academic year 2023-24)

VIISEMESTER (Swappable VII and VIII SEMESTER)

Sl. No	Course and Course Code		Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
					Theory Lecture	Tutorial	Practical / Drawing	SDA	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1	IPCC	BDS701	Scalable Computing (cloud + Scalable Sytems)	TD: DS PSB: DS	3	0	2		03	50	50	100	4
2	IPCC	BDS702	Statistical Machine Learning for Data Science	TD: DS PSB: DS	3	0	2		03	50	50	100	4
3	PCC	BDS703	Data Security & Privacy	TD: DS PSB: DS	4	0	0		03	50	50	100	4
4	PEC	BDS714x	**Professional Elective Course**	TD: DS PSB: DS	3	0	0		03	50	50	100	3
5	OEC	BDS755x	**Open Elective Course**	TD: DS PSB: DS	3	0	0		01	50	50	100	3
6	PROJ	BDS786	**Major Project Phase-II**	TD: DS PSB: DS	0	0	12		03	100	100	200	6
										400	**300**	**700**	**24**

Professional Elective Course

BDS714A	Deep Learning	BDS714C	Data Engineering & MLOps
BDS714B	Business Analytics	BDS714D	Social Network Analysis

Open Elective Course

BDS755A	Introduction to DBMS	BDS755C	Software Engineering
BDS755B	Introduction to Algorithms	BDS755D	Data Management

PCC: Professional Core Course, **PCCL**: Professional Core Course laboratory, **PEC**: Professional Elective Course, **OEC**: Open Elective Course PR: Project Work, **L:** Lecture, **T**: Tutorial, **P**: Practical **S= SDA**: Skill Development Activity, **CIE**: Continuous Internal Evaluation, **SEE**: Semester End Evaluation. **TD-** Teaching Department, **PSB**: Paper Setting department, **OEC**: Open Elective Course, **PEC**: Professional Elective Course. **PROJ**: Project work

Note: VII and VIII semesters of IV years of the program

(1) Institutions can swap the VII and VIII Semester Schemes of Teaching and Examinations to accommodate research internships/ industry internships after the VI semester.

(2) Credits earned for the courses of VII and VIII Semester Scheme of Teaching and Examinations shall be counted against the corresponding semesters whether the VII or VIII semesters is completed during the beginning of the IV year or the later part of IV years of the program.

Professional Elective Courses (PEC): A professional elective (PEC) course is intended to enhance the depth and breadth of educational experience in the Engineering and Technology curriculum. Multidisciplinary courses that are added supplement the latest trend and advanced technology in the selected stream of engineering. Each group will provide an option to select one course. The minimum number of students' strengths for offering professional electives is 10. However, this conditional shall not be applicable to cases where the admission to the program is less than 10.

Open Elective Courses:

Students belonging to a particular stream of Engineering and Technology are not entitled to the open electives offered by their parent Department. However, they can opt for an elective offered by other Departments, provided they satisfy the prerequisite condition if any. Registration to open electives shall be documented under the guidance of the Program Coordinator/ Advisor/Mentor. The minimum numbers of students' strength for offering Open Elective Course is 10. However, this condition shall not be applicable to class where the admission to the program is less than 10.

PROJECT WORK (21XXP75): The objective of the Project work is

(i) To encourage independent learning and the innovative attitude of the students.

(ii) To develop interactive attitude, communication skills, organization, time management, and presentation skills.

(iii) To impart flexibility and adaptability.

(iv) To inspire team working.

(v) To expand intellectual capacity, credibility, judgment and intuition.

(vi) To adhere to punctuality, setting and meeting deadlines.

(vii) To install responsibilities to oneself and others.

(viii) To train students to present the topic of project work in a seminar without any fear, face the audience confidently, enhance communication skills, involve in group discussion to present and exchange ideas.

CIE procedure for Project Work:

(1) Single discipline: The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two senior faculty members of the Department, one of whom shall be the Guide.

The CIE marks awarded for the project work, shall be based on the evaluation of the project work Report, project presentation skill, and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.

(2) Interdisciplinary: Continuous Internal Evaluation shall be group-wise at the college level with the participation of all guides of the college. Participation of external guide/s, if any, is desirable. The CIE marks awarded for the project work, shall be based on the evaluation of project work Report, project presentation skill, and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.

SEE procedure for Project Work: SEE for project work will be conducted by the two examiners appointed by the University. The SEE marks awarded for the project work shall be based on the evaluation of project work Report, project presentation skill, and question and answer session in the ratio 50:25:25.

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI

B.E. in Data Science

Scheme of Teaching and Examinations2022

Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

(Effective from the academic year 2023-24)

VIII SEMESTER (Swappable VII and VIII SEMESTER)

Sl. No	Course and Course Code		Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
					Theory Lecture	Tutorial	Practical / Drawing	SDA	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1	PEC	BDS801x	**Professional Elective (Online Courses) Only through NPTEL**	PSB: DS	3	0	0		03	50	50	100	3
2	OEC	BDS802x	**Open Elective (Online Courses) Only through NPTEL**	PSB: DS	3	0	0		01	50	50	100	3
3	INT	BDS803	**Internship (Industry/Research) (14 - 20 weeks)**		0	0	12		03	100	100	200	10
										200	**200**	**400**	**16**

Professional Elective Course (Online courses)

BDS801A	BOS will publish courses based on the availability	BDS801C	
BDS801B		BDS801D	

Open Elective Courses (Online Courses)

BDS802A	BOS will publish courses based on the availability	BDS802C	
BDS802B		BDS802D	

L: Lecture, **T**: Tutorial, **P**: Practical **S= SDA**: Skill Development Activity, **CIE**: Continuous Internal Evaluation, **SEE**: Semester End Evaluation. **TD-** Teaching Department, **PSB**: Paper Setting department, **OEC**: Open Elective Course, **PEC**: Professional Elective Course. **PROJ**: Project work, **INT**: Industry Internship / Research Internship / Rural Internship

Note: VII and VIII semesters of IV years of the program

Swapping Facility

- Institutions can swap VII and VIII Semester Scheme of Teaching and Examinations to accommodate **research internships/ industry internships/Rural Internship** after the VI semester.

- Credits earned for the courses of VII and VIII Semester Scheme of Teaching and Examinations shall be counted against the corresponding semesters whether VII or VIII semester is completed during the beginning of IV year or later part of IV year of the program.
- Note: For BDS801x and BDS802x courses BOS will announce list of courses in 6th , 7th & 8th Sem . Students can register in any of the semester to earn the credits in 8th Sem.

Elucidation:

At the beginning of IV years of the program i.e., after VI semester, VII semester classwork and VIII semester **Research Internship /Industrial Internship / Rural Internship** shall be permitted to be operated simultaneously by the University so that students have ample opportunity for an internship. In other words, a good percentage of the class shall attend VII semester classwork and a similar percentage of others shall attend to Research Internship or Industrial Internship or Rural Internship.

Research/Industrial /Rural Internship shall be carried out at an Industry, NGO, MSME, Innovation center, Incubation center, Start-up, center of Excellence (CoE), Study Centre established in the parent institute and /or at reputed research organizations/institutes.

The mandatory Research internship /Industry internship / Rural Internship is for 14 to 20 weeks. The internship shall be considered as a head of passing and shall be considered for the award of a degree. Those, who do not take up/complete the internship shall be declared to fail and shall have to complete it during the subsequent University examination after satisfying the internship requirements.

Research internship: A research internship is intended to offer the flavor of current research going on in the research field. It helps students get familiarized with the field and imparts the skill required for carrying out research.

Industry internship: Is an extended period of work experience undertaken by students to supplement their degree for professional development. It also helps them learn to overcome unexpected obstacles and successfully navigate organizations, perspectives, and cultures. Dealing with contingencies helps students recognize, appreciate, and adapt to organizational realities by tempering their knowledge with practical constraints.

Rural Internship: Rural development internship is an initiative of Unnat Bharat Abhiyan Cell, RGIT in association with AICTE to involve students of all departments studying in different academic years for exploring various opportunities in techno-social fields, to connect and work with Rural India for their upliftment.

The faculty coordinator or mentor has to monitor the student's internship progress and interact with them to guide for the successful completion of the internship.

The students are permitted to carry out the internship anywhere in India or abroad. University shall not bear any expenses incurred in respect of the internship.

With the consent of the internal guide and Principal of the Institution, students shall be allowed to carry out the internship at their hometown (**within or outside the state or abroad**), provided favorable facilities are available for the internship and the student remains regularly in contact with the internal guide. **University shall not bear any cost involved in carrying out the internship by students.** However, students can receive any financial assistance extended by the organization.

Professional Elective /Open Elective Course: These are ONLINE courses suggested by the respective Board of Studies. Details of these courses shall be made available for students on the VTU web portal.

Please note: If any clarifications / suggestions please email to **sbhvtuso@yahoo.com**

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI

B.E. in Mechanical Engineering

Scheme of Teaching and Examinations2022

Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

(Effective from the academic year 2023-24)

III SEMESTER

Sl. No	Course	Course Code	Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	SDA	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	**T**	**P**	**S**					
1	PCC	BME301	Mechanics of Materials	TD- ME PSB-ME	2	2	0		03	50	50	100	3
2	IPCC	BME302	Manufacturing Process	TD: ME PSB: ME	3	0	2		03	50	50	100	4
3	IPCC	BME303	Material Science and Engineering	TD: ME PSB: ME	3	0	2		03	50	50	100	4
4	PCC	BME304	Basic Thermodynamics	TD: ME PSB: ME	2	2	0		03	50	50	100	3
5	PCCL	BMEL305	Introduction to Modelling and Design for Manufacturing	TD: ME PSB: ME	0	0	2		03	50	50	100	1
6	ESC	BME306x	ESC/ETC/PLC	TD: Respective Dept. PSB: Respective Dept.	3	0	0		03	50	50	100	3
7	UHV	BSCK307	**Social Connect and Responsibility**	Any Department	0	0	2		01	100	---	100	1
8	AEC/ SEC	BME358x	Ability Enhancement Course/Skill Enhancement Course - III		If the course is a Theory				01	50	50	100	1
					1	0	0						
					If a course is a laboratory				02				
					0	0	2						
9	MC	BNSK359	National Service Scheme (NSS)	NSS coordinator	0	0	2			100	---	100	0
		BPEK359	Physical Education (PE) (Sports and Athletics)	Physical Education Director									
		BYOK359	Yoga	Yoga Teacher									
									Total	**550**	**350**	**900**	**20**

PCC: Professional Core Course, **PCCL**: Professional Core Course laboratory, **UHV**: Universal Human Value Course, **MC**: Mandatory Course (Non-credit), **AEC**: Ability Enhancement Course, **SEC**: Skill Enhancement Course, **L:** Lecture, **T**: Tutorial, **P**: Practical **S= SDA**: Skill Development Activity, **CIE**: Continuous Internal Evaluation, **SEE**: Semester End Evaluation.K: This letter in the course code indicates common to all the stream of engineering. ESC: Engineering Science Course, ETC: Emerging Technology Course, PLC: Programming Language Course

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Engineering Science Course (ESC/ETC/PLC)[L-T-P::3-0-0]			
BME306A	Electric and Hybrid Vehicle Technology	BME306C	Internet of Things (IoT)
BME306B	Smart Materials & Systems	BME306D	Waste handling and Management
Ability Enhancement Course – III			
BME358A	Advanced Python Programming [0-0-2]	BME358C	Spreadsheet for Engineers [0-0-2]
BME358B	Fundamentals of Virtual Reality [0-2-0]	BME358D	Tools in Scientific Computing [0-0-2]

Professional Core Course (IPCC): Refers to Professional Core Course Theory Integrated with practical's of the same course. Credit for IPCC can be 04 and its Teaching–Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from the practical part of IPCC shall be included in the SEE question paper. For more details, the regulation governing the Degree of Bachelor of Engineering /Technology (B.E./B.Tech.) 2022-23 may please be referred.

National Service Scheme /Physical Education/Yoga: All students have to register for any one of the courses namely National Service Scheme (NSS), Physical Education (PE)(Sports and Athletics), and Yoga(YOG) with the concerned coordinator of the course during the first week of III semesters. Activities shall be carried out between III semester to the VI semester (for 4 semesters). Successful completion of the registered course and requisite CIE score is mandatory for the award of the degree. The events shall be appropriately scheduled by the colleges and the same shall be reflected in the calendar prepared for the NSS, PE, and Yoga activities. These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the course is mandatory for the award of degree.

VARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI

B.E. in Mechanical Engineering

Scheme of Teaching and Examinations2022

Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

(Effective from the academic year 2023-24)

IV SEMESTER

Sl. No	Course and Course Code		Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	Self -Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1	PCC	BME401	Applied Thermodynamics	TD: ME PSB:ME	2	2	0		03	50	50	100	3
2	IPCC	BME402	Machining Science & Metrology	TD: ME PSB:ME	3	0	2		03	50	50	100	4
3	IPCC	BME403	Fluid Mechanics	TD: ME PSB:ME	3	0	2		03	50	50	100	4
4	PCCL	BME404	Mechanical Measurements and Metrology lab	TD: ME PSB:ME	0	0	2		03	50	50	100	1
5	ESC	BME405x	ESC/ETC/PLC	TD: Respective Dept. PSB: Respective Dept.	3	0	0		03	50	50	100	3
6	AEC/ SEC	BME456x	Ability Enhancement Course/Skill Enhancement Course- IV	TD and PSB: Concerned department	If the course is Theory				01	50	50	100	1
					1	0	0						
					If the course is a lab				02				
					0	0	2						
4	BSC	BBOK407	Biology For Engineers	TD / PSB: BT, CHE,	3	0	0		03	50	50	100	3
7	UHV	BUHK408	Universal human values course	Any Department	1	0	0		01	50	50	100	1
9	MC	BNSK459	National Service Scheme (NSS)	NSS coordinator	0	0	2			100	---	100	0
		BPEK459	Physical Education (PE) (Sports and Athletics)	Physical Education Director									
		BYOK459	Yoga	Yoga Teacher									
									Total	**500**	**400**	**900**	**20**

PCC: Professional Core Course, **PCCL**: Professional Core Course laboratory, **UHV**: Universal Human Value Course, **MC**: Mandatory Course (Non-credit), **AEC**: Ability

Enhancement Course, **SEC**: Skill Enhancement Course, **L:** Lecture, **T**: Tutorial, **P**: Practical **S= SDA**: Skill Development Activity, **CIE**: Continuous Internal Evaluation, **SEE**: Semester End Evaluation. K :This letter in the course code indicates common to all the stream of engineering.

Engineering Science Course (ESC/ETC/PLC) [L-T-P::3-0-0]			
BME405A	Non Traditional Machining	BME405C	Micro Electro Mechanical Systems
BME405B	Environmental Studies	BME405D	Robotics and Automation
Ability Enhancement Course / Skill Enhancement Course - IV			
BME456A	Introduction to AI & ML [0-0-2]	BME456C	Introduction to Data Analytics [0-0-2]
BME456B	Digital Marketing [0-2-0]	BME456D	Programming in C++ [0-0-2]

Professional Core Course (IPCC): Refers to Professional Core Course Theory Integrated with practical of the same course. Credit for IPCC can be 04 and its Teaching–Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from the practical part of IPCC shall be included in the SEE question paper. For more details, the regulation governing the Degree of Bachelor of Engineering /Technology (B.E./B.Tech.) 2022-23.

National Service Scheme /Physical Education/Yoga: All students have to register for any one of the courses namely National Service Scheme (NSS), Physical Education (PE)(Sports and Athletics), and Yoga(YOG) with the concerned coordinator of the course during the first week of III semesters. Activities shall be carried out between III semester to the VI semester (for 4 semesters). Successful completion of the registered course and requisite CIE score is mandatory for the award of the degree. The events shall be appropriately scheduled by the colleges and the same shall be reflected in the calendar prepared for the NSS, PE, and Yoga activities. These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the courses is mandatory for the award of degree.

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI

B.E. in Mechanical Engineering

Scheme of Teaching and Examinations2022

Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

(Effective from the academic year 2023-24)

V SEMESTER

Sl. No	Course and Course Code		Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	Self -Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1	HSMS	BME501	Industrial Management & Entrepreneurship	TD: ME PSB:ME	3	0	0		03	50	50	100	3
2	IPCC	BME502	Turbo machines	TD: ME PSB:ME	2	2	2		03	50	50	100	4
3	PCC	BME503	Theory of Machines	TD: ME PSB:ME	4	0	0		03	50	50	100	4
4	PCCL	BME504L	CNC Programming and 3-D Printing lab	TD: ME PSB:ME	0	0	2		03	50	50	100	1
5	PEC	BME515x	Professional Elective - I	TD: ME PSB:ME	3	0	0		03	50	50	100	3
6	PROJ	BME586	Mini Project	TD: ME PSB:ME	0	0	4		03	100		100	2
7	AEC	BRMK557	Research Methodology and IPR	Any Department	2	2	0		02	50	50	100	3
8	MC	BESK508	Environmental Studies	TD: CV/Env/Chem PSB:CV	2	0	0		02	50	50	100	2
9	MC	BNSK559	National Service Scheme (NSS)	NSS coordinator	0	0	2			100		100	0
		BPEK559	Physical Education (PE) (Sports and Athletics)	Physical Education Director									
		BYOK559	Yoga	Yoga Teacher									
									Total	**500**	**300**	**800**	**22**

Professional Elective Course

BME515A	Mechatronics	BME515C	Supply chain management & Introduction to SAP
BME515B	Automation in manufacturing	BME515D	Energy Engineering

PCC: Professional Core Course, **PCCL**: Professional Core Course laboratory, **UHV**: Universal Human Value Course, **MC**: Mandatory Course (Non-credit), **AEC**: Ability

Enhancement Course, **SEC**: Skill Enhancement Course, **L:** Lecture, **T**: Tutorial, **P**: Practical **S= SDA**: Skill Development Activity, **CIE**: Continuous Internal Evaluation, **SEE**: Semester End Evaluation. **K :** The letter in the course code indicates common to al the stream of engineering. **PROJ**: Project /Mini Project. **PEC**: Professional Elective Course

Professional Core Course (IPCC): Refers to Professional Core Course Theory Integrated with practical of the same course. Credit for IPCC can be 04 and its Teaching–Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from the practical part of IPCC shall be included in the SEE question paper. For more details, the regulation governing the Degree of Bachelor of Engineering /Technology (B.E./B.Tech.) 2022-23

National Service Scheme /Physical Education/Yoga: All students have to register for any one of the courses namely National Service Scheme (NSS), Physical Education (PE)(Sports and Athletics), and Yoga(YOG) with the concerned coordinator of the course during the first week of III semesters. Activities shall be carried out between III semester to the VI semester (for 4 semesters). Successful completion of the registered course and requisite CIE score is mandatory for the award of the degree. The events shall be appropriately scheduled by the colleges and the same shall be reflected in the calendar prepared for the NSS, PE, and Yoga activities. These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the course is mandatory for the award of degree.

Mini-project work: Mini Project is a laboratory-oriented/hands on course that will provide a platform to students to enhance their practical knowledge and skills by the development of small systems/applications etc. Based on the ability/abilities of the student/s and recommendations of the mentor, a single discipline or a multidisciplinary Mini- project can be assigned to an individual student or to a group having not more than 4 students.

CIE procedure for Mini-project:

(i) Single discipline: The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two faculty members of the Department, one of them being the Guide. The CIE marks awarded for the Mini-project work shall be based on the evaluation of the project report, project presentation skill, and question and answer session in the ratio of 50:25:25. The marks awarded for the project report shall be the same for all the batches mates.

(ii) Interdisciplinary: Continuous Internal Evaluation shall be group-wise at the college level with the participation of all the guides of the project.

The CIE marks awarded for the Mini-project, shall be based on the evaluation of the project report, project presentation skill, and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.

No SEE component for Mini-Project.

Professional Elective Courses (PEC): A professional elective (PEC) course is intended to enhance the depth and breadth of educational experience in the Engineering and Technology curriculum. Multidisciplinary courses that are added supplement the latest trend and advanced technology in the selected stream of engineering. Each group will provide an option to select one course. The minimum number of students' strengths for offering a professional elective is 10. However, this conditional shall not be applicable to cases where the admission to the program is less than 10.

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI

B.E. in Mechanical Engineering

Scheme of Teaching and Examinations2022

Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

(Effective from the academic year 2023-24)

VI SEMESTER

Sl. No	Course and Course Code		Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	Self -Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1	IPCC	BME601	Heat Transfer	TD: ME PSB:ME	2	2	2		03	50	50	100	4
2	PCC	BME602	Machine Design	TD: ME PSB:ME	3	2	0		03	50	50	100	4
3	PEC	BME613x	Professional Elective - II	TD: ME PSB:ME	3	0	0		03	50	50	100	3
4	OEC	BME654x	Open Elective -I	TD: ME PSB:ME	3	0	0		03	50	50	100	3
5	PROJ	BME685	Major Project Phase - I	TD: ME PSB:ME	0	0	4		03	100	--	100	2
6	PCCL	BMEL606L	Design lab	TD: ME PSB:ME	0	0	2		03	50	50	100	1
7	AEC/SDC	BME657x	Ability Enhancement Course/Skill Development Course V		If the course is offered as a Theory				01	50	50	100	1
					1	0	0						
					If course is offered as a practical								
					0	0	2						
8	MC	BNSK658	National Service Scheme (NSS)	NSS coordinator	0	0	2			100	---	100	0
		BPEK658	Physical Education (PE) (Sports and Athletics)	Physical Education Director									
		BYOK658	Yoga	Yoga Teacher									
									Total	**500**	**300**	**800**	**18**

Professional Elective Course

BME613A	Total Quality Management	BME613C	MEMS and Microsystem Technology
BME613B	Refrigeration and Air Conditioning	BME613D	Design for Manufacturing and Assembly

Open Elective Course			
BME654A	Project Management	BME654C	Mechatronics
BME654B	Renewable Energy Power plants	BME654D	Modern Mobility

Ability Enhancement Course / Skill Enhancement Course-V			
BME657A	Basics of Matlab [0-0-2]	BME657C	Simulation and Analysis using Ansys workbench [0-0-2]
BME657B	Fundamental of Virtual Reality ARP Development	BME657D	Introduction Augmented Reality

PCC: Professional Core Course, **PCCL**: Professional Core Course laboratory, **UHV**: Universal Human Value Course, **MC**: Mandatory Course (Non-credit), **AEC**: Ability Enhancement Course, **SEC**: Skill Enhancement Course, **L:** Lecture, **T**: Tutorial, **P**: Practical **S= SDA**: Skill Development Activity, **CIE**: Continuous Internal Evaluation, **SEE**: Semester End Evaluation. **K :** The letter in the course code indicates common to al the stream of engineering. **PROJ**: Project /Mini Project. **PEC**: Professional Elective Course. **PROJ**: Project Phase -I, **OEC**: Open Elective Course

Professional Core Course (IPCC): Refers to Professional Core Course Theory Integrated with practical of the same course. Credit for IPCC can be 04 and its Teaching–Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from the practical part of IPCC shall be included in the SEE question paper. For more details, the regulation governing the Degree of Bachelor of Engineering /Technology (B.E./B.Tech.) 2022-23

National Service Scheme /Physical Education/Yoga: All students have to register for any one of the courses namely National Service Scheme (NSS), Physical Education (PE)(Sports and Athletics), and Yoga(YOG) with the concerned coordinator of the course during the first week of III semesters. Activities shall be carried out between III semester to the VI semester (for 4 semesters). Successful completion of the registered course and requisite CIE score is mandatory for the award of the degree. The events shall be appropriately scheduled by the colleges and the same shall be reflected in the calendar prepared for the NSS, PE, and Yoga activities. These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the course is mandatory for the award of degree.

Professional Elective Courses (PEC): A professional elective (PEC) course is intended to enhance the depth and breadth of educational experience in the Engineering and Technology curriculum. Multidisciplinary courses that are added supplement the latest trend and advanced technology in the selected stream of engineering. Each group will provide an option to select one course. The minimum number of students' strengths for offering professional electives is 10. However, this conditional shall not be applicable to cases where the admission to the program is less than 10.

Open Elective Courses:

Students belonging to a particular stream of Engineering and Technology are not entitled to the open electives offered by their parent Department. However, they can opt for an elective offered by other Departments, provided they satisfy the prerequisite condition if any. Registration to open electives shall be documented under the guidance of the Program Coordinator/ Advisor/Mentor. The minimum numbers of students' strength for offering Open Elective Course is 10. However, this condition shall not be applicable to class where the admission to the program is less than 10.

Project Phase-I : Students have to discuss with the mentor /guide and with their help he/she has to complete the literature survey and prepare the report and finally define the problem statement for the project work.

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI

B.E. in Mechanical Engineering

Scheme of Teaching and Examinations2022

Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

(Effective from the academic year 2023-24)

VIISEMESTER (Swappable VII and VIII SEMESTER)

Sl. No	Course and Course Code		Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	Self -Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1	IPCC	BME701	Finite Element Methods	TD: ME PSB:ME	3	0	2		03	50	50	100	4
2	IPCC	BME702	Hydraulics and Pneumatics	TD: ME PSB:ME	3	0	2		03	50	50	100	4
3	PCC	BME703	Control Engineering	TD: ME PSB:ME	4	0	0		03	50	50	100	4
4	PEC	BME714x	**Professional Elective-III**	TD: ME PSB:ME	3	0	0		03	50	50	100	3
5	OEC	BME755x	**Open Elective- II**	TD: ME PSB:ME	3	0	0		01	50	50	100	3
6	PROJ	BME786	**Major Project Phase-II**		0	0	12		03	100	100	200	6
										400	**300**	**700**	**24**

Professional Elective Course

BME714A	Additive manufacturing	BME714C	IC Engines
BME714B	Product Design and Management	BME714D	Cryogenics

Open Elective Course

BME755A	Non Traditional machining	BME755C	Operations Research
BME755B	Hydraulics and Pneumatics	BME755D	Non-Conventional Energy Resources

PCC: Professional Core Course, **PCCL**: Professional Core Course laboratory, **PEC**: Professional Elective Course, **OEC**: Open Elective Course PR: Project Work, **L:** Lecture, **T**: Tutorial, **P**: Practical **S= SDA**: Skill Development Activity, **CIE**: Continuous Internal Evaluation, **SEE**: Semester End Evaluation. **TD-** Teaching Department, **PSB**: Paper Setting department, **OEC**: Open Elective Course, **PEC**: Professional Elective Course. **PROJ**: Project work

Note: VII and VIII semesters of IV years of the program

(1) Institutions can swap the VII and VIII Semester Schemes of Teaching and Examinations to accommodate research internships/ industry internships after the VI semester.

(2) Credits earned for the courses of VII and VIII Semester Scheme of Teaching and Examinations shall be counted against the corresponding semesters whether the VII or VIII semesters is completed during the beginning of the IV year or the later part of IV years of the program.

Professional Elective Courses (PEC): A professional elective (PEC) course is intended to enhance the depth and breadth of educational experience in the Engineering and Technology curriculum. Multidisciplinary courses that are added supplement the latest trend and advanced technology in the selected stream of engineering. Each group will provide an option to select one course. The minimum number of students' strengths for offering professional electives is 10. However, this conditional shall not be applicable to cases where the admission to the program is less than 10.

Open Elective Courses:

Students belonging to a particular stream of Engineering and Technology are not entitled to the open electives offered by their parent Department. However, they can opt for an elective offered by other Departments, provided they satisfy the prerequisite condition if any. Registration to open electives shall be documented under the guidance of the Program Coordinator/ Advisor/Mentor. The minimum numbers of students' strength for offering Open Elective Course is 10. However, this condition shall not be applicable to class where the admission to the program is less than 10.

PROJECT WORK (21MEP75): The objective of the Project work is

- **(i)** To encourage independent learning and the innovative attitude of the students.
- **(ii)** To develop interactive attitude, communication skills, organization, time management, and presentation skills.
- **(iii)** To impart flexibility and adaptability.
- **(iv)** To inspire team working.
- **(v)** To expand intellectual capacity, credibility, judgment and intuition.
- **(vi)** To adhere to punctuality, setting and meeting deadlines.
- **(vii)** To install responsibilities to oneself and others.
- **(viii)**To train students to present the topic of project work in a seminar without any fear, face the audience confidently, enhance communication skills, involve in group discussion to present and exchange ideas.

CIE procedure for Project Work:

(1) Single discipline: The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two senior faculty members of the Department, one of whom shall be the Guide.

The CIE marks awarded for the project work, shall be based on the evaluation of the project work Report, project presentation skill, and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.

(2) Interdisciplinary: Continuous Internal Evaluation shall be group-wise at the college level with the participation of all guides of the college. Participation of external guide/s, if any, is desirable. The CIE marks awarded for the project work, shall be based on the evaluation of project work Report, project presentation skill, and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.

SEE procedure for Project Work: SEE for project work will be conducted by the two examiners appointed by the University. The SEE marks awarded for the project work shall be based on the evaluation of project work Report, project presentation skill, and question and answer session in the ratio 50:25:25.

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI

B.E. in Mechanical Engineering

Scheme of Teaching and Examinations2022

Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

(Effective from the academic year 2023-24)

VIIISEMESTER (Swappable VII and VIII SEMESTER)

Sl. No	Course and Course Code		Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	Self -Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1	PEC	BME801x	**Professional Elective -IV (Online Courses)**	TD: ME PSB:ME	3	0	0		03	50	50	100	3
2	OEC	BME802x	**Open Elective - III (Online Courses)**	TD: ME PSB:ME	3	0	0		03	50	50	100	3
3	INT	BME803	**Internship (Industry/Research) (14 - 20 weeks)**	TD: ME	0	0	12		03	100	100	200	10
										200	**200**	**400**	**16**

Professional Elective Course (Online courses)

BME801A	Quality Design & Control (Available in NPTEL)	BME801C	Modelling & Analytics for Supply Chain Management (Available in NPTEL)
BME801B	Machinery Fault Diagnosis and Signal Processing (Available in NPTEL)	BME801D	Strategies for Sustainable Design (Available in NPTEL)

Open Elective Courses (Online Courses)

BME802A	Fundamentals of Automotive systems (Available in NPTEL)	BME802C	Computer Integrated Manufacturing (Available in NPTEL)
BME802B	Product Design and Manufacturing (Available in NPTEL)	BME802D	Business Planning & Project Management (Available in Swayam Portal)

L: Lecture, **T**: Tutorial, **P**: Practical **S= SDA**: Skill Development Activity, **CIE**: Continuous Internal Evaluation, **SEE**: Semester End Evaluation. **TD-** Teaching Department, **PSB**: Paper Setting department, **OEC**: Open Elective Course, **PEC**: Professional Elective Course. **PROJ**: Project work, **INT**: Industry Internship / Research Internship / Rural Internship

Note: VII and VIII semesters of IV years of the program

Swapping Facility

- Institutions can swap VII and VIII Semester Scheme of Teaching and Examinations to accommodate **research internships/ industry internships/Rural Internship** after the VI semester**.**
- Credits earned for the courses of VII and VIII Semester Scheme of Teaching and Examinations shall be counted against the corresponding semesters whether VII or VIII semester is completed during the beginning of IV year or later part of IV year of the program.

Elucidation:

At the beginning of IV years of the program i.e., after VI semester, VII semester classwork and VIII semester **Research Internship /Industrial Internship / Rural Internship** shall be permitted to be operated simultaneously by the University so that students have ample opportunity for an internship. In other words, a good percentage of the class shall attend VII semester classwork and a similar percentage of others shall attend to Research Internship or Industrial Internship or Rural Internship.

Research/Industrial /Rural Internship shall be carried out at an Industry, NGO, MSME, Innovation centre, Incubation centre, Start-up, centre of Excellence (CoE), Study Centre established in the parent institute and /or at reputed research organizations/institutes.

The mandatory Research internship /Industry internship / Rural Internship is for 14 to 20 weeks. The internship shall be considered as a head of passing and shall be considered for the award of a degree. Those, who do not take up/complete the internship shall be declared to fail and shall have to complete it during the subsequent University examination after satisfying the internship requirements.

Research internship: A research internship is intended to offer the flavour of current research going on in the research field. It helps students get familiarized with the field and imparts the skill required for carrying out research.

Industry internship: Is an extended period of work experience undertaken by students to supplement their degree for professional development. It also helps them learn to overcome unexpected obstacles and successfully navigate organizations, perspectives, and cultures. Dealing with contingencies helps students recognize, appreciate, and adapt to organizational realities by tempering their knowledge with practical constraints.

Rural Internship: Rural development internship is an initiative of Unnat Bharat Abhiyan Cell, RGIT in association with AICTE to involve students of all departments studying in different academic years for exploring various opportunities in techno-social fields, to connect and work with Rural India for their upliftment.

The faculty coordinator or mentor has to monitor the student's internship progress and interact with them to guide for the successful completion of the internship.

The students are permitted to carry out the internship anywhere in India or abroad. University shall not bear any expenses incurred in respect of the internship.

With the consent of the internal guide and Principal of the Institution, students shall be allowed to carry out the internship at their hometown (**within or outside the state or abroad**), provided favorable facilities are available for the internship and the student remains regularly in contact with the internal guide. **University shall not bear any cost involved in carrying out the internship by students.** However, students can receive any financial assistance extended by the organization.

Professional Elective /Open Elective Course: These are ONLINE courses suggested by the respective Board of Studies. Details of these courses shall be made available for students on the VTU web portal.

Please note: If any clarifications / suggestions please email to **sbhvtuso@yahoo.com**

Mathematics for Computer Science		Semester	3
Course Code	**BCS301**	CIE Marks	50
Teaching Hours/Week (L: T:P: S)	3:2:0:0	SEE Marks	50
Total Hours of Pedagogy	40 hours Theory + 20 Hours Tutorial	Total Marks	100
Credits	04	Exam Hours	3
Examination type (SEE)	**Theory**		

Course objectives: This course will enable the students to:

1. To introduce the concept of random variables, probability distributions, specific discrete and continuous distributions with practical application in Computer Science Engineering and social life situations.
2. To Provide the principles of statistical inferences and the basics of hypothesis testing with emphasis on some commonly encountered hypotheses.
3. To Determine whether an input has a statistically significant effect on the system's response through ANOVA testing.

Teaching-Learning Process
Pedagogy (General Instructions):
Teachers can use the following strategies to accelerate the attainment of the various course outcomes.

1. In addition to the traditional lecture method, different types of innovative teaching methods may be adopted so that the delivered lessons shall develop students' theoretical and applied Mathematical skills.
2. State the need for Mathematics with Engineering Studies and Provide real-life examples.
3. Support and guide the students for self–study.
4. You will assign homework, grading assignments and quizzes, and documenting students' progress.
5. Encourage the students to group learning to improve their creative and analytical skills.
6. Show short related video lectures in the following ways:
    - As an introduction to new topics (pre-lecture activity).
    - As a revision of topics (post-lecture activity).
    - As additional examples (post-lecture activity).
    - As an additional material of challenging topics (pre-and post-lecture activity).
    - As a model solution of some exercises (post-lecture activity).

Module-1: Probability Distributions

Probability Distributions: Review of basic probability theory. Random variables (discrete and continuous), probability mass and density functions. Mathematical expectation, mean and variance. Binomial, Poisson and normal distributions- problems (derivations for mean and standard deviation for Binomial and Poisson distributions only)-Illustrative examples. Exponential distribution. **(12 Hours)**

(RBT Levels: L1, L2 and L3)

Pedagogy	Chalk and Board, Problem-based learning

Module-2: Joint probability distribution & Markov Chain

Joint probability distribution: Joint Probability distribution for two discrete random variables, expectation, covariance and correlation.
Markov Chain: Introduction to Stochastic Process, Probability Vectors, Stochastic matrices, Regular stochastic matrices, Markov chains, Higher transition probabilities, Stationary distribution of Regular Markov chains and absorbing states. **(12 Hours)**
(RBT Levels: L1, L2 and L3)

Pedagogy	Chalk and Board, Problem-based learning

Module-3: Statistical Inference 1

Introduction, sampling distribution, standard error, testing of hypothesis, levels of significance, test of significances, confidence limits, simple sampling of attributes, test of significance for large samples, comparison of large samples. **(12 Hours)**
(RBT Levels: L1, L2 and L3)

Pedagogy	Chalk and Board, Problem-based learning

Module-4: Statistical Inference 2

Sampling variables, central limit theorem and confidences limit for unknown mean. Test of Significance for means of two small samples, students 't' distribution, Chi-square distribution as a test of goodness of fit. F-Distribution. **(12 Hours)**
(RBT Levels: L1, L2 and L3)

Pedagogy	Chalk and Board, Problem-based learning

Module-5: Design of Experiments & ANOVA

Principles of experimentation in design, Analysis of completely randomized design, randomized block design. The ANOVA Technique, Basic Principle of ANOVA, One-way ANOVA, Two-way ANOVA, Latin-square Design, and Analysis of Co-Variance. **(12 Hours)**
(RBT Levels: L1, L2 and L3)

Pedagogy	Chalk and Board, Problem-based learning

Course outcome (Course Skill Set)

At the end of the course, the student will be able to:

1. Explain the basic concepts of probability, random variables, probability distribution
2. Apply suitable probability distribution models for the given scenario.
3. Apply the notion of a discrete-time Markov chain and n-step transition probabilities to solve the given problem
4. Use statistical methodology and tools in the engineering problem-solving process.
5. Compute the confidence intervals for the mean of the population.
6. Apply the ANOVA test related to engineering problems.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment

Test component, there are 25 marks.

- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by the University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.

Marks scored shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Textbooks:

1. **Ronald E. Walpole, Raymond H Myers, Sharon L Myers & Keying Ye** "Probability & Statistics for Engineers & Scientists", Pearson Education, 9th edition, 2017.
2. **Peter Bruce, Andrew Bruce & Peter Gedeck** "Practical Statistics for Data Scientists" O'Reilly Media, Inc., 2nd edition **2020**.

Reference Books: (Name of the author/Title of the Book/ Name of the publisher/Edition and Year)

1. **Erwin Kreyszig**, "Advanced Engineering Mathematics", John Wiley & Sons, 9th Edition, 2006.
2. **B. S. Grewal** "Higher Engineering Mathematics", Khanna publishers, 44th Ed., 2021.
3. **G Haribaskaran** "Probability, Queuing Theory & Reliability Engineering", Laxmi Publication, Latest Edition, 2006
4. **Irwin Miller & Marylees Miller,** John E. Freund's "Mathematical Statistics with Applications" Pearson. Dorling Kindersley Pvt. Ltd. India, 8th edition, 2014.
5. **S C Gupta and V K Kapoor**, "Fundamentals of Mathematical Statistics", S Chand and Company, Latest edition.
6. **Robert V. Hogg, Joseph W. McKean & Allen T. Craig**. "Introduction to Mathematical Statistics", Pearson Education 7th edition, 2013.
7. **Jim Pitman**. Probability, Springer-Verlag, 1993.
8. **Sheldon M. Ross,** "Introduction to Probability Models" 11th edition. Elsevier, 2014.
9. **A. M. Yaglom and I. M. Yaglom**, "Probability and Information". D. Reidel Publishing Company. Distributed by Hindustan Publishing Corporation (India) Delhi, 1983.
10. **P. G. Hoel, S. C. Port and C. J. Stone**, "Introduction to Probability Theory", Universal Book Stall, (Reprint), 2003.
11. **S. Ross**, "A First Course in Probability", Pearson Education India, 6th Ed., 2002.
12. **W. Feller**, "An Introduction to Probability Theory and its Applications", Vol. 1, Wiley, 3rd

Ed., 1968.
13. **N.P. Bali and Manish Goyal**, A Textbook of Engineering Mathematics, Laxmi Publications, Reprint, 2010.
14. **Veerarajan T**, Engineering Mathematics (for semester III), Tata McGraw-Hill, New Delhi, 2010

Web links and Video Lectures (e-Resources):

http://nptel.ac.in/courses.php?disciplineID=111
http://www.class-central.com/subject/math(MOOCs)
http://academicearth.org/
http://www.bookstreet.in.
VTU EDUSAT PROGRAMME – 20
VTU e-Shikshana Program

Activity-Based Learning (Suggested Activities in Class)/Practical-Based Learning

- Programming Assignment
- Seminars

Digital Design and Computer Organization		Semester	3
Course Code	BCS302	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:2:0	SEE Marks	50
Total Hours of Pedagogy	40 hours Theory + 20 Hours of Practicals	Total Marks	100
Credits	04	Exam Hours	3
Examination nature (SEE)	Theory		

Course objectives:

- To demonstrate the functionalities of binary logic system
- To explain the working of combinational and sequential logic system
- To realize the basic structure of computer system
- To illustrate the working of I/O operations and processing unit

Teaching-Learning Process (General Instructions)

These are sample Strategies; that teachers can use to accelerate the attainment of the various course outcomes.

1. Chalk and Talk
2. Live Demo with experiments
3. Power point presentation

MODULE-1 **8 Hr**

Introduction to Digital Design: Binary Logic, Basic Theorems And Properties Of Boolean Algebra, Boolean Functions, Digital Logic Gates, Introduction, The Map Method, Four-Variable Map, Don't-Care Conditions, NAND and NOR Implementation, Other Hardware Description Language – Verilog Model of a simple circuit.

Text book 1: 1.9, 2.4, 2.5, 2.8, 3.1, 3.2, 3.3, 3.5, 3.6, 3.9

MODULE-2 **8 Hr**

Combinational Logic: Introduction, Combinational Circuits, Design Procedure, Binary Adder- Subtractor, Decoders, Encoders, Multiplexers. HDL Models of Combinational Circuits – Adder, Multiplexer, Encoder. **Sequential Logic**: Introduction, Sequential Circuits, Storage Elements: Latches, Flip-Flops.

Text book 1: 4.1, 4.2, 4.4, 4.5, 4.9, 4.10, 4.11, 4.12, 5.1, 5.2, 5.3, 5.4.

MODULE-3 **8 Hr**

Basic Structure of Computers: Functional Units, Basic Operational Concepts, Bus structure, Performance – Processor Clock, Basic Performance Equation, Clock Rate, Performance Measurement.**Machine Instructions and Programs:** Memory Location and Addresses, Memory Operations, Instruction and Instruction sequencing, Addressing Modes.

Text book 2: 1.2, 1.3, 1.4, 1.6, 2.2, 2.3, 2.4, 2.5

MODULE-4 **8 Hr**

Input/output Organization: Accessing I/O Devices, Interrupts – Interrupt Hardware, Enabling and Disabling Interrupts, Handling Multiple Devices, Direct Memory Access: Bus Arbitration, Speed, size and Cost of memory systems. Cache Memories – Mapping Functions.

Text book 2: 4.1, 4.2.1, 4.2.2, 4.2.3, 4.4, 5.4, 5.5.1

MODULE-5 **8 Hr**

Basic Processing Unit: Some Fundamental Concepts: Register Transfers, Performing ALU operations, fetching a word from Memory, Storing a word in memory. Execution of a Complete Instruction. **Pipelining:** Basic concepts, Role of Cache memory, Pipeline Performance.

Text book 2: 7.1, 7.2, 8.1

PRACTICAL COMPONENT OF IPCC

Sl.NO	Experiments Simulation packages preferred: Multisim, Modelsim, PSpice or any other relevant
1	Given a 4-variable logic expression, simplify it using appropriate technique and simulate the same using basic gates.
2	Design a 4 bit full adder and subtractor and simulate the same using basic gates.
3	Design Verilog HDL to implement simple circuits using structural, Data flow and Behavioural model.
4	Design Verilog HDL to implement Binary Adder-Subtractor – Half and Full Adder, Half and Full Subtractor.
5	Design Verilog HDL to implement Decimal adder.
6	Design Verilog program to implement Different types of multiplexer like 2:1, 4:1 and 8:1.
7	Design Verilog program to implement types of De-Multiplexer.
8	Design Verilog program for implementing various types of Flip-Flops such as SR, JK and D.

Course outcomes (Course Skill Set):

At the end of the course, the student will be able to:

CO1: Apply the K–Map techniques to simplify various Boolean expressions.

CO2: Design different types of combinational and sequential circuits along with Verilog programs.

CO3: Describe the fundamentals of machine instructions, addressing modes and Processor performance.

CO4: Explain the approaches involved in achieving communication between processor and I/O devices.

CO5:Analyze internal Organization of Memory and Impact of cache/Pipelining on Processor Performance.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

CIE for the theory component of the IPCC (maximum marks 50)

- IPCC means practical portion integrated with the theory of the course.
- CIE marks for the theory component are **25 marks** and that for the practical component is **25 marks**.
- 25 marks for the theory component are split into **15 marks** for two Internal Assessment Tests (Two Tests, each of 15 Marks with 01-hour duration, are to be conducted) and **10 marks** for other

assessment methods mentioned in 22OB4.2. The first test at the end of 40-50% coverage of the syllabus and the second test after covering 85-90% of the syllabus.

- Scaled-down marks of the sum of two tests and other assessment methods will be CIE marks for the theory component of IPCC (that is for **25 marks)**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the theory component of IPCC.

CIE for the practical component of the IPCC

- **15 marks** for the conduction of the experiment and preparation of laboratory record, and **10 marks** for the test to be conducted after the completion of all the laboratory sessions.
- On completion of every experiment/program in the laboratory, the students shall be evaluated including viva-voce and marks shall be awarded on the same day.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to **15 marks**.
- The laboratory test **(duration 02/03 hours)** after completion of all the experiments shall be conducted for 50 marks and scaled down to **10 marks.**
- Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **25 marks**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the practical component of the IPCC.

SEE for IPCC

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored by the student shall be proportionally scaled down to 50 Marks

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper may include questions from the practical component.

Suggested Learning Resources:

Books

1. M. Morris Mano & Michael D. Ciletti, Digital Design With an Introduction to Verilog Design, 5e, Pearson Education.

2. Carl Hamacher, ZvonkoVranesic, SafwatZaky, Computer Organization, 5th Edition, Tata McGraw Hill.

Web links and Video Lectures (e-Resources):

https://cse11-iiith.vlabs.ac.in/

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

Assign the group task to Design the various types of counters and display the output accordingly

Assessment Methods

- Lab Assessment (25 Marks)
- GATE Based Aptitude Test

OPERATING SYSTEMS		Semester	3
Course Code	BCS303	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:2:0	SEE Marks	50
Total Hours of Pedagogy	40 hours Theory + 20 hours practicals	Total Marks	100
Credits	04	Exam Hours	3
Examination nature (SEE)	**Theory**		

Course objectives:

- To Demonstrate the need for OS and different types of OS
- To discuss suitable techniques for management of different resources
- To demonstrate different APIs/Commands related to processor, memory, storage and file system management.

Teaching-Learning Process (General Instructions)

Teachers can use the following strategies to accelerate the attainment of the various course outcomes.

1. Lecturer methods (L) need not to be only traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.
5. Role play for process scheduling.
6. Demonstrate the installation of any one Linux OS on VMware/Virtual Box

MODULE-1 **8 Hours**

Introduction to operating systems, System structures: What operating systems do; Computer System organization; Computer System architecture; Operating System structure; Operating System operations; Process management; Memory management; Storage management; Protection and Security; Distributed system; Special-purpose systems; Computing environments.

Operating System Services: User - Operating System interface; System calls; Types of system calls; System programs; Operating system design and implementation; Operating System structure; Virtual machines; Operating System debugging, Operating System generation; System boot.

Textbook 1: Chapter – 1 (1.1-1.12), 2 (2.2-2.11)

MODULE-2 **8 Hours**

Process Management: Process concept; Process scheduling; Operations on processes; Inter process communication

Multi-threaded Programming: Overview; Multithreading models; Thread Libraries; Threading issues.

Process Scheduling: Basic concepts; Scheduling Criteria; Scheduling Algorithms; Thread scheduling; Multiple-processor scheduling,

Textbook 1: Chapter – 3 (3.1-3.4), 4 (4.1-4.4), 5 (5.1 -5.5)

MODULE-3 **8 Hours**

Process Synchronization: Synchronization: The critical section problem; Peterson's solution; Synchronization hardware; Semaphores; Classical problems of synchronization;

Deadlocks: System model; Deadlock characterization; Methods for handling deadlocks; Deadlock prevention; Deadlock avoidance; Deadlock detection and recovery from deadlock.

Textbook 1: Chapter – 6 (6.1-6.6), 7 (7.1 -7.7)

MODULE-4 **8 Hours**

Memory Management: Memory management strategies: Background; Swapping; Contiguous memory allocation; Paging; Structure of page table; Segmentation.

Virtual Memory Management: Background; Demand paging; Copy-on-write; Page replacement; Allocation of frames; Thrashing.

Textbook 1: Chapter -8 (8.1-8.6), 9 (9.1-9.6)

MODULE-5 **8 Hours**

File System, Implementation of File System: File system: File concept; Access methods; Directory and Disk structure; File system mounting; File sharing; **Implementing File system:** File system structure; File system implementation; Directory implementation; Allocation methods; Free space management.

Secondary Storage Structure, Protection: Mass storage structures; Disk structure; Disk attachment; Disk scheduling; Disk management; **Protection**: Goals of protection, Principles of protection, Domain of protection, Access matrix.

Textbook 1: Chapter – 10 (10.1-10.5) ,11 (11.1-11.5),12 (12.1-12.5), 14 (14.1-14.4)

PRACTICAL COMPONENT OF IPCC*(May cover all / major modules)*

Sl.NO	Experiments
1	Develop a c program to implement the Process system calls (fork (), exec(), wait(), create process, terminate process)
2	Simulate the following CPU scheduling algorithms to find turnaround time and waiting time a) FCFS b) SJF c) Round Robin d) Priority.
3	Develop a C program to simulate producer-consumer problem using semaphores.
4	Develop a C program which demonstrates interprocess communication between a reader process and a writer process. Use mkfifo, open, read, write and close APIs in your program.
5	Develop a C program to simulate Bankers Algorithm for DeadLock Avoidance.
6	Develop a C program to simulate the following contiguous memory allocation Techniques: a) Worst fit b) Best fit c) First fit.
7	Develop a C program to simulate page replacement algorithms: a) FIFO b) LRU
8	Simulate following File Organization Techniques a) Single level directory b) Two level directory
9	Develop a C program to simulate the Linked file allocation strategies.
10	Develop a C program to simulate SCAN disk scheduling algorithm.

Course outcomes (Course Skill Set):

At the end of the course, the student will be able to:

CO 1. Explain the structure and functionality of operating system

CO 2. Apply appropriate CPU scheduling algorithms for the given problem.

CO 3. Analyse the various techniques for process synchronization and deadlock handling.

CO 4. Apply the various techniques for memory management

CO 5. Explain file and secondary storage management strategies.

CO 6. Describe the need for information protection mechanisms

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

CIE for the theory component of the IPCC (maximum marks 50)

- IPCC means practical portion integrated with the theory of the course.
- CIE marks for the theory component are **25 marks** and that for the practical component is **25 marks**.
- 25 marks for the theory component are split into **15 marks** for two Internal Assessment Tests (Two Tests, each of 15 Marks with 01-hour duration, are to be conducted) and **10 marks** for other assessment methods

mentioned in 22OB4.2. The first test at the end of 40-50% coverage of the syllabus and the second test after covering 85-90% of the syllabus.

- Scaled-down marks of the sum of two tests and other assessment methods will be CIE marks for the theory component of IPCC (that is for **25 marks**).
- The student has to secure 40% of 25 marks to qualify in the CIE of the theory component of IPCC.

CIE for the practical component of the IPCC

- **15 marks** for the conduction of the experiment and preparation of laboratory record, and **10 marks** for the test to be conducted after the completion of all the laboratory sessions.
- On completion of every experiment/program in the laboratory, the students shall be evaluated including viva-voce and marks shall be awarded on the same day.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to **15 marks**.
- The laboratory test **(duration 02/03 hours)** after completion of all the experiments shall be conducted for 50 marks and scaled down to **10 marks.**
- Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **25 marks**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the practical component of the IPCC.

SEE for IPCC

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scoredby the student shall be proportionally scaled down to 50 Marks

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper may include questions from the practical component.

Suggested Learning Resources:

Textbooks

1. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, Operating System Principles 8th edition, Wiley-India, 2015

Reference Books

1. Ann McHoes Ida M Fylnn, Understanding Operating System, Cengage Learning, 6th Edition
2. D.M Dhamdhere, Operating Systems: A Concept Based Approach 3rd Ed, McGraw- Hill, 2013.
3. P.C.P. Bhatt, An Introduction to Operating Systems: Concepts and Practice 4th Edition, PHI(EEE), 2014.
4. William Stallings Operating Systems: Internals and Design Principles, 6th Edition, Pearson.

Web links and Video Lectures (e-Resources):

1. https://youtu.be/mXw9ruZaxzQ

2. https://youtu.be/vBURTt97EkA
3. https://www.youtube.com/watch?v=783KAB-tuE4&list=PLIemF3uozcAKTgsCIj82voMK3TMR0YE_f
4. https://www.youtube.com/watch?v=3-ITLMMeeXY&list=PL3pGy4HtqwD0n7bQfHjPnsWzkeRn6mkO

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Assessment Methods
  - Case Study on Unix Based Systems (10 Marks)
  - Lab Assessment (25 Marks)

DATA STRUCTURES AND APPLICATIONS		Semester	3
Course Code	BCS304	CIE Marks	50
Teaching Hours/Week (L: T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	3
Examination type (SEE)	Theory		

Course objectives:

CLO 1. To explain fundamentals of data structures and their applications.
CLO 2. To illustrate representation of Different data structures such as Stack, Queues, Linked Lists, Trees and Graphs.
CLO 3. To Design and Develop Solutions to problems using Linear Data Structures
CLO 4. To discuss applications of Nonlinear Data Structures in problem solving.
CLO 5. To introduce advanced Data structure concepts such as Hashing and Optimal Binary Search Trees

Teaching-Learning Process (General Instructions)

Teachers can use following strategies to accelerate the attainment of the various course outcomes.

1. Chalk and Talk with Black Board
2. ICT based Teaching
3. Demonstration based Teaching

Module-1 **8Hours**

INTRODUCTION TO DATA STRUCTURES: Data Structures, Classifications (Primitive & Non-Primitive), Data structure Operations
Review of pointers and dynamic Memory Allocation,
ARRAYS and STRUCTURES: Arrays, Dynamic Allocated Arrays, Structures and Unions, Polynomials, Sparse Matrices, representation of Multidimensional Arrays, Strings
STACKS: Stacks, Stacks Using Dynamic Arrays, Evaluation and conversion of Expressions
Text Book: Chapter-1:1.2 Chapter-2: 2.1 to 2.7 Chapter-3: 3.1,3.2,3.6
Reference Book 1: 1.1 to 1.4

Module-2 **8Hours**

QUEUES: Queues, Circular Queues, Using Dynamic Arrays, Multiple Stacks and queues.
LINKED LISTS : Singly Linked, Lists and Chains, Representing Chains in C, Linked Stacks and Queues, Polynomials
Text Book: Chapter-3: 3.3, 3.4, 3.7 Chapter-4: 4.1 to 4.4

Module-3 **8Hours**

LINKED LISTS : Additional List Operations, Sparse Matrices, Doubly Linked List.
TREES: Introduction, Binary Trees, Binary Tree Traversals, Threaded Binary Trees.
Text Book: Chapter-4: 4.5,4.7,4.8 Chapter-5: 5.1 to 5.3, 5.5

Module-4 **8Hours**

TREES(Cont..): Binary Search trees, Selection Trees, Forests, Representation of Disjoint sets, Counting Binary Trees,
GRAPHS: The Graph Abstract Data Types, Elementary Graph Operations
Text Book: Chapter-5: 5.7 to 5.11 Chapter-6: 6.1, 6.2

Module-5 **8Hours**

HASHING: Introduction, Static Hashing, Dynamic Hashing
PRIORITY QUEUES: Single and double ended Priority Queues, Leftist Trees
INTRODUCTION TO EFFICIENT BINARY SEARCH TREES: Optimal Binary Search Trees
Text Book: Chapter 8: 8.1 to 8.3 Chapter 9: 9.1, 9.2 Chapter 10: 10.1

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

CO 1. Explain different data structures and their applications.
CO 2. Apply Arrays, Stacks and Queue data structures to solve the given problems.
CO 3. Use the concept of linked list in problem solving.
CO 4. Develop solutions using trees and graphs to model the real-world problem.
CO 5. Explain the advanced Data Structures concepts such as Hashing Techniques and Optimal Binary Search Trees.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Textbook:

1. Ellis Horowitz, Sartaj Sahni and Susan Anderson-Freed, Fundamentals of Data Structures in C, 2nd Ed, Universities Press, 2014

Reference Books:

1. Seymour Lipschutz, Data Structures Schaum's Outlines, Revised 1^{st} Ed, McGraw Hill, 2014.
2. Gilberg & Forouzan, Data Structures: A Pseudo-code approach with C, 2^{nd} Ed, Cengage Learning,2014.
3. Reema Thareja, Data Structures using C, 3^{rd} Ed, Oxford press, 2012.
4. Jean-Paul Tremblay & Paul G. Sorenson, An Introduction to Data Structures with Applications, 2^{nd} Ed, McGraw Hill, 2013
5. A M Tenenbaum, Data Structures using C, PHI, 1989
6. Robert Kruse, Data Structures and Program Design in C, 2^{nd} Ed, PHI, 1996.

Web links and Video Lectures (e-Resources):

- http://elearning.vtu.ac.in/econtent/courses/video/CSE/06CS35.html
- https://nptel.ac.in/courses/106/105/106105171/
- http://www.nptelvideos.in/2012/11/data-structures-and-algorithms.html
- https://www.youtube.com/watch?v=3Xo6P_V-qns&t=201s
- https://ds2-iiith.vlabs.ac.in/exp/selection-sort/index.html
- https://nptel.ac.in/courses/106/102/106102064/
- https://ds1-iiith.vlabs.ac.in/exp/stacks-queues/index.html
- https://ds1-iiith.vlabs.ac.in/exp/linked-list/basics/overview.html
- https://ds1-iiith.vlabs.ac.in/List%20of%20experiments.html
- https://ds1-iiith.vlabs.ac.in/exp/tree-traversal/index.html
- https://ds1-iiith.vlabs.ac.in/exp/tree-traversal/depth-first-traversal/dft-practice.html
- https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_0135015954280775681259/overview

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Role Play
- Flipped classroom
- Assessment Methods for 25 Marks (opt two Learning Activities)
  - Case Study
  - Programming Assignment
  - Gate Based Aptitude Test
  - MOOC Assignment for selected Module

DATA STRUCTURES LABORATORY
SEMESTER – III

Course Code	**BCSL305**	**CIE Marks**	50
Number of Contact Hours/Week	0:0:2	**SEE Marks**	50
Total Number of Lab Contact Hours	28	**Exam Hours**	03
Credits – 1			

Course Learning Objectives:

This laboratory course enables students to get practical experience in design, develop, implement, analyze and evaluation/testing of

- Dynamic memory management
- Linear data structures and their applications such as stacks, queues and lists
- Non-Linear data structures and their applications such as trees and graphs

Descriptions (if any):

- Implement all the programs in "C " Programming Language and Linux OS.

Programs List:

1. Develop a Program in C for the following:
   a) Declare a calendar as an array of 7 elements (A dynamically Created array) to represent 7 days of a week. Each Element of the array is a structure having three fields. The first field is the name of the Day (A dynamically allocated String), The second field is the date of the Day (A integer), the third field is the description of the activity for a particular day (A dynamically allocated String).
   b) Write functions create(), read() and display(); to create the calendar, to read the data from the keyboard and to print weeks activity details report on screen.

2. Develop a Program in C for the following operations on Strings.
   a. Read a main String (STR), a Pattern String (PAT) and a Replace String (REP)
   b. Perform Pattern Matching Operation: Find and Replace all occurrences of PAT in STR with REP if PAT exists in STR. Report suitable messages in case PAT does not exist in STR

   Support the program with functions for each of the above operations. Don't use Built-in functions.

3. Develop a menu driven Program in C for the following operations on STACK of Integers (Array Implementation of Stack with maximum size MAX)
   a. Push an Element on to Stack
   b. Pop an Element from Stack
   c. Demonstrate how Stack can be used to check Palindrome
   d. Demonstrate Overflow and Underflow situations on Stack
   e. Display the status of Stack
   f. Exit

   Support the program with appropriate functions for each of the above operations

4.	Develop a Program in C for converting an Infix Expression to Postfix Expression. Program should support for both parenthesized and free parenthesized expressions with the operators: +, -, *, /, % (Remainder), ^ (Power) and alphanumeric operands.
5.	Develop a Program in C for the following Stack Applications a. Evaluation of Suffix expression with single digit operands and operators: +, -, *, /, %, ^ b. Solving Tower of Hanoi problem with n disks

6.	Develop a menu driven Program in C for the following operations on Circular QUEUE of Characters (Array Implementation of Queue with maximum size MAX) a. Insert an Element on to Circular QUEUE b. Delete an Element from Circular QUEUE c. Demonstrate Overflow and Underflow situations on Circular QUEUE d. Display the status of Circular QUEUE e. Exit Support the program with appropriate functions for each of the above operations
7.	Develop a menu driven Program in C for the following operations on Singly Linked List (SLL) of Student Data with the fields: *USN, Name, Programme, Sem, PhNo* a. Create a SLL of N Students Data by using *front insertion*. b. Display the status of SLL and count the number of nodes in it c. Perform Insertion / Deletion at End of SLL d. Perform Insertion / Deletion at Front of SLL(Demonstration of stack) e. Exit
8.	Develop a menu driven Program in C for the following operations on Doubly Linked List (DLL) of Employee Data with the fields: *SSN, Name, Dept, Designation, Sal, PhNo* a. Create a DLL of N Employees Data by using *end insertion*. b. Display the status of DLL and count the number of nodes in it c. Perform Insertion and Deletion at End of DLL d. Perform Insertion and Deletion at Front of DLL e. Demonstrate how this DLL can be used as Double Ended Queue. f. Exit
9.	Develop a Program in C for the following operationson Singly Circular Linked List (SCLL) with header nodes a. Represent and Evaluate a Polynomial $P(x,y,z) = 6x^2y^2z-4yz^5+3x^3yz+2xy^5z-2xyz^3$ b. Find the sum of two polynomials POLY1(x,y,z) and POLY2(x,y,z) and store the result in POLYSUM(x,y,z) Support the program with appropriate functions for each of the above operations
10.	Develop a menu driven Program in C for the following operations on Binary Search Tree (BST) of Integers . a. Create a BST of N Integers: 6, 9, 5, 2, 8, 15, 24, 14, 7, 8, 5, 2 b. Traverse the BST in Inorder, Preorder and Post Order c. Search the BST for a given element (KEY) and report the appropriate message d. Exit
11.	Develop a Program in C for the following operations on Graph(G) of Cities a. Create a Graph of N cities using Adjacency Matrix. b. Print all the nodes reachable from a given starting node in a digraph using DFS/BFS method

12.	Given a File of N employee records with a set K of Keys (4-digit) which uniquely determine the records in file F. Assume that file F is maintained in memory by a Hash Table (HT) of m memory locations with L as the set of memory addresses (2-digit) of locations in HT. Let the keys in K and addresses in L are Integers. Develop a Program in C that uses Hash function H: K →L as H(K)=K mod m (remainder method), and implement hashing technique to map a given key K to the address space L. Resolve the collision (if any) using linear probing.
Laboratory Outcomes: The student should be able to:	

- Analyze various linear and non-linear data structures
- Demonstrate the working nature of different types of data structures and their applications
- Use appropriate searching and sorting algorithms for the give scenario.
- Apply the appropriate data structure for solving real world problems

Conduct of Practical Examination:

- Experiment distribution
  - For laboratories having only one part: Students are allowed to pick one experiment from the lot with equal opportunity.
  - For laboratories having PART A and PART B: Students are allowed to pick one experiment from PART A and one experiment from PART B, with equal opportunity.
- Change of experiment is allowed only once and marks allotted for procedure to be made zero of the changed part only.
- Marks Distribution *(Need to change in accordance with university regulations)*
  - c) For laboratories having only one part – Procedure + Execution + Viva-Voce: 15+70+15 = 100 Marks
  - d) For laboratories having PART A and PART B
    - i. Part A – Procedure + Execution + Viva = 6 + 28 + 6 = 40 Marks
    - ii. Part B – Procedure + Execution + Viva = 9 + 42 + 9 = 60 Marks

Object Oriented Programming with JAVA		Semester	3
Course Code	BCS306A	CIE Marks	50
Teaching Hours/Week (L: T:P: S)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	28 Hours of Theory + 20 Hours of Practical	Total Marks	100
Credits	03	Exam Hours	03
Examination type (SEE)	Theory		

Note - Students who have undergone " Basics of Java Programming-BPLCK105C/205C" in first year are not eligible to opt this course

Course objectives:

- To learn primitive constructs JAVA programming language.
- To understand Object Oriented Programming Features of JAVA.
- To gain knowledge on: packages, multithreaded programing and exceptions.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes and make Teaching –Learning more effective

1. Use Online Java Compiler IDE: https://www.jdoodle.com/online-java-compiler/ or any other.
2. Demonstration of programing examples.
3. Chalk and board, power point presentations
4. Online material (Tutorials) and video lectures.

Module-1

An Overview of Java: Object-Oriented Programming (Two Paradigms, Abstraction, The Three OOP Principles), Using Blocks of Code, Lexical Issues (Whitespace, Identifiers, Literals, Comments, Separators, The Java Keywords).

Data Types, Variables, and Arrays: The Primitive Types (Integers, Floating-Point Types, Characters, Booleans), Variables, Type Conversion and Casting, Automatic Type Promotion in Expressions, Arrays, Introducing Type Inference with Local Variables.

Operators: Arithmetic Operators, Relational Operators, Boolean Logical Operators, The Assignment Operator, The ? Operator, Operator Precedence, Using Parentheses.

Control Statements: Java's Selection Statements (if, The Traditional switch), Iteration Statements (while, do-while, for, The For-Each Version of the for Loop, Local Variable Type Inference in a for Loop, Nested Loops), Jump Statements (Using break, Using continue, return).

Chapter 2, 3, 4, 5

Module-2

Introducing Classes: Class Fundamentals**,** Declaring Objects**,** Assigning Object Reference Variables**,** Introducing Methods**,** Constructors**,** The this Keyword**,** Garbage Collection.

Methods and Classes: Overloading Methods, Objects as Parameters, Argument Passing, Returning Objects, Recursion, Access Control, Understanding static, Introducing final, Introducing Nested and Inner Classes.

Chapter 6, 7

Module-3

Inheritance: Inheritance Basics, Using super, Creating a Multilevel Hierarchy, When Constructors Are Executed, Method Overriding, Dynamic Method Dispatch, Using Abstract Classes, Using final with Inheritance, Local Variable Type Inference and Inheritance, The Object Class.

Interfaces: Interfaces, Default Interface Methods, Use static Methods in an Interface, Private Interface Methods.

Chapter 8, 9

Module-4

Packages: Packages, Packages and Member Access, Importing Packages.

Exceptions: Exception-Handling Fundamentals, Exception Types, Uncaught Exceptions, Using try and catch, Multiple catch Clauses, Nested try Statements, throw, throws, finally, Java's Built-in Exceptions, Creating Your Own Exception Subclasses, Chained Exceptions.

Chapter 9, 10

Module-5

Multithreaded Programming: The Java Thread Model, The Main Thread, Creating a Thread, Creating Multiple Threads, Using isAlive() and join(), Thread Priorities, Synchronization, Interthread Communication, Suspending, Resuming, and Stopping Threads, Obtaining a Thread's State.

Enumerations, Type Wrappers and Autoboxing: Enumerations (Enumeration Fundamentals, The values() and valueOf() Methods), Type Wrappers (Character, Boolean, The Numeric Type Wrappers), Autoboxing (Autoboxing and Methods, Autoboxing/Unboxing Occurs in Expressions, Autoboxing/Unboxing Boolean and Character Values).

Chapter 11, 12

Course outcome (Course Skill Set)

At the end of the course, the student will be able to:

1. Demonstrate proficiency in writing simple programs involving branching and looping structures.
2. Design a class involving data members and methods for the given scenario.
3. Apply the concepts of inheritance and interfaces in solving real world problems.
4. Use the concept of packages and exception handling in solving complex problem
5. Apply concepts of multithreading, autoboxing and enumerations in program development

Programming Experiments (Suggested and are not limited to)

1. Develop a JAVA program to add TWO matrices of suitable order N (The value of N should be read from command line arguments).
2. Develop a stack class to hold a maximum of 10 integers with suitable methods. Develop a JAVA main method to illustrate Stack operations.
3. A class called Employee, which models an employee with an ID, name and salary, is designed as shown in the following class diagram. The method raiseSalary (percent) increases the salary by the given percentage. Develop the Employee class and suitable main method for demonstration.
4. A class called MyPoint, which models a 2D point with x and y coordinates, is designed as follows:
   - Two instance variables x (int) and y (int).
   - A default (or "no-arg") constructor that construct a point at the default location of (0, 0).
   - A overloaded constructor that constructs a point with the given x and y coordinates.
   - A method setXY() to set both x and y.
   - A method getXY() which returns the x and y in a 2-element int array.
   - A toString() method that returns a string description of the instance in the format "(x, y)".
   - A method called distance(int x, int y) that returns the distance from this point to another point at the given (x, y) coordinates
   - An overloaded distance(MyPoint another) that returns the distance from this point to the given MyPoint instance (called another)
   - Another overloaded distance() method that returns the distance from this point to the origin (0,0)

   Develop the code for the class MyPoint. Also develop a JAVA program (called TestMyPoint) to test all the methods defined in the class.
5. Develop a JAVA program to create a class named shape. Create three sub classes namely: circle, triangle and square, each class has two member functions named draw () and erase (). Demonstrate

polymorphism concepts by developing suitable methods, defining member data and main program.

6. Develop a JAVA program to create an abstract class Shape with abstract methods calculateArea() and calculatePerimeter(). Create subclasses Circle and Triangle that extend the Shape class and implement the respective methods to calculate the area and perimeter of each shape.
7. Develop a JAVA program to create an interface Resizable with methods resizeWidth(int width) and resizeHeight(int height) that allow an object to be resized. Create a class Rectangle that implements the Resizable interface and implements the resize methods
8. Develop a JAVA program to create an outer class with a function display. Create another class inside the outer class named inner with a function called display and call the two functions in the main class.
9. Develop a JAVA program to raise a custom exception (user defined exception) for DivisionByZero using try, catch, throw and finally.
10. Develop a JAVA program to create a package named mypack and import & implement it in a suitable class.
11. Write a program to illustrate creation of threads using runnable class. (start method start each of the newly created thread. Inside the run method there is sleep() for suspend the thread for 500 milliseconds).
12. Develop a program to create a class MyThread in this class a constructor, call the base class constructor, using super and start the thread. The run method of the class starts after this. It can be observed that both main thread and created child thread are executed concurrently.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

CIE for the theory component of the IPCC (maximum marks 50)

- IPCC means practical portion integrated with the theory of the course.
- CIE marks for the theory component are **25 marks** and that for the practical component is **25 marks**.
- 25 marks for the theory component are split into **15 marks** for two Internal Assessment Tests (Two Tests, each of 15 Marks with 01-hour duration, are to be conducted) and **10 marks** for other assessment methods mentioned in 22OB4.2. The first test at the end of 40-50% coverage of the syllabus and the second test after covering 85-90% of the syllabus.
- Scaled-down marks of the sum of two tests and other assessment methods will be CIE marks for the theory component of IPCC (that is for **25 marks)**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the theory component of IPCC.

CIE for the practical component of the IPCC

- **15 marks** for the conduction of the experiment and preparation of laboratory record, and **10 marks** for the test to be conducted after the completion of all the laboratory sessions.
- On completion of every experiment/program in the laboratory, the students shall be evaluated including viva-voce and marks shall be awarded on the same day.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to **15 marks**.
- The laboratory test **(duration 02/03 hours)** after completion of all the experiments shall be conducted for 50 marks and scaled down to **10 marks.**
- Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **25 marks**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the practical component of the IPCC.

SEE for IPCC

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored by the student shall be proportionally scaled down to 50 Marks

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper may include questions from the practical component.

Suggested Learning Resources:

Textbook

1. Java: The Complete Reference, Twelfth Edition, by Herbert Schildt, November 2021, McGraw-Hill, ISBN: 9781260463422

Reference Books

1. Programming with Java, 6th Edition, by E Balagurusamy, Mar-2019, McGraw Hill Education, ISBN: 9789353162337.
2. Thinking in Java, Fourth Edition, by Bruce Eckel, Prentice Hall, 2006 (https://sd.blackball.lv/library/thinking_in_java_4th_edition.pdf)

Web links and Video Lectures (e-Resources):

- Java Tutorial: https://www.geeksforgeeks.org/java/
- Introduction To Programming In Java (by Evan Jones, Adam Marcus and Eugene Wu): https://ocw.mit.edu/courses/6-092-introduction-to-programming-in-java-january-iap-2010/
- Java Tutorial: https://www.w3schools.com/java/
- Java Tutorial: https://www.javatpoint.com/java-tutorial

Activity Based Learning (Suggested Activities)/ Practical Based learning

1. Installation of Java (Refer: https://www.java.com/en/download/help/index_installing.html)
2. Demonstration of online IDEs like geeksforgeeks, jdoodle or any other Tools
3. Demonstration of class diagrams for the class abstraction, type visibility, composition and inheritance

Assessment Method

- Programming Assignment / Course Project

Python Programming for Data Science		Semester	3
Course Code	BDS306B	CIE Marks	50
Teaching Hours/Week (L: T:P: S)	2:0:2:0	SEE Marks	50
Total Hours of Pedagogy	28 Hours Theory + 20 Hours Practical	Total Marks	100
Credits	03	Exam Hours	03
Examination type (SEE)	Theory		

Note - Students who have undergone " Introduction to Python Programming-BPLCK105B/205B" in first year are not eligible to opt this course

Course Learning objectives:

CLO 1:To understand Python constructs and use them to build the programs.

CLO 2: To analyse different conditional statements and their applications in programs.

CLO 3: To learn and use basic data structures in python language.

CLO 4: To learn and demonstrate array manipulations by reading data from files

CLO 5: To understand and use different data in a data analytics context.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Chalk and board, power point presentations
2. Online material (Tutorials) and video lectures.
3. Demonstration of programing examples.

Module-1 **6 hr**

Introduction to python: Elements of python language, python block structure, variables and assignment statement, data types in python, operations, simple input/output print statements, formatting print statement.

Text Book 1: Chapter 3 (3.2, 3.3, 3.4, 3.6, 3.7, 3.9 and 3.10)

Module-2 **5 hr**

Decision structure: forming conditions, if statement, the if-else and nested if-else, looping statements: introduction to looping, python built in functions for looping, loop statements, jump statement.

Text Book 1: Chapter 4 (4.2 to 4.6) , Chapter 5 (5.1 to 5.4)

Module-3 **5 hr**

Lists: lists, operation on list, Tuples: introduction, creating,indexing and slicing, operations on tuples. sets: creating, operation in sets, introduction dictionaries, creating, operations, nested dictionary, looping over dictionary.

Text Book 1: Chapter 7 (7.2 to 7.3) , Chapter 8 (8.1 to 8.4) and Chapter 9(9.1 to 9.3, 9.7 to 9.12)

Module-4 **6 hr**

The NumPy Library: Ndarray: the heart of the library, Basic operations, indexing, slicing and iterating, conditions and boolean arrays, array manipulation, general concepts, reading and writing array data on files. **The pandas Library:** an introduction to Data structure, other functionalities on indexes, operations between data structures, function application and mapping.

	Text Book 2: Chapter 3 and Chapter 4.
	Module-5 **6 hr**
	The pandas : Reading and Writing data: i/o API tools, CSV and textual files, Reading data in CSV or text files, reading and writing HTML files, reading data from XML files, Microsoft excel files, JSON data, Pickle python object serialization. **Pandas in Depth : data manipulation:** data preparation, concatenating data transformation discretization binning, permutation, string manipulation, data aggregation group iteration. **Text Book 2: Chapter 5 and Chapter 6**

Course outcome (Course Skill Set)

At the end of the course, the student will be able to :
CO1: Describe the constructs of python programming
CO2: Use looping and conditional constructs to build programs.
CO3: Apply the concept of data structure to solve the real world problem.
CO4: Use the NumPy constructs for matrix manipulations
CO5: Apply the Panda constructs for data analytics.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks

Suggested Learning Resources:
Text Books:

1. S. Sridhar, J. Indumathi, V.M. Hariharan "Python Programming" Pearson publishers, 1st edition 2023.

2. Fabio Nelli, "**Python Data Analytics**", Apress, Publishing, 1st Edition, 2015.

Reference Book:

1. Paul Deitel and Harvey deitel,"**Intro to Python for Computer Science and Data science**", 1st edition Pearson Publisher 2020.

Web links and Video Lectures (e-Resources):

- Nptel: Introduction to Python for Data Sciencehttps://www.youtube.com/watch?v=tA42nHmmEKw&list=PLh2mXjKcTPSACrQxPM2_1Ojus5HX88ht7

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Assessment Methods
  - Programming Assignment (10 Marks)

Practical Component

Sl.NO	Experiments
1	Develop a python program to read **n** digit integer number, and separate the integer number and display each digit. [Hint: input:5678 output: 5 6 7 8, use: floor and mod operators)
2	Develop a python program to accept 4 numbers and display them in sorted order using a minimum number of **if else** statements.
3	Develop python scripts to Calculate the mean, median, mode, variance and standard deviation of **n** integer numbers.
4	Develop a program for checking if a given **n** digit number is palindrome or not. [hint: input 1221 output: palindrome, use //and % operator with loop statement]
5	Develop a python script to display a multiplication table for given integer **n**.
6	Develop a python script to rotate right about a given position in that list and display them. [hint: input [1,4,5,-10] position: 2, output: [-10,5,4,1]]
7	DevelopWrite a python script to interchange the digits of a given integer number. [hint: input: 23456, interchange: 3 and 5 output: 25436]

8	Develop a python program to capitalize a given list of strings. [hint: [hello, good, how, simple] output: [Hello, Good, How, Simple]
9	Using a dictionary, Develop a python program to determine and print the number of duplicate words in a sentence.
10	Develop python program to read Numpy array and print row (sum,mean std) and column (sum,mean,std)
11	Develop a python program to read and print in the console CSV file.
12	Develop a python program to read a HTML file with basic tags, and construct a dictionary and display the same in the console.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

CIE for the theory component of the IPCC (maximum marks 50)

- IPCC means practical portion integrated with the theory of the course.
- CIE marks for the theory component are **25 marks** and that for the practical component is **25 marks**.
- 25 marks for the theory component are split into **15 marks** for two Internal Assessment Tests (Two Tests, each of 15 Marks with 01-hour duration, are to be conducted) and **10 marks** for other assessment methods mentioned in 22OB4.2. The first test at the end of 40-50% coverage of the syllabus and the second test after covering 85-90% of the syllabus.
- Scaled-down marks of the sum of two tests and other assessment methods will be CIE marks for the theory component of IPCC (that is for **25 marks)**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the theory component of IPCC.

CIE for the practical component of the IPCC

- **15 marks** for the conduction of the experiment and preparation of laboratory record, and **10 marks** for the test to be conducted after the completion of all the laboratory sessions.
- On completion of every experiment/program in the laboratory, the students shall be evaluated including viva-voce and marks shall be awarded on the same day.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to **15 marks**.
- The laboratory test **(duration 02/03 hours)** after completion of all the experiments shall be conducted for 50 marks and scaled down to **10 marks.**
- Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **25 marks**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the practical component of the IPCC.

SEE for IPCC

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored by the student shall be proportionally scaled down to 50 Marks

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper may include questions from the practical component.

Data Analytics with R		Semester	3
Course Code	**BDS306C**	CIE Marks	50
Teaching Hours/Week (L: T:P: S)	2;0;2;0	SEE Marks	50
Total Hours of Pedagogy	28 Hours Theory + 20 Hours Practical	Total Marks	100
Credits	03	Exam Hours	03
Examination type (SEE)	Theory		

Course Learning objectives:

CLO 1: To Gain the knowledge of R Programming Concepts

CLO 2: To Explain the concepts of Data Visualization

CLO 3: To Explain the concept of Statistics in R.

CLO 4: To Work with R charts and Graphs

Teaching-Learning Process (General Instructions)

1. Chalk and board, power point presentations
2. Online material (Tutorials) and video lectures.
3. Demonstration of programing examples.

Module-1 **5 hours**

Basics of R

Introducing R, Initiating R, Packages in R, Environments and Functions, Flow Controls, Loops, Basic Data Types in R, Vectors

Chapter 1: 1.1 to 1.7 Chapter 2: 2.1,2.2

Module-2 **5 hours**

Basics of R Continued

Matrices and Arrays, Lists, Data Frames, Factors, Strings, Dates and Times

Chapter 2: 2.3,2.4,2.5,2.6,2.7.2.8.1,2.8.2

Module-3 **6 Hours**

Data Preparation

Datasets, Importing and Exporting files, Accessing Databases, Data Cleaning and Transformation

Chapter 3: 3.1,3.2,3.3,3.4

Module-4 **6 Hours**

Graphics using R

Exploratory Data Analysis, Main Graphical Packages, Pie Charts, Scatter Plots, Line Plots, Histograms, Box Plots, Bar Plots, Other Graphical packages

Chapter 4: 4.1 to 4.9

Module-5 **6 Hours**

Statistical Analysis using R

Basic Statistical Measures, Normal distribution, Binomial distribution, Correlation Analysis, Regression Analysis-Linear Regression Analysis of Variance

Chapter 5: 5.1, 5.3, 5.4, 5.5, 5.6.1, 5.7

Course outcome (Course Skill Set)

At the end of the course, the student will be able to :
CO1: Describe the structures of R Programming.
CO2: Illustrate the basics of Data Preparation with real world examples.
CO3: Apply the Graphical Packages of R for visualization.
CO4: Apply various Statistical Analysis methods for data analytics.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Text Books:

R Programming: An Approach to Data Analytics, G. Sudhamathy and C. Jothi Venkateswaran, MJP Publishers, 2019

Reference Books:

1..An Introduction to R, Notes on R: A Programming Environment for Data Analysis and Graphics. W. N. Venables, D.M. Smith and the R Development Core Team. Version 3.0.1 (2013-05-16)

2. Cotton, R. (2013). Learning R: A Step by Step Function Guide to Data Analysis. 1st ed. O'Reilly Media Inc

Web links and Video Lectures (e-Resources):

1. URL: https://cran.r-project.org/doc/manuals/r-release/R-intro.pdf
2. http://www.tutorialspoint.com/r/r_tutorial.pdf
3. https://users.phhp.ufl.edu/rlp176/Courses/PHC6089/R_notes/intro.html
4. https://cran.r-project.org/web/packages/explore/vignettes/explore_mtcars.html
5. https://www.w3schools.com/r/r_stat_data_set.asp
6. https://rpubs.com/BillB/217355

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Programming Assignment (10 Marks)

Practical Component

Sl.NO	Experiments
1	Demonstrate the steps for installation of R and R Studio. Perform the following: a) Assign different type of values to variables and display the type of variable. Assign different types such as Double, Integer, Logical, Complex and Character and understand the difference between each data type. b) Demonstrate Arithmetic and Logical Operations with simple examples. c) Demonstrate generation of sequences and creation of vectors. d) Demonstrate Creation of Matrices e) Demonstrate the Creation of Matrices from Vectors using Binding Function. f) Demonstrate element extraction from vectors, matrices and arrays
2	Assess the Financial Statement of an Organization being supplied with 2 vectors of data: Monthly Revenue and Monthly Expenses for the Financial Year. You can create your own sample data vector for this experiment) Calculate the following financial metrics: a. Profit for each month. b. Profit after tax for each month (Tax Rate is 30%). c. Profit margin for each month equals to profit after tax divided by revenue. d. Good Months – where the profit after tax was greater than the mean for the year. e. Bad Months – where the profit after tax was less than the mean for the year. f. The best month – where the profit after tax was max for the year. g. The worst month – where the profit after tax was min for the year. **Note:** a. All Results need to be presented as vectors b. Results for Dollar values need to be calculated with \$0.01 precision, but need to be presented in Units of \$1000 (i.e 1k) with no decimal points c. Results for the profit margin ratio need to be presented in units of % with no decimal point. d. It is okay for tax to be negative for any given month (deferred tax asset) e. Generate CSV file for the data.
3	Develop a program to create two 3 X 3 matrices A and B and perform the following operations a) Transpose of the matrix b) addition c) subtraction d) multiplication
4	Develop a program to find the factorial of given number using recursive function calls.

5 Develop an R Program using functions to find all the prime numbers up to a specified number by the method of Sieve of Eratosthenes.

6 The built-in data set mammals contain data on body weight versus brain weight. Develop R commands to:
a) Find the Pearson and Spearman correlation coefficients. Are they similar?
b) Plot the data using the plot command.
c) Plot the logarithm (log) of each variable and see if that makes a difference.

7 Develop R program to create a Data Frame with following details and do the following operations.

itemCode	**itemCategory**	**itemPrice**
1001	Electronics	700
1002	Desktop Supplies	300
1003	Office Supplies	350
1004	USB	400
1005	CD Drive	800

a) Subset the Data frame and display the details of only those items whose price is greater than or equal to 350.
b) Subset the Data frame and display only the items where the category is either “Office Supplies” or “Desktop Supplies”
c) Create another Data Frame called “item-details” with three different fields itemCode, ItemQtyonHand and ItemReorderLvl and merge the two frames

8 Let us use the built-in dataset air quality which has Daily air quality measurements in New York, May to September 1973. Develop R program to generate histogram by using appropriate arguments for the following statements.

a) Assigning names, using the air quality data set.
b) Change colors of the Histogram
c) Remove Axis and Add labels to Histogram
d) Change Axis limits of a Histogram
e) Add Density curve to the histogram

9 Design a data frame in R for storing about 20 employee details. Create a CSV file named “input.csv” that defines all the required information about the employee such as id, name, salary, start_date, dept. Import into R and do the following analysis.

a) Find the total number rows & columns
b) Find the maximum salary
c) Retrieve the details of the employee with maximum salary
d) Retrieve all the employees working in the IT Department.
e) Retrieve the employees in the IT Department whose salary is greater than 20000 and write these details into another file “output.csv”

10 Using the built in dataset mtcars which is a popular dataset consisting of the design and fuel consumption patterns of 32 different automobiles. The data was extracted from the 1974 Motor Trend US magazine, and comprises fuel consumption and 10 aspects of automobile design and performance for 32 automobiles (1973-74 models). Format A data frame with 32 observations on 11 variables : [1] mpg Miles/(US) gallon, [2] cyl Number of cylinders [3] disp Displacement (cu.in.), [4] hp Gross horsepower [5] drat Rear axle ratio,[6] wt Weight (lb/1000) [7] qsec 1/4 mile time, [8] vs V/S, [9] am Transmission (0 = automatic, 1 = manual), [10] gear Number of forward gears, [11] carb Number of carburetors

Develop R program, to solve the following:

a) What is the total number of observations and variables in the dataset?
b) Find the car with the largest hp and the least hp using suitable functions
c) Plot histogram / density for each variable and determine whether continuous variables are normally distributed or not. If not, what is their skewness?
d) What is the average difference of gross horse power(hp) between automobiles with 3 and 4 number of cylinders(cyl)? Also determine the difference in their standard deviations.
e) Which pair of variables has the highest Pearson correlation?

11	Demonstrate the progression of salary with years of experience using a suitable data set (You can create your own dataset). Plot the graph visualizing the best fit line on the plot of the given data points. Plot a curve of Actual Values vs. Predicted values to show their correlation and performance of the model. Interpret the meaning of the slope and y-intercept of the line with respect to the given data. Implement using lm function. Save the graphs and coefficients in files. Attach the predicted values of salaries as a new column to the original data set and save the data as a new CSV file.

Assessment Details (both CIE and SEE)

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CIE for the theory component of the IPCC (maximum marks 50)

- IPCC means practical portion integrated with the theory of the course.
- CIE marks for the theory component are **25 marks** and that for the practical component is **25 marks**.
- 25 marks for the theory component are split into **15 marks** for two Internal Assessment Tests (Two Tests, each of 15 Marks with 01-hour duration, are to be conducted) and **10 marks** for other assessment methods mentioned in 22OB4.2. The first test at the end of 40-50% coverage of the syllabus and the second test after covering 85-90% of the syllabus.
- Scaled-down marks of the sum of two tests and other assessment methods will be CIE marks for the theory component of IPCC (that is for **25 marks)**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the theory component of IPCC.

CIE for the practical component of the IPCC

- **15 marks** for the conduction of the experiment and preparation of laboratory record, and **10 marks** for the test to be conducted after the completion of all the laboratory sessions.
- On completion of every experiment/program in the laboratory, the students shall be evaluated including viva-voce and marks shall be awarded on the same day.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to **15 marks**.
- The laboratory test **(duration 02/03 hours)** after completion of all the experiments shall be conducted for 50 marks and scaled down to **10 marks.**
- Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **25 marks**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the practical component of the IPCC.

SEE for IPCC

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored by the student shall be proportionally scaled down to 50 Marks

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper may include questions from the practical component.

BSCK307 – Social Connect & Responsibility 2022 Scheme & syllabus for 3rd sem		Semester	3rd
Course Code	**BSCK307**	CIE Marks	**100**
Teaching Hours/Week (L:T:P: S)	0:0:3:1	SEE Marks	------
Total Hours of Pedagogy	40 hour Practical Session +15 hour Planning	Total Marks	**100**
Examination nature (No SEE – Only CIE)	For CIE Assessment - Activities Report Evaluation by College NSS Officer / HOD / Sports Dept / Any Dept.		
Credits	01 - Credit		

Course objectives: The course will enable the students to:

1. Provide a formal platform for students to communicate and connect to the surrounding.
2. create a responsible connection with the society.
3. Understand the community in general in which they work.
4. Identify the needs and problems of the community and involve them in problem –solving.
5. Develop among themselves a sense of social & civic responsibility & utilize their knowledge in finding practical solutions to individual and community problems.
6. Develop competence required for group-living and sharing of responsibilities & gain skills in mobilizing community participation to acquire leadership qualities and democratic attitudes.

General Instructions - Pedagogy :

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. In addition to the traditional lecture method, different types of innovative teaching methods may be adopted so that the activities will develop students' theoretical and applied social and cultural skills.
2. State the need for activities and its present relevance in the society and Provide real-life examples.
3. Support and guide the students for self-planned activities.
4. You will also be responsible for assigning homework, grading assignments and quizzes, and documenting students' progress in real activities in the field.
5. Encourage the students for group work to improve their creative and analytical skills.

Contents :

The course is mainly activity-based that will offer a set of activities for the student that enables them to connect with fellow human beings, nature, society, and the world at large.

The course will engage students for interactive sessions, open mic, reading group, storytelling sessions, and semester-long activities conducted by faculty mentors.

In the following a set of activities planned for the course have been listed:

Social Connect & Responsibility - Contents

Part I:

Plantation and adoption of a tree:

Plantation of a tree that will be adopted for four years by a group of BE / B.Tech students. (ONE STUDENT ONE TREE) They will also make an excerpt either as a documentary or a photo blog describing the plant's origin, its usage in daily life, its appearance in folklore and literature - – Objectives, Visit, case study, report, outcomes.

Part II :

Heritage walk and crafts corner:

Heritage tour, knowing the history and culture of the city, connecting to people around through their history, knowing the city and its craftsman, photo blog and documentary on evolution and practice of various craft forms - – Objectives,Visit, case study, report, outcomes.

Part III :

Organic farming and waste management:

Usefulness of organic farming, wet waste management in neighboring villages, and implementation in the campus –

Objectives,Visit, case study, report, outcomes.

Part IV:

Water conservation:

Knowing the present practices in the surrounding villages and implementation in the campus, documentary or photoblog presenting the current practices – Objectives, Visit, case study, report, outcomes.

Part V :

Food walk:

City's culinary practices, food lore, and indigenous materials of the region used in cooking – Objectives, Visit, case study, report, outcomes.

Course outcomes (Course Skill Set):

At the end of the course, the student will be able to:

CO1: Communicate and connect to the surrounding.

CO2: Create a responsible connection with the society.

CO3: Involve in the community in general in which they work.

CO4: Notice the needs and problems of the community and involve them in problem –solving.

CO5: Develop among themselves a sense of social & civic responsibility & utilize their knowledge in finding practical solutions to individual and community problems.

CO6: Develop competence required for group-living and sharing of responsibilities & gain skills in mobilizing community participation to acquire leadership qualities and democratic attitudes.

Activities:

Jamming session, open mic, and poetry: Platform to connect to others. Share the stories with others. Share the experience of Social Connect. Exhibit the talent like playing instruments, singing, one-act play, art-painting, and fine art.

PEDAGOGY:

The pedagogy will include interactive lectures, inspiring guest talks, field visits, social immersion, and a course project. Applying and synthesizing information from these sources to define the social problem to address and take up the solution as the course project, with your group. Social immersionwith NGOs/social sections will be a key part of the course. Will all lead to the course project that will address the needs of the social sector?

COURSE TOPICS:

The course will introduce social context and various players in the social space, and present approaches to discovering and understanding social needs. Social immersion and inspiring conversional will culminate in developing an actual, idea for problem-based intervention, based on an in-depth understanding of a key social problem.

Duration :

A total of 40 - 50 hrs engagement per semester is required for the 3rd semester of the B.E. /B.Tech. program. The students will be divided into groups. Each group will be handled by faculty mentor. Faculty mentor will design the activities (particularly Jamming sessions open mic ,and poetry) Faculty mentors has to design the evaluation system as per VTU guidelines of scheme & syllabus.

Guideline for Assessment Process:

Continuous Internal Evaluation (CIE):

After completion of the course, the student shall prepare, with daily diary as reference, a comprehensive report in consultation with the mentor/s to indicate what he has observed and learned in the social connect period. The report should be signed by the mentor. The report shall

be evaluated on the basis of the following criteria and/or other relevant criteria pertaining to the activity completed. Marks allotted for the diary are out of 50. Planning and scheduling the social connect Information/Data collected during the social connect Analysis of the information/data and report writing Considering all above points allotting the marks as mentioned below

Excellent : 80 to 100
Good : 60 to 79
Satisfactory : 40 to 59
Unsatisfactory and fail : <39

Special Note :

NO SEE – Semester End Exam – Completely Practical and activities based evaluation

Pedagogy – Guidelines :

It may differ depending on local resources available for the study as well as environment and climatic differences, location and time of execution.

Sl No	Topic	Group size	Location	Activity execution	Reporting	Evaluation Of the Topic
1.	**Plantation and adoption of a tree:**	May be individual or team	Farmers land/ parks / Villages / roadside/ community area / College campus etc…..	Site selection /proper consultation/Continuous monitoring/ Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics Of scheme and syllabus by Faculty
2.	**Heritage walk and crafts corner:**	May be individual or team	Temples / monumental places / Villages/ City Areas / Grama panchayat/ public associations/Government Schemes officers/ campus etc…..	Site selection /proper consultation/Continuous monitoring/ Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics Of scheme and syllabus by Faculty
3.	**Organic farming and waste management:**	May be individual or team	Farmers land / parks / Villages visits / roadside/ community area / College campus etc…..	Group selection / proper consultation / Continuous monitoring / Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics Of scheme and syllabus by Faculty
4.	**Water conservation:** & conservation techniques	May be individual or team	Villages/ City Areas / Grama panchayat/ public associations/Government Schemes officers / campus etc…..	site selection / proper consultation/Continuous monitoring/ Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics Of scheme and syllabus by Faculty
5.	**Food walk: Practices in society**	May be individual or team	Villages/ City Areas / Grama panchayat/ public associations/Government Schemes officers/ campus etc…..	Group selection / proper consultation / Continuous monitoring / Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics Of scheme and syllabus by Faculty

Plan of Action (Execution of Activities)

Sl.NO	Practice Session Description
1	**Lecture session in field to start activities**
2	**Students Presentation on Ideas**
3	**Commencement of activity and its progress**
4	**Execution of Activity**
5	**Execution of Activity**
6	**Execution of Activity**
7	**Execution of Activity**
8	**Case study based Assessment, Individual performance**
9	**Sector/ Team wise study and its consolidation**
10	**Video based seminar for 10 minutes by each student At the end of semester with Report.**

- Each student should do activities according to the scheme and syllabus.
- At the end of semester student performance has to be evaluated by the faculty for the assigned activity progress and its completion.
- At last consolidated report of all activities from 1st to 5th, compiled report should be submitted as per the instructions and scheme.

Assessment Details for CIE (both CIE and SEE)

Weightage	**CIE – 100%**	
Field Visit, Plan, Discussion	10 Marks	• Implementation strategies of the project (NSS work). • The last report should be signed by NSS Officer, the HOD and principal. • At last report should be evaluated by the NSS officer of the institute. • Finally the consolidated marks sheet should be sent to the university and also to be made available at LIC visit.
Commencement of activities and its progress	20 Marks	
Case study based Assessment Individual performance with report	20 Marks	
Sector wise study & its consolidation 5*5 = 25	25 Marks	
Video based seminar for 10 minutes by each student At the end of semester with Report. **Activities 1 to 5, 5*5 = 25**	25 Marks	
Total marks for the course in each semester	**100 Marks**	
For each activity, 20 marks CIE will be evaluated for IA marks at the end of semester, Report and assessment copy should be made available in the department.		
Students should present the progress of the activities as per the schedule in the prescribed practical session in the field. There should be positive progress in the vertical order for the benefit of society in general through activities.		

Data Analytics with Excel		Semester	3
Course Code	BCS358A	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	0:0:2:0	SEE Marks	50
Credits	01	Exam Hours	100
Examination type (SEE)	Practical		

Course objectives:

- To Apply analysis techniques to datasets in Excel
- Learn how to use Pivot Tables and Pivot Charts to streamline your workflow in Excel
- Understand and Identify the principles of data analysis
- Become adept at using Excel functions and techniques for analysis
- Build presentation ready dashboards in Excel

Sl.NO	Experiments
1	**Getting Started with Excel**: Creation of spread sheets, Insertion of rows and columns, Drag & Fill, use of Aggregate functions.
2	**Working with Data** : Importing data, Data Entry & Manipulation, Sorting & Filtering.
3	**Working with Data:** Data Validation, Pivot Tables & Pivot Charts.
4	**Data Analysis Process**: Conditional Formatting, What-If Analysis, Data Tables, Charts & Graphs.
5	**Cleaning Data with Text Functions**: use of UPPER and LOWER, TRIM function, Concatenate.
6	**Cleaning Data Containing Date and Time Values:** use of DATEVALUE function, DATEADD and DATEDIF, TIMEVALUE functions.
7	**Conditional Formatting**: formatting, parsing, and highlighting data in spreadsheets during data analysis.
8	**Working with Multiple Sheets**: work with multiple sheets within a workbook is crucial for organizing and managing data, perform complex calculations and create comprehensive reports.
9	Create worksheet with following fields: Empno, Ename, Basic Pay(BP), Travelling Allowance(TA), Dearness Allowance(DA), House Rent Allowance(HRA), Income Tax(IT), Provident Fund(PF), Net Pay(NP). Use appropriate formulas to calculate the above scenario. Analyse the data using appropriate chart and report the data.
10	Create worksheet on Inventory Management: Sheet should contain Product code, Product name, Product type, MRP, Cost after % of discount, Date of purchase. Use appropriate formulas to calculate the above scenario. Analyse the data using appropriate chart and report the data.

11	Create worksheet on Sales analysis of Merchandise Store: data consisting of Order ID, Customer ID, Gender, age, date of order, month, online platform, Category of product, size, quantity, amount, shipping city and other details. Use of formula to segregate different categories and perform a comparative study using pivot tables and different sort of charts.
12	Generation of report & presentation using Autofilter &macro.

Course outcomes (Course Skill Set):
At the end of the course the student will be able to:

- Use advanced functions and productivity tools to assist in developing worksheets.
- Manipulate data lists using Outline and PivotTables.
- Use Consolidation to summarise and report results from multiple worksheets.
- Apply Macros and Autofilter to solve the given real world scenario.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation (CIE):

CIE marks for the practical course are **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment is to be evaluated for conduction with an observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments are designed by the faculty who is handling the laboratory session and are made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled down to **30 marks** (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct a test of 100 marks after the completion of all the experiments listed in the syllabus.
- In a test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability.
- The marks scored shall be scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and marks of a test is the total CIE marks scored by the student.

Semester End Evaluation (SEE):

- SEE marks for the practical course are 50 Marks.
- SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the Head of the Institute.
- The examination schedule and names of examiners are informed to the university before the conduction of the examination. These practical examinations are to be conducted between the schedule mentioned in the academic calendar of the University.

- All laboratory experiments are to be included for practical examination.
- (Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.
- Students can pick one question (experiment) from the questions lot prepared by the examiners jointly.
- Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.

- General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)
- Change of experiment is allowed only once and 15% of Marks allotted to the procedure part are to be made zero.

The minimum duration of SEE is 02 hours

Suggested Learning Resources:

- **Berk & Carey** - Data Analysis with Microsoft® Excel: Updated for Offi ce 2007®, Third Edition, © 2010 Brooks/Cole, Cengage Learning, ISBN-13: 978-0-495-39178-4
- **Wayne L. Winston** - Microsoft Excel 2019: Data Analysis And Business Modeling, PHI, ISBN: 9789389347180
- **Aryan Gupta** - Data Analysis in Excel: The Best Guide. (https://www.simplilearn.com/tutorials/excel-tutorial/data-analysis-excel)

Ethics and Public Policy for AI

Ethics and Public Policy for AI		Semester	
Course Code	**BAI358B**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	**1:0:0**	SEE Marks	50
Total Hours of Pedagogy	14	Total Marks	100
Credits	03	Exam Hours	2
Examination type (SEE)	Theory		

Course objectives:

- ***To understand Ethical Framework for a Good AI Society, establishing Rules for trustworthy AI***
- ***To Designing ethics for good society***
- ***To familiar with Tools, methods and practices for designing AI for social good***
- ***To familiar with Innovation and future AI***
- ***To understand the Case Study: Ai in health care, knowing Regulation and Governance of AI ethics***

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. **Chalk and Talk**
2. **Real time Examples**
3. **Natural Approaches**

Module-1

An Ethical Framework for a Good AI Society: opportunities, Risks, principles and Recommendations.
Establishing the rules for building trustworthy AI

Textbook1: Chapter 3, chapter 4

Module-2

Translating principles into practices of digital ethics: five risks of being Unethical
The Ethics of Algorithms: Key problems and Solution
How to Design AI for Social Good: Seven Essential Factors

Textbook1: Chapter 6, Chapter 8, Chapter 9

Module-3

How to design AI for social good: seven essential factors
From What to How: An Initial Review of publicly available AI Ethics tools, Methods and Research to Translate principles into Practices

Textbook1: Chapter 9, Chapter 10

Module-4

Innovating with Confidence: Embedding AI Governance and fairness in financial Services Risk management framework,
What the near future of AI could be.

Textbook1: Chapter 20, chapter 22

Module-5

Human-AI Relationship, AI and Workforce, Autonomous Machines and Moral Decisions,
AI in HealthCare: balancing Progress and Ethics,

Regulation and Governance of AI Ethics

Textbook2 : Chapter 5,Chapter 8, Chapter 9

Course outcome (Course Skill Set)

At the end of the course, the student will be able to :

1. ***Describe Ethical Framework for a Good AI Society, establishing Rules for trustworthy AI***
2. ***Explain ethics for good society***
3. ***Illustrate various Tools, methods and practices for designing AI for social good***
4. ***Describe the Innovation and future AI***
5. ***Illustrate Regulation and Governance of AI ethics in Healthcare domain.***

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Books

1. "Ethics, governance and Policies in Artificial Intelligence", Author-Editor : Luciano Floridi, Springer, 1st Edition 2021, vol 144, Oxford Internet Institute, University of ixford, UK, ISSN 0921-8599, e-ISSN 2542-8349 Philosophical Studies series, ISBN 978-3-030-81906-4 e-ISBN 978-3-030-81907-1, ://doi.orghttps/10.1007/978-3-030-81907-1, 2021.
2. "Ethics and AI: Navigating the Moral Landscape of Digital Age", Author: Aaron Aboagye,

Project Management with Git		Semester	3
Course Code	**BCS358C**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	0: 0 : 2: 0	SEE Marks	50
Credits	01	Exam Marks	100
Examination type (SEE)	Practical		

Course objectives:

- .To familiar with basic command of Git
- To create and manage branches
- To understand how to collaborate and work with Remote Repositories
- To familiar with virion controlling commands

Sl.NO	Experiments
1	**Setting Up and Basic Commands** Initialize a new Git repository in a directory. Create a new file and add it to the staging area and commit the changes with an appropriate commit message.
2	**Creating and Managing Branches** Create a new branch named "feature-branch." Switch to the "master" branch. Merge the "feature-branch" into "master."
3	**Creating and Managing Branches** Write the commands to stash your changes, switch branches, and then apply the stashed changes.
4	**Collaboration and Remote Repositories** Clone a remote Git repository to your local machine.
5	**Collaboration and Remote Repositories** Fetch the latest changes from a remote repository and rebase your local branch onto the updated remote branch.
6	**Collaboration and Remote Repositories** Write the command to merge "feature-branch" into "master" while providing a custom commit message for the merge.
7	**Git Tags and Releases** Write the command to create a lightweight Git tag named "v1.0" for a commit in your local repository.
8	**Advanced Git Operations**

	Write the command to cherry-pick a range of commits from "source-branch" to the current branch.
9	**Analysing and Changing Git History** Given a commit ID, how would you use Git to view the details of that specific commit, including the author, date, and commit message?
10	**Analysing and Changing Git History** Write the command to list all commits made by the author "JohnDoe" between "2023-01-01" and "2023-12-31."
11	**Analysing and Changing Git History** Write the command to display the last five commits in the repository's history.
12	**Analysing and Changing Git History** Write the command to undo the changes introduced by the commit with the ID "abc123".

Course outcomes (Course Skill Set):
At the end of the course the student will be able to:

- Use the basics commands related to git repository
- Create and manage the branches
- Apply commands related to Collaboration and Remote Repositories
- Use the commands related to Git Tags, Releases and advanced git operations
- Analyse and change the git history

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation (CIE):

CIE marks for the practical course are **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment is to be evaluated for conduction with an observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments are designed by the faculty who is handling the laboratory session and are made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled down to **30 marks** (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct a test of 100 marks after the completion of all the experiments listed in the syllabus.
- In a test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability.
- The marks scored shall be scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and marks of a test is the total CIE marks scored by the student.

Semester End Evaluation (SEE):

- SEE marks for the practical course are 50 Marks.
- SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the Head of the Institute.
- The examination schedule and names of examiners are informed to the university before the conduction of the examination. These practical examinations are to be conducted between the schedule mentioned in the academic calendar of the University.

- All laboratory experiments are to be included for practical examination.
- (Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.
- Students can pick one question (experiment) from the questions lot prepared by the examiners jointly.
- Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.
- General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)
- Change of experiment is allowed only once and 15% of Marks allotted to the procedure part are to be made zero.

The minimum duration of SEE is 02 hours

Suggested Learning Resources:

- Version Control with Git, 3rd Edition, by Prem Kumar Ponuthorai, Jon Loeliger Released October 2022, Publisher(s): O'Reilly Media, Inc.
- Pro Git book, written by Scott Chacon and Ben Straub and published by Apress, https://git-scm.com/book/en/v2
- https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_0130944433473699842782_shared/overview
- https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_01330134712177459211926_shared/overview

PHP Programming		Semester	3
Course Code	BAI358D	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	0:0:2:0	SEE Marks	50
Credits	01	Exam Hours	02
Examination type (SEE)	Practical		

Course objectives:

- To introduce the PHP syntax, elements, and control structures
- To make use of PHP Functions and File handling
- To illustrate the concept of PHP arrays and OOPs

Sl.NO	Experiments
AIM: Introduction to HTML/PHP environment, PHP Data Types, Variables, Literals, and operators	
1	a. Develop a PHP program to calculate areas of Triangle and Rectangle. b. Develop a PHP program to calculate Compound Interest.
2	Demonstrating the various forms to concatenate multiple strings Develop program(s) to demonstrate concatenation of strings: (i) Strings represented with literals (single quote or double quote) (ii) Strings as variables (iii) Multiple strings represented with literals (single quote or double quote) and variables (iv) Strings and string variables containing single quotes as part string contents (v) Strings containing HTML segments having elements with attributes
3	a. Develop a PHP Program(s) to check given number is: (i) Odd or even (ii) Divisible by a given number (N) (iii) Square of a another number b. Develop a PHP Program to compute the roots of a quadratic equation by accepting the coefficients. Print the appropriate messages.
4	a. Develop a PHP program to find the square root of a number by using the newton's algorithm. b. Develop a PHP program to generate Floyd's triangle.
5	a. Develop a PHP application that reads a list of numbers and calculates mean and standard deviation. b. Develop a PHP application that reads scores between 0 and 100 (possibly including both 0 and 100) and creates a histogram array whose elements contain the number of scores between 0 and 9, 10 and 19, etc. The last "box" in the histogram should include scores between 90 and 100. Use a function to generate the histogram.
6	a. Develop PHP program to demonstrate the date() with different parameter options. b. Develop a PHP program to generate the Fibonacci series using a recursive function.
7	Develop a PHP program to accept the file and perform the following (i) Print the first N lines of a file (ii) Update/Add the content of a file
8	Develop a PHP program to read the content of the file and print the frequency of occurrence of the word accepted by the user in the file
9	Develop a PHP program to filter the elements of an array with key names. Sample Input Data: 1st array: ('c1' => 'Red', 'c2' => 'Green', 'c3' => 'White', c4 => 'Black') 2nd array: ('c2', 'c4')

	Output: Array ([c1] => Red [c3] => White)
10	Develop a PHP program that illustrates the concept of classes and objects by reading and printing employee data, including Emp_Name, Emp_ID, Emp_Dept, Emp_Salary, and Emp_DOJ.
11	a. Develop a PHP program to count the occurrences of Aadhaar numbers present in a text. b. Develop a PHP program to find the occurrences of a given pattern and replace them with a text.
12	Develop a PHP program to read the contents of a HTML form and display the contents on a browser.

NOTE: Necessary HTML elements (and CSS) can be used for designing the experiments.

Course outcomes (Course Skill Set):

At the end of the course, the student will be able to:

- Apply basic concepts of PHP to develop web program
- Develop programs in PHP involving control structures
- Develop programs to handle structured data (object) and data items (array)
- Develop programs to access and manipulate contents of files
- Use super-global arrays and regular expressions to solve real world problems.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation (CIE):

CIE marks for the practical course are **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment is to be evaluated for conduction with an observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments are designed by the faculty who is handling the laboratory session and are made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled down to **30 marks** (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct a test of 100 marks after the completion of all the experiments listed in the syllabus.
- In a test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability.
- The marks scored shall be scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and marks of a test is the total CIE marks scored by the student.

Semester End Evaluation (SEE):

- SEE marks for the practical course are 50 Marks.
- SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the Head of the Institute.
- The examination schedule and names of examiners are informed to the university before the conduction of the examination. These practical examinations are to be conducted between the schedule mentioned in the academic calendar of the University.
- All laboratory experiments are to be included for practical examination.
- (Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.

- Students can pick one question (experiment) from the questions lot prepared by the examiners jointly.
- Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.
- General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)
- Change of experiment is allowed only once and 15% of Marks allotted to the procedure part are to be made zero.

The minimum duration of SEE is 02 hours

Suggested Learning Resources:

- BOOK: Programming in HTML and PHP (Coding for Scientists and Engineers, BY DEVID R BROOKS, Springer International Publishing AG 2017
- PHP TUTORIALS: [https://www.w3schools.com/php/}
- PHP TUTORIALS: [https://www.tutorialspoint.com/php/index.htm]
- HTML TUTORIALS: [https://www.w3schools.com/html/]

	Mathematics for Computer Science		Semester	3
	Course Code	**BCS301**	CIE Marks	50
	Teaching Hours/Week (L: T:P: S)	3:2:0:0	SEE Marks	50
	Total Hours of Pedagogy	40 hours Theory + 20 Hours Tutorial	Total Marks	100
	Credits	04	Exam Hours	3
	Examination type (SEE)	**Theory**		

Course objectives: This course will enable the students to:

1. To introduce the concept of random variables, probability distributions, specific discrete and continuous distributions with practical application in Computer Science Engineering and social life situations.
2. To Provide the principles of statistical inferences and the basics of hypothesis testing with emphasis on some commonly encountered hypotheses.
3. To Determine whether an input has a statistically significant effect on the system's response through ANOVA testing.

Teaching-Learning Process

Pedagogy (General Instructions):

Teachers can use the following strategies to accelerate the attainment of the various course outcomes.

1. In addition to the traditional lecture method, different types of innovative teaching methods may be adopted so that the delivered lessons shall develop students' theoretical and applied Mathematical skills.
2. State the need for Mathematics with Engineering Studies and Provide real-life examples.
3. Support and guide the students for self–study.
4. You will assign homework, grading assignments and quizzes, and documenting students' progress.
5. Encourage the students to group learning to improve their creative and analytical skills.
6. Show short related video lectures in the following ways:
   - As an introduction to new topics (pre-lecture activity).
   - As a revision of topics (post-lecture activity).
   - As additional examples (post-lecture activity).
   - As an additional material of challenging topics (pre-and post-lecture activity).
   - As a model solution of some exercises (post-lecture activity).

Module-1: Probability Distributions

Probability Distributions: Review of basic probability theory. Random variables (discrete and continuous), probability mass and density functions. Mathematical expectation, mean and variance. Binomial, Poisson and normal distributions- problems (derivations for mean and standard deviation for Binomial and Poisson distributions only)-Illustrative examples. Exponential distribution. **(12 Hours)**

(RBT Levels: L1, L2 and L3)

Pedagogy	Chalk and Board, Problem-based learning

Module-2: Joint probability distribution & Markov Chain

	Joint probability distribution: Joint Probability distribution for two discrete random variables, expectation, covariance and correlation. **Markov Chain:** Introduction to Stochastic Process, Probability Vectors, Stochastic matrices, Regular stochastic matrices, Markov chains, Higher transition probabilities, Stationary distribution of Regular Markov chains and absorbing states. **(12 Hours)** **(RBT Levels: L1, L2 and L3)**
	Pedagogy — Chalk and Board, Problem-based learning
	Module-3: Statistical Inference 1
	Introduction, sampling distribution, standard error, testing of hypothesis, levels of significance, test of significances, confidence limits, simple sampling of attributes, test of significance for large samples, comparison of large samples. **(12 Hours)** **(RBT Levels: L1, L2 and L3)**
	Pedagogy — Chalk and Board, Problem-based learning
	Module-4: Statistical Inference 2
	Sampling variables, central limit theorem and confidences limit for unknown mean. Test of Significance for means of two small samples, students 't' distribution, Chi-square distribution as a test of goodness of fit. F-Distribution. **(12 Hours)** **(RBT Levels: L1, L2 and L3)**
	Pedagogy — Chalk and Board, Problem-based learning
	Module-5: Design of Experiments & ANOVA
	Principles of experimentation in design, Analysis of completely randomized design, randomized block design. The ANOVA Technique, Basic Principle of ANOVA, One-way ANOVA, Two-way ANOVA, Latin-square Design, and Analysis of Co-Variance. **(12 Hours)** **(RBT Levels: L1, L2 and L3)**
	Pedagogy — Chalk and Board, Problem-based learning

Course outcome (Course Skill Set)

At the end of the course, the student will be able to:

1. Explain the basic concepts of probability, random variables, probability distribution
2. Apply suitable probability distribution models for the given scenario.
3. Apply the notion of a discrete-time Markov chain and n-step transition probabilities to solve the given problem
4. Use statistical methodology and tools in the engineering problem-solving process.
5. Compute the confidence intervals for the mean of the population.
6. Apply the ANOVA test related to engineering problems.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment

Test component, there are 25 marks.

- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by the University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.

Marks scored shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Textbooks:

1. **Ronald E. Walpole, Raymond H Myers, Sharon L Myers & Keying Ye** "Probability & Statistics for Engineers & Scientists", Pearson Education, 9th edition, 2017.
2. **Peter Bruce, Andrew Bruce & Peter Gedeck** "Practical Statistics for Data Scientists" O'Reilly Media, Inc., 2nd edition **2020.**

Reference Books: (Name of the author/Title of the Book/ Name of the publisher/Edition and Year)

1. **Erwin Kreyszig**, "Advanced Engineering Mathematics", John Wiley & Sons, 9th Edition, 2006.
2. **B. S. Grewal** "Higher Engineering Mathematics", Khanna publishers, 44th Ed., 2021.
3. **G Haribaskaran** "Probability, Queuing Theory & Reliability Engineering", Laxmi Publication, Latest Edition, 2006
4. **Irwin Miller & Marylees Miller,** John E. Freund's "Mathematical Statistics with Applications" Pearson. Dorling Kindersley Pvt. Ltd. India, 8th edition, 2014.
5. **S C Gupta and V K Kapoor**, "Fundamentals of Mathematical Statistics", S Chand and Company, Latest edition.
6. **Robert V. Hogg, Joseph W. McKean & Allen T. Craig**. "Introduction to Mathematical Statistics", Pearson Education 7th edition, 2013.
7. **Jim Pitman**. Probability, Springer-Verlag, 1993.
8. **Sheldon M. Ross,** "Introduction to Probability Models" 11th edition. Elsevier, 2014.
9. **A. M. Yaglom and I. M. Yaglom**, "Probability and Information". D. Reidel Publishing Company. Distributed by Hindustan Publishing Corporation (India) Delhi, 1983.
10. **P. G. Hoel, S. C. Port and C. J. Stone**, "Introduction to Probability Theory", Universal Book Stall, (Reprint), 2003.
11. **S. Ross**, "A First Course in Probability", Pearson Education India, 6th Ed., 2002.
12. **W. Feller**, "An Introduction to Probability Theory and its Applications", Vol. 1, Wiley, 3rd

Ed., 1968.
13. **N.P. Bali and Manish Goyal**, A Textbook of Engineering Mathematics, Laxmi Publications, Reprint, 2010.
14. **Veerarajan T**, Engineering Mathematics (for semester III), Tata McGraw-Hill, New Delhi, 2010

Web links and Video Lectures (e-Resources):

http://nptel.ac.in/courses.php?disciplineID=111
http://www.class-central.com/subject/math(MOOCs)
http://academicearth.org/
http://www.bookstreet.in.
VTU EDUSAT PROGRAMME – 20
VTU e-Shikshana Program

Activity-Based Learning (Suggested Activities in Class)/Practical-Based Learning

- Programming Assignment
- Seminars

Digital Design and Computer Organization		Semester	3
Course Code	BCS302	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:2:0	SEE Marks	50
Total Hours of Pedagogy	40 hours Theory + 20 Hours of Practicals	Total Marks	100
Credits	04	Exam Hours	3
Examination nature (SEE)	Theory		

Course objectives:

- To demonstrate the functionalities of binary logic system
- To explain the working of combinational and sequential logic system
- To realize the basic structure of computer system
- To illustrate the working of I/O operations and processing unit

Teaching-Learning Process (General Instructions)

These are sample Strategies; that teachers can use to accelerate the attainment of the various course outcomes.

1. Chalk and Talk
2. Live Demo with experiments
3. Power point presentation

MODULE-1 **8 Hr**

Introduction to Digital Design: Binary Logic, Basic Theorems And Properties Of Boolean Algebra, Boolean Functions, Digital Logic Gates, Introduction, The Map Method, Four-Variable Map, Don't-Care Conditions, NAND and NOR Implementation, Other Hardware Description Language – Verilog Model of a simple circuit.

Text book 1: 1.9, 2.4, 2.5, 2.8, 3.1, 3.2, 3.3, 3.5, 3.6, 3.9

MODULE-2 **8 Hr**

Combinational Logic: Introduction, Combinational Circuits, Design Procedure, Binary Adder- Subtractor, Decoders, Encoders, Multiplexers. HDL Models of Combinational Circuits – Adder, Multiplexer, Encoder. **Sequential Logic**: Introduction, Sequential Circuits, Storage Elements: Latches, Flip-Flops.

Text book 1: 4.1, 4.2, 4.4, 4.5, 4.9, 4.10, 4.11, 4.12, 5.1, 5.2, 5.3, 5.4.

MODULE-3 **8 Hr**

Basic Structure of Computers: Functional Units, Basic Operational Concepts, Bus structure, Performance – Processor Clock, Basic Performance Equation, Clock Rate, Performance Measurement.**Machine Instructions and Programs:** Memory Location and Addresses, Memory Operations, Instruction and Instruction sequencing, Addressing Modes.

Text book 2: 1.2, 1.3, 1.4, 1.6, 2.2, 2.3, 2.4, 2.5

MODULE-4 **8 Hr**

Input/output Organization: Accessing I/O Devices, Interrupts – Interrupt Hardware, Enabling and Disabling Interrupts, Handling Multiple Devices, Direct Memory Access: Bus Arbitration, Speed, size and Cost of memory systems. Cache Memories – Mapping Functions.

Text book 2: 4.1, 4.2.1, 4.2.2, 4.2.3, 4.4, 5.4, 5.5.1

MODULE-5 **8 Hr**

Basic Processing Unit: Some Fundamental Concepts: Register Transfers, Performing ALU operations, fetching a word from Memory, Storing a word in memory. Execution of a Complete Instruction. **Pipelining:** Basic concepts, Role of Cache memory, Pipeline Performance.

Text book 2: 7.1, 7.2, 8.1

PRACTICAL COMPONENT OF IPCC

Sl.NO	Experiments Simulation packages preferred: Multisim, Modelsim, PSpice or any other relevant
1	Given a 4-variable logic expression, simplify it using appropriate technique and simulate the same using basic gates.
2	Design a 4 bit full adder and subtractor and simulate the same using basic gates.
3	Design Verilog HDL to implement simple circuits using structural, Data flow and Behavioural model.
4	Design Verilog HDL to implement Binary Adder-Subtractor – Half and Full Adder, Half and Full Subtractor.
5	Design Verilog HDL to implement Decimal adder.
6	Design Verilog program to implement Different types of multiplexer like 2:1, 4:1 and 8:1.
7	Design Verilog program to implement types of De-Multiplexer.
8	Design Verilog program for implementing various types of Flip-Flops such as SR, JK and D.

Course outcomes (Course Skill Set):

At the end of the course, the student will be able to:

CO1: Apply the K–Map techniques to simplify various Boolean expressions.

CO2: Design different types of combinational and sequential circuits along with Verilog programs.

CO3: Describe the fundamentals of machine instructions, addressing modes and Processor performance.

CO4: Explain the approaches involved in achieving communication between processor and I/O devices.

CO5:Analyze internal Organization of Memory and Impact of cache/Pipelining on Processor Performance.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

CIE for the theory component of the IPCC (maximum marks 50)

- IPCC means practical portion integrated with the theory of the course.
- CIE marks for the theory component are **25 marks** and that for the practical component is **25 marks**.
- 25 marks for the theory component are split into **15 marks** for two Internal Assessment Tests (Two Tests, each of 15 Marks with 01-hour duration, are to be conducted) and **10 marks** for other

assessment methods mentioned in 22OB4.2. The first test at the end of 40-50% coverage of the syllabus and the second test after covering 85-90% of the syllabus.

- Scaled-down marks of the sum of two tests and other assessment methods will be CIE marks for the theory component of IPCC (that is for **25 marks)**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the theory component of IPCC.

CIE for the practical component of the IPCC

- **15 marks** for the conduction of the experiment and preparation of laboratory record, and **10 marks** for the test to be conducted after the completion of all the laboratory sessions.
- On completion of every experiment/program in the laboratory, the students shall be evaluated including viva-voce and marks shall be awarded on the same day.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to **15 marks**.
- The laboratory test **(duration 02/03 hours)** after completion of all the experiments shall be conducted for 50 marks and scaled down to **10 marks.**
- Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **25 marks**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the practical component of the IPCC.

SEE for IPCC

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored by the student shall be proportionally scaled down to 50 Marks

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper may include questions from the practical component.

Suggested Learning Resources:

Books

1. M. Morris Mano & Michael D. Ciletti, Digital Design With an Introduction to Verilog Design, 5e, Pearson Education.

2. Carl Hamacher, ZvonkoVranesic, SafwatZaky, Computer Organization, 5^{th} Edition, Tata McGraw Hill.

Web links and Video Lectures (e-Resources):

https://cse11-iiith.vlabs.ac.in/

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

Assign the group task to Design the various types of counters and display the output accordingly

Assessment Methods

- Lab Assessment (25 Marks)
- GATE Based Aptitude Test

OPERATING SYSTEMS		Semester	3
Course Code	BCS303	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:2:0	SEE Marks	50
Total Hours of Pedagogy	40 hours Theory + 20 hours practicals	Total Marks	100
Credits	04	Exam Hours	3
Examination nature (SEE)	**Theory**		

Course objectives:

- To Demonstrate the need for OS and different types of OS
- To discuss suitable techniques for management of different resources
- To demonstrate different APIs/Commands related to processor, memory, storage and file system management.

Teaching-Learning Process (General Instructions)

Teachers can use the following strategies to accelerate the attainment of the various course outcomes.

1. Lecturer methods (L) need not to be only traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.
5. Role play for process scheduling.
6. Demonstrate the installation of any one Linux OS on VMware/Virtual Box

MODULE-1 **8 Hours**

Introduction to operating systems, System structures: What operating systems do; Computer System organization; Computer System architecture; Operating System structure; Operating System operations; Process management; Memory management; Storage management; Protection and Security; Distributed system; Special-purpose systems; Computing environments.

Operating System Services: User - Operating System interface; System calls; Types of system calls; System programs; Operating system design and implementation; Operating System structure; Virtual machines; Operating System debugging, Operating System generation; System boot.

Textbook 1: Chapter – 1 (1.1-1.12), 2 (2.2-2.11)

MODULE-2 **8 Hours**

Process Management: Process concept; Process scheduling; Operations on processes; Inter process communication

Multi-threaded Programming: Overview; Multithreading models; Thread Libraries; Threading issues.

Process Scheduling: Basic concepts; Scheduling Criteria; Scheduling Algorithms; Thread scheduling; Multiple-processor scheduling,

Textbook 1: Chapter – 3 (3.1-3.4), 4 (4.1-4.4), 5 (5.1 -5.5)

MODULE-3 **8 Hours**

Process Synchronization: Synchronization: The critical section problem; Peterson's solution; Synchronization hardware; Semaphores; Classical problems of synchronization;

Deadlocks: System model; Deadlock characterization; Methods for handling deadlocks; Deadlock prevention; Deadlock avoidance; Deadlock detection and recovery from deadlock.

Textbook 1: Chapter – 6 (6.1-6.6), 7 (7.1 -7.7)

MODULE-4	8 Hours

Memory Management: Memory management strategies: Background; Swapping; Contiguous memory allocation; Paging; Structure of page table; Segmentation.

Virtual Memory Management: Background; Demand paging; Copy-on-write; Page replacement; Allocation of frames; Thrashing.

Textbook 1: Chapter -8 (8.1-8.6), 9 (9.1-9.6)

MODULE-5	8 Hours

File System, Implementation of File System: File system: File concept; Access methods; Directory and Disk structure; File system mounting; File sharing; **Implementing File system:** File system structure; File system implementation; Directory implementation; Allocation methods; Free space management.

Secondary Storage Structure, Protection: Mass storage structures; Disk structure; Disk attachment; Disk scheduling; Disk management; **Protection**: Goals of protection, Principles of protection, Domain of protection, Access matrix.

Textbook 1: Chapter – 10 (10.1-10.5) ,11 (11.1-11.5),12 (12.1-12.5), 14 (14.1-14.4)

PRACTICAL COMPONENT OF IPCC *(May cover all / major modules)*

Sl.NO	Experiments
1	Develop a c program to implement the Process system calls (fork (), exec(), wait(), create process, terminate process)
2	Simulate the following CPU scheduling algorithms to find turnaround time and waiting time a) FCFS b) SJF c) Round Robin d) Priority.
3	Develop a C program to simulate producer-consumer problem using semaphores.
4	Develop a C program which demonstrates interprocess communication between a reader process and a writer process. Use mkfifo, open, read, write and close APIs in your program.
5	Develop a C program to simulate Bankers Algorithm for DeadLock Avoidance.
6	Develop a C program to simulate the following contiguous memory allocation Techniques: a) Worst fit b) Best fit c) First fit.
7	Develop a C program to simulate page replacement algorithms: a) FIFO b) LRU
8	Simulate following File Organization Techniques a) Single level directory b) Two level directory
9	Develop a C program to simulate the Linked file allocation strategies.
10	Develop a C program to simulate SCAN disk scheduling algorithm.

Course outcomes (Course Skill Set):

At the end of the course, the student will be able to:

CO 1. Explain the structure and functionality of operating system

CO 2. Apply appropriate CPU scheduling algorithms for the given problem.

CO 3. Analyse the various techniques for process synchronization and deadlock handling.

CO 4. Apply the various techniques for memory management

CO 5. Explain file and secondary storage management strategies.

CO 6. Describe the need for information protection mechanisms

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

CIE for the theory component of the IPCC (maximum marks 50)

- IPCC means practical portion integrated with the theory of the course.
- CIE marks for the theory component are **25 marks** and that for the practical component is **25 marks**.
- 25 marks for the theory component are split into **15 marks** for two Internal Assessment Tests (Two Tests, each of 15 Marks with 01-hour duration, are to be conducted) and **10 marks** for other assessment methods

mentioned in 22OB4.2. The first test at the end of 40-50% coverage of the syllabus and the second test after covering 85-90% of the syllabus.

- Scaled-down marks of the sum of two tests and other assessment methods will be CIE marks for the theory component of IPCC (that is for **25 marks**).
- The student has to secure 40% of 25 marks to qualify in the CIE of the theory component of IPCC.

CIE for the practical component of the IPCC

- **15 marks** for the conduction of the experiment and preparation of laboratory record, and **10 marks** for the test to be conducted after the completion of all the laboratory sessions.
- On completion of every experiment/program in the laboratory, the students shall be evaluated including viva-voce and marks shall be awarded on the same day.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to **15 marks**.
- The laboratory test **(duration 02/03 hours)** after completion of all the experiments shall be conducted for 50 marks and scaled down to **10 marks.**
- Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **25 marks**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the practical component of the IPCC.

SEE for IPCC

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scoredby the student shall be proportionally scaled down to 50 Marks

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper may include questions from the practical component.

Suggested Learning Resources:

Textbooks

1. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, Operating System Principles 8th edition, Wiley-India, 2015

Reference Books

1. Ann McHoes Ida M Fylnn, Understanding Operating System, Cengage Learning, 6th Edition
2. D.M Dhamdhere, Operating Systems: A Concept Based Approach 3rd Ed, McGraw- Hill, 2013.
3. P.C.P. Bhatt, An Introduction to Operating Systems: Concepts and Practice 4th Edition, PHI(EEE), 2014.
4. William Stallings Operating Systems: Internals and Design Principles, 6th Edition, Pearson.

Web links and Video Lectures (e-Resources):

1. https://youtu.be/mXw9ruZaxzQ

2. https://youtu.be/vBURTt97EkA
3. https://www.youtube.com/watch?v=783KAB-tuE4&list=PLIemF3uozcAKTgsCIj82voMK3TMR0YE_f
4. https://www.youtube.com/watch?v=3-ITLMMeeXY&list=PL3pGy4HtqwD0n7bQfHjPnsWzkeRn6mkO

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Assessment Methods
  - Case Study on Unix Based Systems (10 Marks)
  - Lab Assessment (25 Marks)

DATA STRUCTURES AND APPLICATIONS		Semester	3
Course Code	BCS304	CIE Marks	50
Teaching Hours/Week (L: T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	3
Examination type (SEE)	Theory		

Course objectives:

CLO 1. To explain fundamentals of data structures and their applications.
CLO 2. To illustrate representation of Different data structures such as Stack, Queues, Linked Lists, Trees and Graphs.
CLO 3. To Design and Develop Solutions to problems using Linear Data Structures
CLO 4. To discuss applications of Nonlinear Data Structures in problem solving.
CLO 5. To introduce advanced Data structure concepts such as Hashing and Optimal Binary Search Trees

Teaching-Learning Process (General Instructions)

Teachers can use following strategies to accelerate the attainment of the various course outcomes.

1. Chalk and Talk with Black Board
2. ICT based Teaching
3. Demonstration based Teaching

Module-1 **8Hours**

INTRODUCTION TO DATA STRUCTURES: Data Structures, Classifications (Primitive & Non-Primitive), Data structure Operations
Review of pointers and dynamic Memory Allocation,
ARRAYS and STRUCTURES: Arrays, Dynamic Allocated Arrays, Structures and Unions, Polynomials, Sparse Matrices, representation of Multidimensional Arrays, Strings
STACKS: Stacks, Stacks Using Dynamic Arrays, Evaluation and conversion of Expressions
Text Book: Chapter-1:1.2 Chapter-2: 2.1 to 2.7 Chapter-3: 3.1,3.2,3.6
Reference Book 1: 1.1 to 1.4

Module-2 **8Hours**

QUEUES: Queues, Circular Queues, Using Dynamic Arrays, Multiple Stacks and queues.
LINKED LISTS : Singly Linked, Lists and Chains, Representing Chains in C, Linked Stacks and Queues, Polynomials
Text Book: Chapter-3: 3.3, 3.4, 3.7 Chapter-4: 4.1 to 4.4

Module-3 **8Hours**

LINKED LISTS : Additional List Operations, Sparse Matrices, Doubly Linked List.
TREES: Introduction, Binary Trees, Binary Tree Traversals, Threaded Binary Trees.
Text Book: Chapter-4: 4.5,4.7,4.8 Chapter-5: 5.1 to 5.3, 5.5

Module-4 **8Hours**

TREES(Cont..): Binary Search trees, Selection Trees, Forests, Representation of Disjoint sets, Counting Binary Trees,
GRAPHS: The Graph Abstract Data Types, Elementary Graph Operations
Text Book: Chapter-5: 5.7 to 5.11 Chapter-6: 6.1, 6.2

Module-5 **8Hours**

HASHING: Introduction, Static Hashing, Dynamic Hashing
PRIORITY QUEUES: Single and double ended Priority Queues, Leftist Trees
INTRODUCTION TO EFFICIENT BINARY SEARCH TREES: Optimal Binary Search Trees
Text Book: Chapter 8: 8.1 to 8.3 Chapter 9: 9.1, 9.2 Chapter 10: 10.1

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

CO 1. Explain different data structures and their applications.
CO 2. Apply Arrays, Stacks and Queue data structures to solve the given problems.
CO 3. Use the concept of linked list in problem solving.
CO 4. Develop solutions using trees and graphs to model the real-world problem.
CO 5. Explain the advanced Data Structures concepts such as Hashing Techniques and Optimal Binary Search Trees.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Textbook:

1. Ellis Horowitz, Sartaj Sahni and Susan Anderson-Freed, Fundamentals of Data Structures in C, 2^{nd} Ed, Universities Press, 2014

Reference Books:

1. Seymour Lipschutz, Data Structures Schaum's Outlines, Revised 1st Ed, McGraw Hill, 2014.
2. Gilberg & Forouzan, Data Structures: A Pseudo-code approach with C, 2nd Ed, Cengage Learning,2014.
3. Reema Thareja, Data Structures using C, 3rd Ed, Oxford press, 2012.
4. Jean-Paul Tremblay & Paul G. Sorenson, An Introduction to Data Structures with Applications, 2nd Ed, McGraw Hill, 2013
5. A M Tenenbaum, Data Structures using C, PHI, 1989
6. Robert Kruse, Data Structures and Program Design in C, 2nd Ed, PHI, 1996.

Web links and Video Lectures (e-Resources):

- http://elearning.vtu.ac.in/econtent/courses/video/CSE/06CS35.html
- https://nptel.ac.in/courses/106/105/106105171/
- http://www.nptelvideos.in/2012/11/data-structures-and-algorithms.html
- https://www.youtube.com/watch?v=3Xo6P_V-qns&t=201s
- https://ds2-iiith.vlabs.ac.in/exp/selection-sort/index.html
- https://nptel.ac.in/courses/106/102/106102064/
- https://ds1-iiith.vlabs.ac.in/exp/stacks-queues/index.html
- https://ds1-iiith.vlabs.ac.in/exp/linked-list/basics/overview.html
- https://ds1-iiith.vlabs.ac.in/List%20of%20experiments.html
- https://ds1-iiith.vlabs.ac.in/exp/tree-traversal/index.html
- https://ds1-iiith.vlabs.ac.in/exp/tree-traversal/depth-first-traversal/dft-practice.html
- https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_013501595428077568125 59/overview

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Role Play
- Flipped classroom
- Assessment Methods for 25 Marks (opt two Learning Activities)
  - Case Study
  - Programming Assignment
  - Gate Based Aptitude Test
  - MOOC Assignment for selected Module

DATA STRUCTURES LABORATORY
SEMESTER – III

Course Code	**BCSL305**	**CIE Marks**	50
Number of Contact Hours/Week	0:0:2	**SEE Marks**	50
Total Number of Lab Contact Hours	28	**Exam Hours**	03

Credits – 1

Course Learning Objectives:

This laboratory course enables students to get practical experience in design, develop, implement, analyze and evaluation/testing of

- Dynamic memory management
- Linear data structures and their applications such as stacks, queues and lists
- Non-Linear data structures and their applications such as trees and graphs

Descriptions (if any):

- Implement all the programs in "C " Programming Language and Linux OS.

Programs List:

1.	Develop a Program in C for the following: a) Declare a calendar as an array of 7 elements (A dynamically Created array) to represent 7 days of a week. Each Element of the array is a structure having three fields. The first field is the name of the Day (A dynamically allocated String), The second field is the date of the Day (A integer), the third field is the description of the activity for a particular day (A dynamically allocated String). b) Write functions create(), read() and display(); to create the calendar, to read the data from the keyboard and to print weeks activity details report on screen.
2.	Develop a Program in C for the following operations on Strings. a. Read a main String (STR), a Pattern String (PAT) and a Replace String (REP) b. Perform Pattern Matching Operation: Find and Replace all occurrences of PAT in STR with REP if PAT exists in STR. Report suitable messages in case PAT does not exist in STR Support the program with functions for each of the above operations. Don't use Built-in functions.
3.	Develop a menu driven Program in C for the following operations on STACK of Integers (Array Implementation of Stack with maximum size MAX) a. Push an Element on to Stack b. Pop an Element from Stack c. Demonstrate how Stack can be used to check Palindrome d. Demonstrate Overflow and Underflow situations on Stack e. Display the status of Stack f. Exit Support the program with appropriate functions for each of the above operations

4.	Develop a Program in C for converting an Infix Expression to Postfix Expression. Program should support for both parenthesized and free parenthesized expressions with the operators: +, -, *, /, % (Remainder), ^ (Power) and alphanumeric operands.
5.	Develop a Program in C for the following Stack Applications a. Evaluation of Suffix expression with single digit operands and operators: +, -, *, /, %, ^ b. Solving Tower of Hanoi problem with n disks

6.	Develop a menu driven Program in C for the following operations on Circular QUEUE of Characters (Array Implementation of Queue with maximum size MAX) a. Insert an Element on to Circular QUEUE b. Delete an Element from Circular QUEUE c. Demonstrate Overflow and Underflow situations on Circular QUEUE d. Display the status of Circular QUEUE e. Exit Support the program with appropriate functions for each of the above operations
7.	Develop a menu driven Program in C for the following operations on Singly Linked List (SLL) of Student Data with the fields: *USN, Name, Programme, Sem, PhNo* a. Create a SLL of N Students Data by using *front insertion*. b. Display the status of SLL and count the number of nodes in it c. Perform Insertion / Deletion at End of SLL d. Perform Insertion / Deletion at Front of SLL(Demonstration of stack) e. Exit
8.	Develop a menu driven Program in C for the following operations on Doubly Linked List (DLL) of Employee Data with the fields: *SSN, Name, Dept, Designation, Sal, PhNo* a. Create a DLL of N Employees Data by using *end insertion*. b. Display the status of DLL and count the number of nodes in it c. Perform Insertion and Deletion at End of DLL d. Perform Insertion and Deletion at Front of DLL e. Demonstrate how this DLL can be used as Double Ended Queue. f. Exit
9.	Develop a Program in C for the following operationson Singly Circular Linked List (SCLL) with header nodes a. Represent and Evaluate a Polynomial $P(x,y,z) = 6x^2y^2z-4yz^5+3x^3yz+2xy^5z-2xyz^3$ b. Find the sum of two polynomials POLY1(x,y,z) and POLY2(x,y,z) and store the result in POLYSUM(x,y,z) Support the program with appropriate functions for each of the above operations
10.	Develop a menu driven Program in C for the following operations on Binary Search Tree (BST) of Integers . a. Create a BST of N Integers: 6, 9, 5, 2, 8, 15, 24, 14, 7, 8, 5, 2 b. Traverse the BST in Inorder, Preorder and Post Order c. Search the BST for a given element (KEY) and report the appropriate message d. Exit
11.	Develop a Program in C for the following operations on Graph(G) of Cities a. Create a Graph of N cities using Adjacency Matrix. b. Print all the nodes reachable from a given starting node in a digraph using DFS/BFS method

12.	Given a File of N employee records with a set K of Keys (4-digit) which uniquely determine the records in file F. Assume that file F is maintained in memory by a Hash Table (HT) of m memory locations with L as the set of memory addresses (2-digit) of locations in HT. Let the keys in K and addresses in L are Integers. Develop a Program in C that uses Hash function H: K →L as H(K)=K mod m (remainder method), and implement hashing technique to map a given key K to the address space L. Resolve the collision (if any) using linear probing.

Laboratory Outcomes: The student should be able to:

- Analyze various linear and non-linear data structures
- Demonstrate the working nature of different types of data structures and their applications
- Use appropriate searching and sorting algorithms for the give scenario.
- Apply the appropriate data structure for solving real world problems

Conduct of Practical Examination:

- Experiment distribution
  - For laboratories having only one part: Students are allowed to pick one experiment from the lot with equal opportunity.
  - For laboratories having PART A and PART B: Students are allowed to pick one experiment from PART A and one experiment from PART B, with equal opportunity.
- Change of experiment is allowed only once and marks allotted for procedure to be made zero of the changed part only.
- Marks Distribution *(Need to change in accordance with university regulations)*

  c) For laboratories having only one part – Procedure + Execution + Viva-Voce: 15+70+15 = 100 Marks

  d) For laboratories having PART A and PART B

     i. Part A – Procedure + Execution + Viva = 6 + 28 + 6 = 40 Marks

     ii. Part B – Procedure + Execution + Viva = 9 + 42 + 9 = 60 Marks

Object Oriented Programming with JAVA		Semester	3
Course Code	BCS306A	CIE Marks	50
Teaching Hours/Week (L: T:P: S)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	28 Hours of Theory + 20 Hours of Practical	Total Marks	100
Credits	03	Exam Hours	03
Examination type (SEE)	Theory		

Note - Students who have undergone " Basics of Java Programming-BPLCK105C/205C" in first year are not eligible to opt this course

Course objectives:

- To learn primitive constructs JAVA programming language.
- To understand Object Oriented Programming Features of JAVA.
- To gain knowledge on: packages, multithreaded programing and exceptions.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes and make Teaching –Learning more effective

1. Use Online Java Compiler IDE: https://www.jdoodle.com/online-java-compiler/ or any other.
2. Demonstration of programing examples.
3. Chalk and board, power point presentations
4. Online material (Tutorials) and video lectures.

Module-1

An Overview of Java: Object-Oriented Programming (Two Paradigms, Abstraction, The Three OOP Principles), Using Blocks of Code, Lexical Issues (Whitespace, Identifiers, Literals, Comments, Separators, The Java Keywords).

Data Types, Variables, and Arrays: The Primitive Types (Integers, Floating-Point Types, Characters, Booleans), Variables, Type Conversion and Casting, Automatic Type Promotion in Expressions, Arrays, Introducing Type Inference with Local Variables.

Operators: Arithmetic Operators, Relational Operators, Boolean Logical Operators, The Assignment Operator, The ? Operator, Operator Precedence, Using Parentheses.

Control Statements: Java's Selection Statements (if, The Traditional switch), Iteration Statements (while, do-while, for, The For-Each Version of the for Loop, Local Variable Type Inference in a for Loop, Nested Loops), Jump Statements (Using break, Using continue, return).

Chapter 2, 3, 4, 5

Module-2

Introducing Classes: Class Fundamentals, Declaring Objects, Assigning Object Reference Variables, Introducing Methods, Constructors, The this Keyword, Garbage Collection.

Methods and Classes: Overloading Methods, Objects as Parameters, Argument Passing, Returning Objects, Recursion, Access Control, Understanding static, Introducing final, Introducing Nested and Inner Classes.

Chapter 6, 7

Module-3

Inheritance: Inheritance Basics, Using super, Creating a Multilevel Hierarchy, When Constructors Are Executed, Method Overriding, Dynamic Method Dispatch, Using Abstract Classes, Using final with Inheritance, Local Variable Type Inference and Inheritance, The Object Class.

Interfaces: Interfaces, Default Interface Methods, Use static Methods in an Interface, Private Interface Methods.

Chapter 8, 9

Module-4

Packages: Packages, Packages and Member Access, Importing Packages.

Exceptions: Exception-Handling Fundamentals**,** Exception Types**,** Uncaught Exceptions**,** Using try and catch, Multiple catch Clauses, Nested try Statements, throw, throws, finally, Java's Built-in Exceptions, Creating Your Own Exception Subclasses, Chained Exceptions.

Chapter 9, 10

Module-5

Multithreaded Programming: The Java Thread Model, The Main Thread, Creating a Thread, Creating Multiple Threads, Using isAlive() and join(), Thread Priorities, Synchronization, Interthread Communication, Suspending, Resuming, and Stopping Threads, Obtaining a Thread's State.

Enumerations, Type Wrappers and Autoboxing: Enumerations (Enumeration Fundamentals**,** The values() and valueOf() Methods), Type Wrappers (Character, Boolean, The Numeric Type Wrappers), Autoboxing (Autoboxing and Methods, Autoboxing/Unboxing Occurs in Expressions, Autoboxing/Unboxing Boolean and Character Values).

Chapter 11, 12

Course outcome (Course Skill Set)

At the end of the course, the student will be able to:

1. Demonstrate proficiency in writing simple programs involving branching and looping structures.
2. Design a class involving data members and methods for the given scenario.
3. Apply the concepts of inheritance and interfaces in solving real world problems.
4. Use the concept of packages and exception handling in solving complex problem
5. Apply concepts of multithreading, autoboxing and enumerations in program development

Programming Experiments (Suggested and are not limited to)

1. Develop a JAVA program to add TWO matrices of suitable order N (The value of N should be read from command line arguments).
2. Develop a stack class to hold a maximum of 10 integers with suitable methods. Develop a JAVA main method to illustrate Stack operations.
3. A class called Employee, which models an employee with an ID, name and salary, is designed as shown in the following class diagram. The method raiseSalary (percent) increases the salary by the given percentage. Develop the Employee class and suitable main method for demonstration.
4. A class called MyPoint, which models a 2D point with x and y coordinates, is designed as follows:
    - Two instance variables x (int) and y (int).
    - A default (or "no-arg") constructor that construct a point at the default location of (0, 0).
    - A overloaded constructor that constructs a point with the given x and y coordinates.
    - A method setXY() to set both x and y.
    - A method getXY() which returns the x and y in a 2-element int array.
    - A toString() method that returns a string description of the instance in the format "(x, y)".
    - A method called distance(int x, int y) that returns the distance from this point to another point at the given (x, y) coordinates
    - An overloaded distance(MyPoint another) that returns the distance from this point to the given MyPoint instance (called another)
    - Another overloaded distance() method that returns the distance from this point to the origin (0,0)

    Develop the code for the class MyPoint. Also develop a JAVA program (called TestMyPoint) to test all the methods defined in the class.
5. Develop a JAVA program to create a class named shape. Create three sub classes namely: circle, triangle and square, each class has two member functions named draw () and erase (). Demonstrate

polymorphism concepts by developing suitable methods, defining member data and main program.

6. Develop a JAVA program to create an abstract class Shape with abstract methods calculateArea() and calculatePerimeter(). Create subclasses Circle and Triangle that extend the Shape class and implement the respective methods to calculate the area and perimeter of each shape.
7. Develop a JAVA program to create an interface Resizable with methods resizeWidth(int width) and resizeHeight(int height) that allow an object to be resized. Create a class Rectangle that implements the Resizable interface and implements the resize methods
8. Develop a JAVA program to create an outer class with a function display. Create another class inside the outer class named inner with a function called display and call the two functions in the main class.
9. Develop a JAVA program to raise a custom exception (user defined exception) for DivisionByZero using try, catch, throw and finally.
10. Develop a JAVA program to create a package named mypack and import & implement it in a suitable class.
11. Write a program to illustrate creation of threads using runnable class. (start method start each of the newly created thread. Inside the run method there is sleep() for suspend the thread for 500 milliseconds).
12. Develop a program to create a class MyThread in this class a constructor, call the base class constructor, using super and start the thread. The run method of the class starts after this. It can be observed that both main thread and created child thread are executed concurrently.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

CIE for the theory component of the IPCC (maximum marks 50)

- IPCC means practical portion integrated with the theory of the course.
- CIE marks for the theory component are **25 marks** and that for the practical component is **25 marks**.
- 25 marks for the theory component are split into **15 marks** for two Internal Assessment Tests (Two Tests, each of 15 Marks with 01-hour duration, are to be conducted) and **10 marks** for other assessment methods mentioned in 22OB4.2. The first test at the end of 40-50% coverage of the syllabus and the second test after covering 85-90% of the syllabus.
- Scaled-down marks of the sum of two tests and other assessment methods will be CIE marks for the theory component of IPCC (that is for **25 marks)**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the theory component of IPCC.

CIE for the practical component of the IPCC

- **15 marks** for the conduction of the experiment and preparation of laboratory record, and **10 marks** for the test to be conducted after the completion of all the laboratory sessions.
- On completion of every experiment/program in the laboratory, the students shall be evaluated including viva-voce and marks shall be awarded on the same day.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to **15 marks**.
- The laboratory test **(duration 02/03 hours)** after completion of all the experiments shall be conducted for 50 marks and scaled down to **10 marks.**
- Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **25 marks**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the practical component of the IPCC.

SEE for IPCC

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored by the student shall be proportionally scaled down to 50 Marks

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper may include questions from the practical component.

Suggested Learning Resources:

Textbook

1. Java: The Complete Reference, Twelfth Edition, by Herbert Schildt, November 2021, McGraw-Hill, ISBN: 9781260463422

Reference Books

1. Programming with Java, 6th Edition, by E Balagurusamy, Mar-2019, McGraw Hill Education, ISBN: 9789353162337.
2. Thinking in Java, Fourth Edition, by Bruce Eckel, Prentice Hall, 2006 (https://sd.blackball.lv/library/thinking_in_java_4th_edition.pdf)

Web links and Video Lectures (e-Resources):

- Java Tutorial: https://www.geeksforgeeks.org/java/
- Introduction To Programming In Java (by Evan Jones, Adam Marcus and Eugene Wu): https://ocw.mit.edu/courses/6-092-introduction-to-programming-in-java-january-iap-2010/
- Java Tutorial: https://www.w3schools.com/java/
- Java Tutorial: https://www.javatpoint.com/java-tutorial

Activity Based Learning (Suggested Activities)/ Practical Based learning

1. Installation of Java (Refer: https://www.java.com/en/download/help/index_installing.html)
2. Demonstration of online IDEs like geeksforgeeks, jdoodle or any other Tools
3. Demonstration of class diagrams for the class abstraction, type visibility, composition and inheritance

Assessment Method

- Programming Assignment / Course Project

OBJECT ORIENTED PROGRAMMING with C++		Semester	3
Course Code	BCS306B	CIE Marks	50
Teaching Hours/Week (L: T:P: S)	2;0:2	SEE Marks	50
Total Hours of Pedagogy	28 Hours Theory + 20 Hours of Practical	Total Marks	100
Credits	03	Exam Hours	03
Examination type (SEE)	**Theory**		

Note - Students who have undergone " Introduction to C++ Programming-BPLCK105D/205D" in first year are not eligible to opt this course

Course objectives:

- To understand object-oriented programming using C++and Gain knowledge about the capability to store information together in an object.
- To illustrate the capability of a class to rely upon another class and functions.
- To Create and process data in files using file I/O functions
- To understand the generic programming features of C++ including Exception handling

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Chalk and board, power point presentations
2. Online material (Tutorials) and video lectures.
3. Demonstration of programing examples.

Module-1 **5 Hours**

An overview of C++: What is object-Oriented Programming? Introducing C++ Classes, The General Form of a C++ Program.

Classes and Objects: Classes, Friend Functions, Friend Classes, Inline Functions, Parameterized Constructors, Static Class Members, When Constructors and Destructors are Executed, The Scope Resolution Operator, Passing Objects to functions, Returning Objects, Object Assignment

Ch 11, Ch 12

Module-2 **6 Hours**

Arrays, Pointers, References, and the Dynamic Allocation Operators: Arrays of Objects, Pointers to Objects, The this Pointer, Pointers to derived types, Pointers to class members.

Functions Overloading, Copy Constructors: Functions Overloading, Overloading Constructor Functions. Copy Constructors, Default Function Arguments, Function Overloading and Ambiguity.

Ch 13, Ch 14

Module-3 **6 Hours**

Operator Overloading: Creating a Member Operator Function, Operator Overloading Using a Friend Function, Overloading new and delete

Inheritance: Base-Class Access Control, Inheritance and Protected Members, Inheriting Multiple Base Classes , Constructors, Destructors and Inheritance, Granting Access, Virtual Base Classes

Ch 15, Ch 16

Module-4 **5 Hours**

Virtual Functions and Polymorphism: Virtual Functions, The Virtual Attribute is Inherited, Virtual Functions are Hierarchical,

Pure Virtual Functions, Using Virtual Functions, Early vs Late Binding.

Templates: Generic Functions, Applying Generic Functions, Generic Classes. The type name and export Keywords. The Power of Templates

Ch 17, Ch 18

Module-5 **6 Hours**

Exception Handling: Exception Handling Fundamentals, Handling Derived-Class Exceptions, Exception Handling Options, Applying Exception Handling.

The C++ I/O System Basics: C++ Streams, The C++ Classes, Formatted I/O

File I/O: <fstream> and File Classes, Opening and Closing a File, Reading and Writing Text Files, Detecting EOF.

Ch 19, Ch 20, Ch21

Course outcome (Course Skill Set)

At the end of the course, the student will be able to :

1 Illustrate the basic concepts of object-oriented programming.
2 Design appropriate classes for the given real world scenario.
3 Apply the knowledge of compile-time / run-time polymorphism to solve the given problem
4 Use the knowledge of inheritance for developing optimized solutions
5 Apply the concepts of templates and exception handling for the given problem
6 Use the concepts of input output streams for file operations

Suggested Learning Resources:

Books

1. Herbert schildt, The Complete Reference C++, 4th edition, TMH, 2005

Reference Books

1. Balagurusamy E, Object Oriented Programming with C++, Tata McGraw Hill Education Pvt.Ltd., Sixth Edition 2016.
2. Bhave , " Object Oriented Programming With C++", Pearson Education , 2004.
3. A K Sharma , "Object Oriented Programming with C++", Pearson Education, 2014

Web links and Video Lectures (e-Resources):

1. Basics of C++ - https://www.youtube.com/watch?v=BClS40yzssA
2. Functions of C++ - https://www.youtube.com/watch?v=p8ehAjZWjPw

Tutorial Link:

1. https://www.w3schools.com/cpp/cpp_intro.asp
2. https://www.edx.org/course/introduction-to-c-3
3. https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_01384364250678886443375_shared/overview

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Group Assignment to develop small projects and demonstrate using C++

Practical Component

Sl.NO	Experiments
1	Develop a C++ program to find the largest of three numbers
2	Develop a C++ program to sort the elements in ascending and descending order.
3	Develop a C++ program using classes to display student name, roll number, marks obtained in two subjects and total score of student
4	Develop a C++ program for a bank empolyee to print name of the employee, account_no. & balance. Print invalid balance if amount<500, Display the same, also display the balance after withdraw and deposit.
5	Develop a C++ program to demonstrate function overloading for the following prototypes. add(int a, int b) add(double a, double b
6	Develop a C++ program using Operator Overloading for overloading Unary minus operator.
7	Develop a C++ program to implement Multiple inheritance for performing arithmetic operation of two numbers
8	Develop a C++ program using Constructor in Derived classes to initialize alpha, beta and gamma and display corresponding values.
9	Develop a C++ program to create a text file, check file created or not, if created it will write some text into the file and then read the text from the file.
10	Develop a C++ program to write and read time in/from binary file using fstream
11	Develop a function which throws a division by zero exception and catch it in catch block. Write a C++ program to demonstrate usage of try, catch and throw to handle exception.
12	Develop a C++ program that handles array out of bounds exception using C++.

Assessment Details (both CIE and SEE)
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CIE for the practical component of the IPCC

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- The laboratory test **(duration 02/03 hours)** after completion of all the experiments shall be conducted for 50 marks and scaled down to **10 marks.**
- Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **25 marks**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the practical component of the IPCC.

SEE for IPCC
Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored by the student shall be proportionally scaled down to 50 Marks

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper may include questions from the practical component.

BSCK307 – Social Connect & Responsibility 2022 Scheme & syllabus for 3rd sem		Semester	3rd
Course Code	**BSCK307**	CIE Marks	**100**
Teaching Hours/Week (L:T:P: S)	0:0:3:1	SEE Marks	------
Total Hours of Pedagogy	40 hour Practical Session +15 hour Planning	Total Marks	**100**
Examination nature (No SEE – Only CIE)	For CIE Assessment - Activities Report Evaluation by College NSS Officer / HOD / Sports Dept / Any Dept.		
Credits	01 - Credit		

Course objectives: The course will enable the students to:

1. Provide a formal platform for students to communicate and connect to the surrounding.
2. create a responsible connection with the society.
3. Understand the community in general in which they work.
4. Identify the needs and problems of the community and involve them in problem –solving.
5. Develop among themselves a sense of social & civic responsibility & utilize their knowledge in finding practical solutions to individual and community problems.
6. Develop competence required for group-living and sharing of responsibilities & gain skills in mobilizing community participation to acquire leadership qualities and democratic attitudes.

General Instructions - Pedagogy :

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. In addition to the traditional lecture method, different types of innovative teaching methods may be adopted so that the activities will develop students' theoretical and applied social and cultural skills.
2. State the need for activities and its present relevance in the society and Provide real-life examples.
3. Support and guide the students for self-planned activities.
4. You will also be responsible for assigning homework, grading assignments and quizzes, and documenting students' progress in real activities in the field.
5. Encourage the students for group work to improve their creative and analytical skills.

Contents :

The course is mainly activity-based that will offer a set of activities for the student that enables them to connect with fellow human beings, nature, society, and the world at large.

The course will engage students for interactive sessions, open mic, reading group, storytelling sessions, and semester-long activities conducted by faculty mentors.

In the following a set of activities planned for the course have been listed:

Social Connect & Responsibility - Contents

Part I:

Plantation and adoption of a tree:

Plantation of a tree that will be adopted for four years by a group of BE / B.Tech students. (ONE STUDENT ONE TREE) They will also make an excerpt either as a documentary or a photo blog describing the plant's origin, its usage in daily life, its appearance in folklore and literature - – Objectives, Visit, case study, report, outcomes.

Part II :

Heritage walk and crafts corner:

Heritage tour, knowing the history and culture of the city, connecting to people around through their history, knowing the city and its craftsman, photo blog and documentary on evolution and practice of various craft forms - – Objectives,Visit, case study, report, outcomes.

Part III :

Organic farming and waste management:

Usefulness of organic farming, wet waste management in neighboring villages, and implementation in the campus –

Objectives,Visit, case study, report, outcomes.

Part IV:

Water conservation:

Knowing the present practices in the surrounding villages and implementation in the campus, documentary or photoblog presenting the current practices – Objectives, Visit, case study, report, outcomes.

Part V :

Food walk:

City's culinary practices, food lore, and indigenous materials of the region used in cooking – Objectives, Visit, case study, report, outcomes.

Course outcomes (Course Skill Set):

At the end of the course, the student will be able to:

CO1: Communicate and connect to the surrounding.

CO2: Create a responsible connection with the society.

CO3: Involve in the community in general in which they work.

CO4: Notice the needs and problems of the community and involve them in problem –solving.

CO5: Develop among themselves a sense of social & civic responsibility & utilize their knowledge in finding practical solutions to individual and community problems.

CO6: Develop competence required for group-living and sharing of responsibilities & gain skills in mobilizing community participation to acquire leadership qualities and democratic attitudes.

Activities:

Jamming session, open mic, and poetry: Platform to connect to others. Share the stories with others. Share the experience of Social Connect. Exhibit the talent like playing instruments, singing, one-act play, art-painting, and fine art.

PEDAGOGY:

The pedagogy will include interactive lectures, inspiring guest talks, field visits, social immersion, and a course project. Applying and synthesizing information from these sources to define the social problem to address and take up the solution as the course project, with your group. Social immersionwith NGOs/social sections will be a key part of the course. Will all lead to the course project that will address the needs of the social sector?

COURSE TOPICS:

The course will introduce social context and various players in the social space, and present approaches to discovering and understanding social needs. Social immersion and inspiring conversional will culminate in developing an actual, idea for problem-based intervention, based on an in-depth understanding of a key social problem.

Duration :

A total of 40 - 50 hrs engagement per semester is required for the 3rd semester of the B.E. /B.Tech. program. The students will be divided into groups. Each group will be handled by faculty mentor. Faculty mentor will design the activities (particularly Jamming sessions open mic ,and poetry) Faculty mentors has to design the evaluation system as per VTU guidelines of scheme & syllabus.

Guideline for Assessment Process:

Continuous Internal Evaluation (CIE):

After completion of the course, the student shall prepare, with daily diary as reference, a comprehensive report in consultation with the mentor/s to indicate what he has observed and learned in the social connect period. The report should be signed by the mentor. The report shall

be evaluated on the basis of the following criteria and/or other relevant criteria pertaining to the activity completed. Marks allotted for the diary are out of 50. Planning and scheduling the social connect Information/Data collected during the social connect Analysis of the information/data and report writing Considering all above points allotting the marks as mentioned below

Excellent : 80 to 100
Good : 60 to 79
Satisfactory : 40 to 59
Unsatisfactory and fail : <39

Special Note :

NO SEE – Semester End Exam – Completely Practical and activities based evaluation

Pedagogy – Guidelines :

It may differ depending on local resources available for the study as well as environment and climatic differences, location and time of execution.

Sl No	Topic	Group size	Location	Activity execution	Reporting	Evaluation Of the Topic
1.	**Plantation and adoption of a tree:**	May be individual or team	Farmers land/ parks / Villages / roadside/ community area / College campus etc…..	Site selection /proper consultation/Continuous monitoring/ Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics Of scheme and syllabus by Faculty
2.	**Heritage walk and crafts corner:**	May be individual or team	Temples / monumental places / Villages/ City Areas / Grama panchayat/ public associations/Government Schemes officers/ campus etc…..	Site selection /proper consultation/Continuous monitoring/ Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics Of scheme and syllabus by Faculty
3.	**Organic farming and waste management:**	May be individual or team	Farmers land / parks / Villages visits / roadside/ community area / College campus etc…..	Group selection / proper consultation / Continuous monitoring / Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics Of scheme and syllabus by Faculty
4.	**Water conservation:** & conservation techniques	May be individual or team	Villages/ City Areas / Grama panchayat/ public associations/Government Schemes officers / campus etc…..	site selection / proper consultation/Continuous monitoring/ Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics Of scheme and syllabus by Faculty
5.	**Food walk: Practices in society**	May be individual or team	Villages/ City Areas / Grama panchayat/ public associations/Government Schemes officers/ campus etc…..	Group selection / proper consultation / Continuous monitoring / Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics Of scheme and syllabus by Faculty

Plan of Action (Execution of Activities)

Sl.NO	Practice Session Description
1	**Lecture session in field to start activities**
2	**Students Presentation on Ideas**
3	**Commencement of activity and its progress**
4	**Execution of Activity**
5	**Execution of Activity**
6	**Execution of Activity**
7	**Execution of Activity**
8	**Case study based Assessment, Individual performance**
9	**Sector/ Team wise study and its consolidation**
10	**Video based seminar for 10 minutes by each student At the end of semester with Report.**

- Each student should do activities according to the scheme and syllabus.
- At the end of semester student performance has to be evaluated by the faculty for the assigned activity progress and its completion.
- At last consolidated report of all activities from 1st to 5th, compiled report should be submitted as per the instructions and scheme.

Assessment Details for CIE (both CIE and SEE)

Weightage	**CIE – 100%**	
Field Visit, Plan, Discussion	10 Marks	• Implementation strategies of the project (NSS work). • The last report should be signed by NSS Officer, the HOD and principal. • At last report should be evaluated by the NSS officer of the institute. • Finally the consolidated marks sheet should be sent to the university and also to be made available at LIC visit.
Commencement of activities and its progress	20 Marks	
Case study based Assessment Individual performance with report	20 Marks	
Sector wise study & its consolidation 5*5 = 25	25 Marks	
Video based seminar for 10 minutes by each student At the end of semester with Report. **Activities 1 to 5, 5*5 = 25**	25 Marks	
Total marks for the course in each semester	**100 Marks**	

For each activity, 20 marks CIE will be evaluated for IA marks at the end of semester, Report and assessment copy should be made available in the department.

Students should present the progress of the activities as per the schedule in the prescribed practical session in the field. There should be positive progress in the vertical order for the benefit of society in general through activities.

Data Analytics with Excel		Semester	3
Course Code	**BCS358A**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	0:0:2:0	SEE Marks	50
Credits	01	Exam Hours	100
Examination type (SEE)	Practical		

Course objectives:

- To Apply analysis techniques to datasets in Excel
- Learn how to use Pivot Tables and Pivot Charts to streamline your workflow in Excel
- Understand and Identify the principles of data analysis
- Become adept at using Excel functions and techniques for analysis
- Build presentation ready dashboards in Excel

Sl.NO	Experiments
1	**Getting Started with Excel**: Creation of spread sheets, Insertion of rows and columns, Drag & Fill, use of Aggregate functions.
2	**Working with Data** : Importing data, Data Entry & Manipulation, Sorting & Filtering.
3	**Working with Data:** Data Validation, Pivot Tables & Pivot Charts.
4	**Data Analysis Process**: Conditional Formatting, What-If Analysis, Data Tables, Charts & Graphs.
5	**Cleaning Data with Text Functions**: use of UPPER and LOWER, TRIM function, Concatenate.
6	**Cleaning Data Containing Date and Time Values:** use of DATEVALUE function, DATEADD and DATEDIF, TIMEVALUE functions.
7	**Conditional Formatting**: formatting, parsing, and highlighting data in spreadsheets during data analysis.
8	**Working with Multiple Sheets**: work with multiple sheets within a workbook is crucial for organizing and managing data, perform complex calculations and create comprehensive reports.
9	Create worksheet with following fields: Empno, Ename, Basic Pay(BP), Travelling Allowance(TA), Dearness Allowance(DA), House Rent Allowance(HRA), Income Tax(IT), Provident Fund(PF), Net Pay(NP). Use appropriate formulas to calculate the above scenario. Analyse the data using appropriate chart and report the data.
10	Create worksheet on Inventory Management: Sheet should contain Product code, Product name, Product type, MRP, Cost after % of discount, Date of purchase. Use appropriate formulas to calculate the above scenario. Analyse the data using appropriate chart and report the data.

11	Create worksheet on Sales analysis of Merchandise Store: data consisting of Order ID, Customer ID, Gender, age, date of order, month, online platform, Category of product, size, quantity, amount, shipping city and other details. Use of formula to segregate different categories and perform a comparative study using pivot tables and different sort of charts.
12	Generation of report & presentation using Autofilter &macro.

Course outcomes (Course Skill Set):
At the end of the course the student will be able to:

- Use advanced functions and productivity tools to assist in developing worksheets.
- Manipulate data lists using Outline and PivotTables.
- Use Consolidation to summarise and report results from multiple worksheets.
- Apply Macros and Autofilter to solve the given real world scenario.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation (CIE):

CIE marks for the practical course are **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment is to be evaluated for conduction with an observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments are designed by the faculty who is handling the laboratory session and are made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled down to **30 marks** (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct a test of 100 marks after the completion of all the experiments listed in the syllabus.
- In a test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability.
- The marks scored shall be scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and marks of a test is the total CIE marks scored by the student.

Semester End Evaluation (SEE):

- SEE marks for the practical course are 50 Marks.
- SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the Head of the Institute.
- The examination schedule and names of examiners are informed to the university before the conduction of the examination. These practical examinations are to be conducted between the schedule mentioned in the academic calendar of the University.

- All laboratory experiments are to be included for practical examination.
- (Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.
- Students can pick one question (experiment) from the questions lot prepared by the examiners jointly.
- Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.
- General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)
- Change of experiment is allowed only once and 15% of Marks allotted to the procedure part are to be made zero.

The minimum duration of SEE is 02 hours

Suggested Learning Resources:

- **Berk & Carey** - Data Analysis with Microsoft® Excel: Updated for Offi ce 2007®, Third Edition, © 2010 Brooks/Cole, Cengage Learning, ISBN-13: 978-0-495-39178-4
- **Wayne L. Winston** - Microsoft Excel 2019: Data Analysis And Business Modeling, PHI, ISBN: 9789389347180
- **Aryan Gupta** - Data Analysis in Excel: The Best Guide. (https://www.simplilearn.com/tutorials/excel-tutorial/data-analysis-excel)

R Programming		Semester	3
Course Code	BCS358B	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	0:0:2:0	SEE Marks	50
Credits	01	Exam Hours	02
Examination type (SEE)	Practical		

Course objectives:

- To explore and understand how R and R Studio interactive environment.
- To understand the different data Structures, data types in R.
- To learn and practice programming techniques using R programming.
- To import data into R from various data sources and generate visualizations.
- To draw insights from datasets using data analytics techniques.

Sl.NO	Experiments
1	Demonstrate the steps for installation of R and R Studio. Perform the following: a) Assign different type of values to variables and display the type of variable. Assign different types such as Double, Integer, Logical, Complex and Character and understand the difference between each data type. b) Demonstrate Arithmetic and Logical Operations with simple examples. c) Demonstrate generation of sequences and creation of vectors. d) Demonstrate Creation of Matrices e) Demonstrate the Creation of Matrices from Vectors using Binding Function. f) Demonstrate element extraction from vectors, matrices and arrays **Suggested Reading** – Text Book 1 – Chapter 1 (What is R, Installing R, Choosing an IDE – RStudio, How to Get Help in R, Installing Extra Related Software), Chapter 2 (Mathematical Operations and Vectors, Assigning Variables, Special Numbers, Logical Vectors), Chapter 3 (Classes, Different Types of Numbers, Other Common Classes, Checking and Changing Classes, Examining Variables)
2	Assess the Financial Statement of an Organization being supplied with 2 vectors of data: Monthly Revenue and Monthly Expenses for the Financial Year. You can create your own sample data vector for this experiment) Calculate the following financial metrics: a. Profit for each month. b. Profit after tax for each month (Tax Rate is 30%). c. Profit margin for each month equals to profit after tax divided by revenue. d. Good Months – where the profit after tax was greater than the mean for the year. e. Bad Months – where the profit after tax was less than the mean for the year. f. The best month – where the profit after tax was max for the year. g. The worst month – where the profit after tax was min for the year. **Note:** a. All Results need to be presented as vectors b. Results for Dollar values need to be calculated with $0.01 precision, but need to be presented in Units of $1000 (i.e 1k) with no decimal points c. Results for the profit margin ratio need to be presented in units of % with no decimal point. d. It is okay for tax to be negative for any given month (deferred tax asset) e. Generate CSV file for the data. **Suggested Reading** – Text Book 1 – Chapter 4 (Vectors, Combining Matrices)
3	Develop a program to create two 3 X 3 matrices A and B and perform the following operations a) Transpose of the matrix b) addition c) subtraction d) multiplication **Suggested Reading** – Text Book 1 – Chapter 4 (Matrices and Arrays – Array Arithmetic)
4	Develop a program to find the factorial of given number using recursive function calls. **Suggested Reading** – Reference Book 1 – Chapter 5 (5.5 – Recursive Programming) Text Book 1 – Chapter 8 (Flow Control and Loops – If and Else, Vectorized If, while loops, for loops), Chapter 6 (Creating and Calling Functions, Passing Functions to and from other functions)

<table>
<tr><td>5</td><td>Develop an R Program using functions to find all the prime numbers up to a specified number by the method of Sieve of Eratosthenes.
Suggested Reading – Reference Book
1 - Chapter 5 (5.5 – Recursive Programming)
Text Book 1 – Chapter 8 (Flow Control and Loops – If and Else, Vectorized If, while loops, for loops), Chapter 6 (Creating and Calling Functions, Passing Functions to and from other functions)</td></tr>
<tr><td>6</td><td>The built-in data set mammals contain data on body weight versus brain weight. Develop R commands to:
a) Find the Pearson and Spearman correlation coefficients. Are they similar?
b) Plot the data using the plot command.
c) Plot the logarithm (log) of each variable and see if that makes a difference.
Suggested Reading – Text Book 1 –Chapter 12 – (Built-in Datasets) Chapter 14 – (Scatterplots)
Reference Book 2 – 13.2.5 (Covariance and Correlation)</td></tr>
<tr><td>7</td><td>Develop R program to create a Data Frame with following details and do the following operations.
<table>
<tr><th>itemCode</th><th>itemCategory</th><th>itemPrice</th></tr>
<tr><td>1001</td><td>Electronics</td><td>700</td></tr>
<tr><td>1002</td><td>Desktop Supplies</td><td>300</td></tr>
<tr><td>1003</td><td>Office Supplies</td><td>350</td></tr>
<tr><td>1004</td><td>USB</td><td>400</td></tr>
<tr><td>1005</td><td>CD Drive</td><td>800</td></tr>
</table>
a) Subset the Data frame and display the details of only those items whose price is greater than or equal to 350.
b) Subset the Data frame and display only the items where the category is either “Office Supplies” or “Desktop Supplies”
c) Create another Data Frame called “item-details” with three different fields itemCode, ItemQtyonHand and ItemReorderLvl and merge the two frames

Suggested Reading –Textbook 1: Chapter 5 (Lists and Data Frames)</td></tr>
<tr><td>8</td><td>Let us use the built-in dataset air quality which has Daily air quality measurements in New York, May to September 1973. Develop R program to generate histogram by using appropriate arguments for the following statements.
a) Assigning names, using the air quality data set.
b) Change colors of the Histogram
c) Remove Axis and Add labels to Histogram
d) Change Axis limits of a Histogram
e) Add Density curve to the histogram
Suggested Reading –Reference Book 2 – Chapter 7 (7.4 – The ggplot2 Package), Chapter 24 (Smoothing and Shading)</td></tr>
<tr><td>9</td><td>Design a data frame in R for storing about 20 employee details. Create a CSV file named “input.csv” that defines all the required information about the employee such as id, name, salary, start_date, dept. Import into R and do the following analysis.
a) Find the total number rows & columns
b) Find the maximum salary
c) Retrieve the details of the employee with maximum salary
d) Retrieve all the employees working in the IT Department.
e) Retrieve the employees in the IT Department whose salary is greater than 20000 and write these</td></tr>
</table>

<table>
<tr><td></td><td>details into another file “output.csv”
Suggested Reading – Text Book 1 – Chapter 12(CSV and Tab Delimited Files)</td></tr>
<tr><td>10</td><td>Using the built in dataset mtcars which is a popular dataset consisting of the design and fuel consumption patterns of 32 different automobiles. The data was extracted from the 1974 Motor Trend US magazine, and comprises fuel consumption and 10 aspects of automobile design and performance for 32 automobiles (1973-74 models). Format A data frame with 32 observations on 11 variables : [1] mpg Miles/(US) gallon, [2] cyl Number of cylinders [3] disp Displacement (cu.in.), [4] hp Gross horsepower [5] drat Rear axle ratio,[6] wt Weight (lb/1000) [7] qsec 1/4 mile time, [8] vs V/S, [9] am Transmission (0 = automatic, 1 = manual), [10] gear Number of forward gears, [11] carb Number of carburetors

Develop R program, to solve the following:
a) What is the total number of observations and variables in the dataset?
b) Find the car with the largest hp and the least hp using suitable functions
c) Plot histogram / density for each variable and determine whether continuous variables are normally distributed or not. If not, what is their skewness?
d) What is the average difference of gross horse power(hp) between automobiles with 3 and 4 number of cylinders(cyl)? Also determine the difference in their standard deviations.
e) Which pair of variables has the highest Pearson correlation?

References (Web links):
1. https://cran.r-project.org/web/packages/explore/vignettes/explore_mtcars.html
2. https://www.w3schools.com/r/r_stat_data_set.asp
3. https://rpubs.com/BillB/217355</td></tr>
<tr><td>11</td><td>Demonstrate the progression of salary with years of experience using a suitable data set (You can create your own dataset). Plot the graph visualizing the best fit line on the plot of the given data points. Plot a curve of Actual Values vs. Predicted values to show their correlation and performance of the model. Interpret the meaning of the slope and y-intercept of the line with respect to the given data. Implement using lm function. Save the graphs and coefficients in files. Attach the predicted values of salaries as a new column to the original data set and save the data as a new CSV file.

Suggested Reading – Reference Book 2 – Chapter 20 (General Concepts, Statistical Inference, Prediction)</td></tr>
</table>

Course outcomes (Course Skill Set):
At the end of the course the student will be able to:

- Explain the fundamental syntax of R data types, expressions and the usage of the R-Studio IDE
- Develop a program in R with programming constructs: conditionals, looping and functions.
- Apply the list and data frame structure of the R programming language.
- Use visualization packages and file handlers for data analysis..

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation (CIE):

CIE marks for the practical course are **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment is to be evaluated for conduction with an observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments are designed by the faculty who is handling the laboratory session and are made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled down to **30 marks** (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct a test of 100 marks after the completion of all the experiments listed in the syllabus.
- In a test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability.
- The marks scored shall be scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and marks of a test is the total CIE marks scored by the student.

Semester End Evaluation (SEE):

- SEE marks for the practical course are 50 Marks.
- SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the Head of the Institute.
- The examination schedule and names of examiners are informed to the university before the conduction of the examination. These practical examinations are to be conducted between the schedule mentioned in the academic calendar of the University.
- All laboratory experiments are to be included for practical examination.
- (Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. OR based on the course requirement evaluation

rubrics shall be decided jointly by examiners.

- Students can pick one question (experiment) from the questions lot prepared by the examiners jointly.
- Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.

- General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)
- Change of experiment is allowed only once and 15% of Marks allotted to the procedure part are to be made zero.

The minimum duration of SEE is 02 hours

Suggested Learning Resources:

Book:

1. Cotton, R. (2013). Learning R: A Step by Step Function Guide to Data Analysis. 1st ed. O'Reilly Media Inc.

References:

1. Jones, O., Maillardet. R. and Robinson, A. (2014). Introduction to Scientific Programming and Simulation Using R. Chapman & Hall/CRC, The R Series.
2. Davies, T.M. (2016) The Book of R: A First Course in Programming and Statistics. No Starch Press.

Project Management with Git		Semester	3
Course Code	**BCS358C**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	0: 0 : 2: 0	SEE Marks	50
Credits	01	Exam Marks	100
Examination type (SEE)	Practical		

Course objectives:

- .To familiar with basic command of Git
- To create and manage branches
- To understand how to collaborate and work with Remote Repositories
- To familiar with virion controlling commands

Sl.NO	Experiments
1	**Setting Up and Basic Commands** Initialize a new Git repository in a directory. Create a new file and add it to the staging area and commit the changes with an appropriate commit message.
2	**Creating and Managing Branches** Create a new branch named "feature-branch." Switch to the "master" branch. Merge the "feature-branch" into "master."
3	**Creating and Managing Branches** Write the commands to stash your changes, switch branches, and then apply the stashed changes.
4	**Collaboration and Remote Repositories** Clone a remote Git repository to your local machine.
5	**Collaboration and Remote Repositories** Fetch the latest changes from a remote repository and rebase your local branch onto the updated remote branch.
6	**Collaboration and Remote Repositories** Write the command to merge "feature-branch" into "master" while providing a custom commit message for the merge.
7	**Git Tags and Releases** Write the command to create a lightweight Git tag named "v1.0" for a commit in your local repository.
8	**Advanced Git Operations**

	Write the command to cherry-pick a range of commits from "source-branch" to the current branch.
9	**Analysing and Changing Git History** Given a commit ID, how would you use Git to view the details of that specific commit, including the author, date, and commit message?
10	**Analysing and Changing Git History** Write the command to list all commits made by the author "JohnDoe" between "2023-01-01" and "2023-12-31."
11	**Analysing and Changing Git History** Write the command to display the last five commits in the repository's history.
12	**Analysing and Changing Git History** Write the command to undo the changes introduced by the commit with the ID "abc123".

Course outcomes (Course Skill Set):
At the end of the course the student will be able to:

- Use the basics commands related to git repository
- Create and manage the branches
- Apply commands related to Collaboration and Remote Repositories
- Use the commands related to Git Tags, Releases and advanced git operations
- Analyse and change the git history

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation (CIE):

CIE marks for the practical course are **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

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- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled down to **30 marks** (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct a test of 100 marks after the completion of all the experiments listed in the syllabus.
- In a test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability.
- The marks scored shall be scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and marks of a test is the total CIE marks scored by the student.

Semester End Evaluation (SEE):

- SEE marks for the practical course are 50 Marks.
- SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the Head of the Institute.
- The examination schedule and names of examiners are informed to the university before the conduction of the examination. These practical examinations are to be conducted between the schedule mentioned in the academic calendar of the University.

- All laboratory experiments are to be included for practical examination.
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- Students can pick one question (experiment) from the questions lot prepared by the examiners jointly.
- Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.
- General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)
- Change of experiment is allowed only once and 15% of Marks allotted to the procedure part are to be made zero.

The minimum duration of SEE is 02 hours

Suggested Learning Resources:

- Version Control with Git, 3rd Edition, by Prem Kumar Ponuthorai, Jon Loeliger Released October 2022, Publisher(s): O'Reilly Media, Inc.
- Pro Git book, written by Scott Chacon and Ben Straub and published by Apress, https://git-scm.com/book/en/v2
- https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_01309444334736998427 82_shared/overview
- https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_013301347121774592119 26_shared/overview

Data Visualization with Python		Semester	III
Course Code	**BCS358D**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	0: 0: 2: 0	SEE Marks	50
Credits	01	Exam Hours	100
Examination type (SEE)	Practical		

Course objectives:

- CLO 1. Demonstrate the use of IDLE or PyCharm IDE to create Python Applications
- CLO 2. Using Python programming language to develop programs for solving real-world problems
- CLO 3. Implementation of Matplotlib for drawing different Plots
- CLO 4. Demonstrate working with Seaborn, Bokeh.
- CLO 5. Working with Plotly for 3D, Time Series and Maps.

	Experiments
Sl. No.	***PART A – List of problems for which student should develop program and execute in theLaboratory***
1	a) Write a python program to find the best of two test average marks out of three test's marks accepted from the user. b) Develop a Python program to check whether a given number is palindrome or not andalso count the number of occurrences of each digit in the input number. Datatypes: https://www.youtube.com/watch?v=gCCVsvgR2KU Operators: https://www.youtube.com/watch?v=v5MR5JnKcZI Flow Control: https://www.youtube.com/watch?v=PqFKRqpHrjwFor loop: https://www.youtube.com/watch?v=0ZvaDa8eT5s While loop: https://www.youtube.com/watch?v=HZARImviDxg Exceptions: https://www.youtube.com/watch?v=6SPDvPK38tw
2	a) Defined as a function F as Fn = Fn-1 + Fn-2. Write a Python program which accepts a value for N (where N >0) as input and pass this value to the function. Display suitable error message if the condition for input value is not followed. b) Develop a python program to convert binary to decimal, octal to hexadecimal using functions. Functions:https://www.youtube.com/watch?v=BVfCWuca9nw Arguments:https://www.youtube.com/watch?v=ijXMGpoMkhQ Return value: https://www.youtube.com/watch?v=nuNXiEDnM44
3	a) Write a Python program that accepts a sentence and find the number of words, digits, uppercase letters and lowercase letters. b) Write a Python program to find the string similarity between two given strings **Sample Output:** Original string: Python Exercises Python Exercises Similarity between two said strings: 1.0 **Sample Output:** Original string: Python Exercises Python Exercise Similarity between two said strings: 0.967741935483871 Strings: https://www.youtube.com/watch?v=lSItwlnF0eU String functions: https://www.youtube.com/watch?v=9a3CxJyTq00

4	a) Write a Python program to Demonstrate how to Draw a Bar Plot using Matplotlib. b) Write a Python program to Demonstrate how to Draw a Scatter Plot using Matplotlib. https://www.youtube.com/watch?v=RRHQ6Fs1b8w&list=PLjVLYmrlmjGcC0B_FP3bkJ-JIPkV5GuZR&index=3 https://www.youtube.com/watch?v=7ABCuhWO9II&list=PLjVLYmrlmjGcC0B_FP3bkJ-JIPkV5GuZR&index=4
5	a) Write a Python program to Demonstrate how to Draw a Histogram Plot using Matplotlib. b) Write a Python program to Demonstrate how to Draw a Pie Chart using Matplotlib. https://www.youtube.com/watch?v=Qk7caotaQUQ&list=PLjVLYmrlmjGcC0B_FP3bkJ-JIPkV5GuZR&index=6 https://www.youtube.com/watch?v=PSji21jUNO0&list=PLjVLYmrlmjGcC0B_FP3bkJ-JIPkV5GuZR&index=7
6	a) Write a Python program to illustrate Linear Plotting using Matplotlib. b) Write a Python program to illustrate liner plotting with line formatting using Matplotlib. https://www.youtube.com/watch?v=UO98lJQ3QGI&list=PL-osiE80TeTvipOqomVEeZ1HRrcEvtZB_
7	Write a Python program which explains uses of customizing seaborn plots with Aesthetic functions. https://www.youtube.com/watch?v=6GUZXDef2U0
8	Write a Python program to explain working with bokeh line graph using Annotations and Legends. a) Write a Python program for plotting different types of plots using Bokeh. https://www.youtube.com/watch?v=HDvxYoRadcA
9	Write a Python program to draw 3D Plots using Plotly Libraries. https://www.youtube.com/watch?v=cCck7hCanpw&list=PLE50-dh6JzC4onX-qkv9H3HtPbBVA8M94&index=4

10	a) Write a Python program to draw Time Series using Plotly Libraries. b) Write a Python program for creating Maps using Plotly Libraries. https://www.youtube.com/watch?v=xnJ2TNrGYik&list=PLE50-dh6JzC4onX-qkv9H3HtPbBVA8M94&index=5 https://www.youtube.com/watch?v=D35m2CdMhVs&list=PLE50-dh6JzC4onX-qkv9H3HtPbBVA8M94&index=6
Python (Full Course): https://www.youtube.com/watch?v=_uQrJ0TkZlc	
Pedagogy	For the above experiments the following pedagogy can be considered. Problem based learning, Active learning, MOOC, Chalk &Talk

Course outcomes (Course Skill Set):
At the end of the course the student will be able to:

CO 1. Demonstrate the use of IDLE or PyCharm IDE to create Python Applications

CO 2. Use Python programming constructs to develop programs for solving real-world problems

CO 3. Use Matplotlib for drawing different Plots

CO 4. Demonstrate working with Seaborn, Bokeh for visualization.

CO 5. Use Plotly for drawing Time Series and Maps.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation (CIE):

CIE marks for the practical course are **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment is to be evaluated for conduction with an observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments are designed by the faculty who is handling the laboratory session and are made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled down to **30 marks** (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct a test of 100 marks after the completion of all the experiments listed in the syllabus.
- In a test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability.
- The marks scored shall be scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and marks of a test is the total CIE marks scored by the student.

Semester End Evaluation (SEE):

SEE marks for the practical course are 50 Marks.

SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the Head of the Institute.

The examination schedule and names of examiners are informed to the university before the conduction of the examination. These practical examinations are to be conducted between the schedule mentioned in the academic calendar of the University.

All laboratory experiments are to be included for practical examination.

(Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.

Students can pick one question (experiment) from the questions lot prepared by the examiners jointly.

Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.

General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)

Change of experiment is allowed only once and 15% of Marks allotted to the procedure part are to be made zero.

The minimum duration of SEE is 02 hours

- **Weightage of marks for PART A is 80% and for PART B is 20%. General rubrics suggested to be followed for part A and part B.**
- **Change of experiment is allowed only once and Marks allotted to the procedure part to be made zero (Not allowed for Part B).**
- **The duration of SEE is 03 hours**

Rubrics suggested in Annexure-II of Regulation book

Textbooks:

1. **Al Sweigart, "Automate the Boring Stuff with Python",1stEdition, No Starch Press, 2015. (Available under CC-BY-NC-SA license at https://automatetheboringstuff.com/)**
2. **Reema Thareja "Python Programming Using Problem Solving Approach" Oxford University Press.**
3. **Allen B. Downey, "Think Python: How to Think Like a Computer Scientist", 2nd Edition, Green Tea Press, 2015. (Available under CC-BY-NC license at http://greenteapress.com/thinkpython2/thinkpython2.pdf)**
4. **Jake VanderPlas "Python Data Science Handbook" 1st Edition, O'REILLY.**

	Mathematics for Computer Science		Semester	3
	Course Code	**BCS301**	CIE Marks	50
	Teaching Hours/Week (L: T:P: S)	3:2:0:0	SEE Marks	50
	Total Hours of Pedagogy	40 hours Theory + 20 Hours Tutorial	Total Marks	100
	Credits	04	Exam Hours	3
	Examination type (SEE)	**Theory**		

Course objectives: This course will enable the students to:

1. To introduce the concept of random variables, probability distributions, specific discrete and continuous distributions with practical application in Computer Science Engineering and social life situations.
2. To Provide the principles of statistical inferences and the basics of hypothesis testing with emphasis on some commonly encountered hypotheses.
3. To Determine whether an input has a statistically significant effect on the system's response through ANOVA testing.

Teaching-Learning Process
Pedagogy (General Instructions):
Teachers can use the following strategies to accelerate the attainment of the various course outcomes.

1. In addition to the traditional lecture method, different types of innovative teaching methods may be adopted so that the delivered lessons shall develop students' theoretical and applied Mathematical skills.
2. State the need for Mathematics with Engineering Studies and Provide real-life examples.
3. Support and guide the students for self–study.
4. You will assign homework, grading assignments and quizzes, and documenting students' progress.
5. Encourage the students to group learning to improve their creative and analytical skills.
6. Show short related video lectures in the following ways:
   - As an introduction to new topics (pre-lecture activity).
   - As a revision of topics (post-lecture activity).
   - As additional examples (post-lecture activity).
   - As an additional material of challenging topics (pre-and post-lecture activity).
   - As a model solution of some exercises (post-lecture activity).

Module-1: Probability Distributions

Probability Distributions: Review of basic probability theory. Random variables (discrete and continuous), probability mass and density functions. Mathematical expectation, mean and variance. Binomial, Poisson and normal distributions- problems (derivations for mean and standard deviation for Binomial and Poisson distributions only)-Illustrative examples. Exponential distribution. **(12 Hours)**

(RBT Levels: L1, L2 and L3)

Pedagogy	Chalk and Board, Problem-based learning

Module-2: Joint probability distribution & Markov Chain

	Joint probability distribution: Joint Probability distribution for two discrete random variables, expectation, covariance and correlation. **Markov Chain:** Introduction to Stochastic Process, Probability Vectors, Stochastic matrices, Regular stochastic matrices, Markov chains, Higher transition probabilities, Stationary distribution of Regular Markov chains and absorbing states. **(12 Hours)** **(RBT Levels: L1, L2 and L3)**
	Pedagogy — Chalk and Board, Problem-based learning
	Module-3: Statistical Inference 1
	Introduction, sampling distribution, standard error, testing of hypothesis, levels of significance, test of significances, confidence limits, simple sampling of attributes, test of significance for large samples, comparison of large samples. **(12 Hours)** **(RBT Levels: L1, L2 and L3)**
	Pedagogy — Chalk and Board, Problem-based learning
	Module-4: Statistical Inference 2
	Sampling variables, central limit theorem and confidences limit for unknown mean. Test of Significance for means of two small samples, students 't' distribution, Chi-square distribution as a test of goodness of fit. F-Distribution. **(12 Hours)** **(RBT Levels: L1, L2 and L3)**
	Pedagogy — Chalk and Board, Problem-based learning
	Module-5: Design of Experiments & ANOVA
	Principles of experimentation in design, Analysis of completely randomized design, randomized block design. The ANOVA Technique, Basic Principle of ANOVA, One-way ANOVA, Two-way ANOVA, Latin-square Design, and Analysis of Co-Variance. **(12 Hours)** **(RBT Levels: L1, L2 and L3)**
	Pedagogy — Chalk and Board, Problem-based learning

Course outcome (Course Skill Set)

At the end of the course, the student will be able to:

1. Explain the basic concepts of probability, random variables, probability distribution
2. Apply suitable probability distribution models for the given scenario.
3. Apply the notion of a discrete-time Markov chain and n-step transition probabilities to solve the given problem
4. Use statistical methodology and tools in the engineering problem-solving process.
5. Compute the confidence intervals for the mean of the population.
6. Apply the ANOVA test related to engineering problems.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment

Test component, there are 25 marks.

- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by the University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.

Marks scored shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Textbooks:

1. **Ronald E. Walpole, Raymond H Myers, Sharon L Myers & Keying Ye** "Probability & Statistics for Engineers & Scientists", Pearson Education, 9th edition, 2017.
2. **Peter Bruce, Andrew Bruce & Peter Gedeck** "Practical Statistics for Data Scientists" O'Reilly Media, Inc., 2nd edition **2020.**

Reference Books: (Name of the author/Title of the Book/ Name of the publisher/Edition and Year)

1. **Erwin Kreyszig**, "Advanced Engineering Mathematics", John Wiley & Sons, 9th Edition, 2006.
2. **B. S. Grewal** "Higher Engineering Mathematics", Khanna publishers, 44th Ed., 2021.
3. **G Haribaskaran** "Probability, Queuing Theory & Reliability Engineering", Laxmi Publication, Latest Edition, 2006
4. **Irwin Miller & Marylees Miller,** John E. Freund's "Mathematical Statistics with Applications" Pearson. Dorling Kindersley Pvt. Ltd. India, 8th edition, 2014.
5. **S C Gupta and V K Kapoor**, "Fundamentals of Mathematical Statistics", S Chand and Company, Latest edition.
6. **Robert V. Hogg, Joseph W. McKean & Allen T. Craig**. "Introduction to Mathematical Statistics", Pearson Education 7th edition, 2013.
7. **Jim Pitman**. Probability, Springer-Verlag, 1993.
8. **Sheldon M. Ross,** "Introduction to Probability Models" 11th edition. Elsevier, 2014.
9. **A. M. Yaglom and I. M. Yaglom**, "Probability and Information". D. Reidel Publishing Company. Distributed by Hindustan Publishing Corporation (India) Delhi, 1983.
10. **P. G. Hoel, S. C. Port and C. J. Stone**, "Introduction to Probability Theory", Universal Book Stall, (Reprint), 2003.
11. **S. Ross**, "A First Course in Probability", Pearson Education India, 6th Ed., 2002.
12. **W. Feller**, "An Introduction to Probability Theory and its Applications", Vol. 1, Wiley, 3rd

Ed., 1968. 13. **N.P. Bali and Manish Goyal**, A Textbook of Engineering Mathematics, Laxmi Publications, Reprint, 2010. 14. **Veerarajan T**, Engineering Mathematics (for semester III), Tata McGraw-Hill, New Delhi, 2010
Web links and Video Lectures (e-Resources):
http://nptel.ac.in/courses.php?disciplineID=111 http://www.class-central.com/subject/math(MOOCs) http://academicearth.org/ http://www.bookstreet.in. VTU EDUSAT PROGRAMME – 20 VTU e-Shikshana Program
Activity-Based Learning (Suggested Activities in Class)/Practical-Based Learning • Programming Assignment • Seminars

Digital Design and Computer Organization		Semester	3
Course Code	BCS302	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:2:0	SEE Marks	50
Total Hours of Pedagogy	40 hours Theory + 20 Hours of Practicals	Total Marks	100
Credits	04	Exam Hours	3
Examination nature (SEE)	Theory		

Course objectives:

- To demonstrate the functionalities of binary logic system
- To explain the working of combinational and sequential logic system
- To realize the basic structure of computer system
- To illustrate the working of I/O operations and processing unit

Teaching-Learning Process (General Instructions)

These are sample Strategies; that teachers can use to accelerate the attainment of the various course outcomes.

1. Chalk and Talk
2. Live Demo with experiments
3. Power point presentation

MODULE-1 **8 Hr**

Introduction to Digital Design: Binary Logic, Basic Theorems And Properties Of Boolean Algebra, Boolean Functions, Digital Logic Gates, Introduction, The Map Method, Four-Variable Map, Don't-Care Conditions, NAND and NOR Implementation, Other Hardware Description Language – Verilog Model of a simple circuit.

Text book 1: 1.9, 2.4, 2.5, 2.8, 3.1, 3.2, 3.3, 3.5, 3.6, 3.9

MODULE-2 **8 Hr**

Combinational Logic: Introduction, Combinational Circuits, Design Procedure, Binary Adder- Subtractor, Decoders, Encoders, Multiplexers. HDL Models of Combinational Circuits – Adder, Multiplexer, Encoder. **Sequential Logic**: Introduction, Sequential Circuits, Storage Elements: Latches, Flip-Flops.

Text book 1: 4.1, 4.2, 4.4, 4.5, 4.9, 4.10, 4.11, 4.12, 5.1, 5.2, 5.3, 5.4.

MODULE-3 **8 Hr**

Basic Structure of Computers: Functional Units, Basic Operational Concepts, Bus structure, Performance – Processor Clock, Basic Performance Equation, Clock Rate, Performance Measurement.**Machine Instructions and Programs:** Memory Location and Addresses, Memory Operations, Instruction and Instruction sequencing, Addressing Modes.

Text book 2: 1.2, 1.3, 1.4, 1.6, 2.2, 2.3, 2.4, 2.5

MODULE-4 **8 Hr**

Input/output Organization: Accessing I/O Devices, Interrupts – Interrupt Hardware, Enabling and Disabling Interrupts, Handling Multiple Devices, Direct Memory Access: Bus Arbitration, Speed, size and Cost of memory systems. Cache Memories – Mapping Functions.

Text book 2: 4.1, 4.2.1, 4.2.2, 4.2.3, 4.4, 5.4, 5.5.1

MODULE-5 **8 Hr**

Basic Processing Unit: Some Fundamental Concepts: Register Transfers, Performing ALU operations, fetching a word from Memory, Storing a word in memory. Execution of a Complete Instruction. **Pipelining:** Basic concepts, Role of Cache memory, Pipeline Performance. **Text book 2: 7.1, 7.2, 8.1**

PRACTICAL COMPONENT OF IPCC

Sl.NO	Experiments Simulation packages preferred: Multisim, Modelsim, PSpice or any other relevant
1	Given a 4-variable logic expression, simplify it using appropriate technique and simulate the same using basic gates.
2	Design a 4 bit full adder and subtractor and simulate the same using basic gates.
3	Design Verilog HDL to implement simple circuits using structural, Data flow and Behavioural model.
4	Design Verilog HDL to implement Binary Adder-Subtractor – Half and Full Adder, Half and Full Subtractor.
5	Design Verilog HDL to implement Decimal adder.
6	Design Verilog program to implement Different types of multiplexer like 2:1, 4:1 and 8:1.
7	Design Verilog program to implement types of De-Multiplexer.
8	Design Verilog program for implementing various types of Flip-Flops such as SR, JK and D.

Course outcomes (Course Skill Set):

At the end of the course, the student will be able to:

CO1: Apply the K–Map techniques to simplify various Boolean expressions.

CO2: Design different types of combinational and sequential circuits along with Verilog programs.

CO3: Describe the fundamentals of machine instructions, addressing modes and Processor performance.

CO4: Explain the approaches involved in achieving communication between processor and I/O devices.

CO5:Analyze internal Organization of Memory and Impact of cache/Pipelining on Processor Performance.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

CIE for the theory component of the IPCC (maximum marks 50)

- IPCC means practical portion integrated with the theory of the course.
- CIE marks for the theory component are **25 marks** and that for the practical component is **25 marks**.
- 25 marks for the theory component are split into **15 marks** for two Internal Assessment Tests (Two Tests, each of 15 Marks with 01-hour duration, are to be conducted) and **10 marks** for other

assessment methods mentioned in 22OB4.2. The first test at the end of 40-50% coverage of the syllabus and the second test after covering 85-90% of the syllabus.

- Scaled-down marks of the sum of two tests and other assessment methods will be CIE marks for the theory component of IPCC (that is for **25 marks)**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the theory component of IPCC.

CIE for the practical component of the IPCC

- **15 marks** for the conduction of the experiment and preparation of laboratory record, and **10 marks** for the test to be conducted after the completion of all the laboratory sessions.
- On completion of every experiment/program in the laboratory, the students shall be evaluated including viva-voce and marks shall be awarded on the same day.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to **15 marks**.
- The laboratory test **(duration 02/03 hours)** after completion of all the experiments shall be conducted for 50 marks and scaled down to **10 marks.**
- Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **25 marks**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the practical component of the IPCC.

SEE for IPCC

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored by the student shall be proportionally scaled down to 50 Marks

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper may include questions from the practical component.

Suggested Learning Resources:

Books

1. M. Morris Mano & Michael D. Ciletti, Digital Design With an Introduction to Verilog Design, 5e, Pearson Education.

2. Carl Hamacher, ZvonkoVranesic, SafwatZaky, Computer Organization, 5th Edition, Tata McGraw Hill.

Web links and Video Lectures (e-Resources):

https://cse11-iiith.vlabs.ac.in/

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning Assign the group task to Design the various types of counters and display the output accordingly Assessment Methods ● Lab Assessment (25 Marks) ● GATE Based Aptitude Test

OPERATING SYSTEMS		Semester	3
Course Code	BCS303	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:2:0	SEE Marks	50
Total Hours of Pedagogy	40 hours Theory + 20 hours practicals	Total Marks	100
Credits	04	Exam Hours	3
Examination nature (SEE)	**Theory**		

Course objectives:

- To Demonstrate the need for OS and different types of OS
- To discuss suitable techniques for management of different resources
- To demonstrate different APIs/Commands related to processor, memory, storage and file system management.

Teaching-Learning Process (General Instructions)

Teachers can use the following strategies to accelerate the attainment of the various course outcomes.

1. Lecturer methods (L) need not to be only traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.
5. Role play for process scheduling.
6. Demonstrate the installation of any one Linux OS on VMware/Virtual Box

MODULE-1 **8 Hours**

Introduction to operating systems, System structures: What operating systems do; Computer System organization; Computer System architecture; Operating System structure; Operating System operations; Process management; Memory management; Storage management; Protection and Security; Distributed system; Special-purpose systems; Computing environments.

Operating System Services: User - Operating System interface; System calls; Types of system calls; System programs; Operating system design and implementation; Operating System structure; Virtual machines; Operating System debugging, Operating System generation; System boot.

Textbook 1: Chapter – 1 (1.1-1.12), 2 (2.2-2.11)

MODULE-2 **8 Hours**

Process Management: Process concept; Process scheduling; Operations on processes; Inter process communication

Multi-threaded Programming: Overview; Multithreading models; Thread Libraries; Threading issues.

Process Scheduling: Basic concepts; Scheduling Criteria; Scheduling Algorithms; Thread scheduling; Multiple-processor scheduling,

Textbook 1: Chapter – 3 (3.1-3.4), 4 (4.1-4.4), 5 (5.1 -5.5)

MODULE-3 **8 Hours**

Process Synchronization: Synchronization: The critical section problem; Peterson's solution; Synchronization hardware; Semaphores; Classical problems of synchronization;

Deadlocks: System model; Deadlock characterization; Methods for handling deadlocks; Deadlock prevention; Deadlock avoidance; Deadlock detection and recovery from deadlock.

Textbook 1: Chapter – 6 (6.1-6.6), 7 (7.1 -7.7)

MODULE-4	8 Hours

Memory Management: Memory management strategies: Background; Swapping; Contiguous memory allocation; Paging; Structure of page table; Segmentation.

Virtual Memory Management: Background; Demand paging; Copy-on-write; Page replacement; Allocation of frames; Thrashing.

Textbook 1: Chapter -8 (8.1-8.6), 9 (9.1-9.6)

MODULE-5	8 Hours

File System, Implementation of File System: File system: File concept; Access methods; Directory and Disk structure; File system mounting; File sharing; **Implementing File system:** File system structure; File system implementation; Directory implementation; Allocation methods; Free space management.

Secondary Storage Structure, Protection: Mass storage structures; Disk structure; Disk attachment; Disk scheduling; Disk management; **Protection**: Goals of protection, Principles of protection, Domain of protection, Access matrix.

Textbook 1: Chapter – 10 (10.1-10.5) ,11 (11.1-11.5),12 (12.1-12.5), 14 (14.1-14.4)

PRACTICAL COMPONENT OF IPCC*(May cover all / major modules)*

Sl.NO	Experiments
1	Develop a c program to implement the Process system calls (fork (), exec(), wait(), create process, terminate process)
2	Simulate the following CPU scheduling algorithms to find turnaround time and waiting time a) FCFS b) SJF c) Round Robin d) Priority.
3	Develop a C program to simulate producer-consumer problem using semaphores.
4	Develop a C program which demonstrates interprocess communication between a reader process and a writer process. Use mkfifo, open, read, write and close APIs in your program.
5	Develop a C program to simulate Bankers Algorithm for DeadLock Avoidance.
6	Develop a C program to simulate the following contiguous memory allocation Techniques: a) Worst fit b) Best fit c) First fit.
7	Develop a C program to simulate page replacement algorithms: a) FIFO b) LRU
8	Simulate following File Organization Techniques a) Single level directory b) Two level directory
9	Develop a C program to simulate the Linked file allocation strategies.
10	Develop a C program to simulate SCAN disk scheduling algorithm.

Course outcomes (Course Skill Set):

At the end of the course, the student will be able to:

CO 1. Explain the structure and functionality of operating system

CO 2. Apply appropriate CPU scheduling algorithms for the given problem.

CO 3. Analyse the various techniques for process synchronization and deadlock handling.

CO 4. Apply the various techniques for memory management

CO 5. Explain file and secondary storage management strategies.

CO 6. Describe the need for information protection mechanisms

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

CIE for the theory component of the IPCC (maximum marks 50)

- IPCC means practical portion integrated with the theory of the course.
- CIE marks for the theory component are **25 marks** and that for the practical component is **25 marks**.
- 25 marks for the theory component are split into **15 marks** for two Internal Assessment Tests (Two Tests, each of 15 Marks with 01-hour duration, are to be conducted) and **10 marks** for other assessment methods

mentioned in 22OB4.2. The first test at the end of 40-50% coverage of the syllabus and the second test after covering 85-90% of the syllabus.

- Scaled-down marks of the sum of two tests and other assessment methods will be CIE marks for the theory component of IPCC (that is for **25 marks**).
- The student has to secure 40% of 25 marks to qualify in the CIE of the theory component of IPCC.

CIE for the practical component of the IPCC

- **15 marks** for the conduction of the experiment and preparation of laboratory record, and **10 marks** for the test to be conducted after the completion of all the laboratory sessions.
- On completion of every experiment/program in the laboratory, the students shall be evaluated including viva-voce and marks shall be awarded on the same day.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to **15 marks**.
- The laboratory test **(duration 02/03 hours)** after completion of all the experiments shall be conducted for 50 marks and scaled down to **10 marks.**
- Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **25 marks**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the practical component of the IPCC.

SEE for IPCC

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scoredby the student shall be proportionally scaled down to 50 Marks

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper may include questions from the practical component.

Suggested Learning Resources:

Textbooks

1. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, Operating System Principles 8th edition, Wiley-India, 2015

Reference Books

1. Ann McHoes Ida M Fylnn, Understanding Operating System, Cengage Learning, 6th Edition
2. D.M Dhamdhere, Operating Systems: A Concept Based Approach 3rd Ed, McGraw- Hill, 2013.
3. P.C.P. Bhatt, An Introduction to Operating Systems: Concepts and Practice 4th Edition, PHI(EEE), 2014.
4. William Stallings Operating Systems: Internals and Design Principles, 6th Edition, Pearson.

Web links and Video Lectures (e-Resources):

1. https://youtu.be/mXw9ruZaxzQ

2. https://youtu.be/vBURTt97EkA 3. https://www.youtube.com/watch?v=783KAB-tuE4&list=PLIemF3uozcAKTgsCIj82voMK3TMR0YE_f 4. https://www.youtube.com/watch?v=3-ITLMMeeXY&list=PL3pGy4HtqwD0n7bQfHjPnsWzkeRn6mkO

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning
• Assessment Methods
  ○ Case Study on Unix Based Systems (10 Marks)
  ○ Lab Assessment (25 Marks)

	DATA STRUCTURES AND APPLICATIONS		Semester	3
	Course Code	BCS304	CIE Marks	50
	Teaching Hours/Week (L: T:P: S)	3:0:0:0	SEE Marks	50
	Total Hours of Pedagogy	40	Total Marks	100
	Credits	03	Exam Hours	3
	Examination type (SEE)	**Theory**		

Course objectives:

CLO 1. To explain fundamentals of data structures and their applications.
CLO 2. To illustrate representation of Different data structures such as Stack, Queues, Linked Lists, Trees and Graphs.
CLO 3. To Design and Develop Solutions to problems using Linear Data Structures
CLO 4. To discuss applications of Nonlinear Data Structures in problem solving.
CLO 5. To introduce advanced Data structure concepts such as Hashing and Optimal Binary Search Trees

Teaching-Learning Process (General Instructions)

Teachers can use following strategies to accelerate the attainment of the various course outcomes.

1. Chalk and Talk with Black Board
2. ICT based Teaching
3. Demonstration based Teaching

Module-1 **8Hours**

INTRODUCTION TO DATA STRUCTURES: Data Structures, Classifications (Primitive & Non-Primitive), Data structure Operations
Review of pointers and dynamic Memory Allocation,
ARRAYS and STRUCTURES: Arrays, Dynamic Allocated Arrays, Structures and Unions, Polynomials, Sparse Matrices, representation of Multidimensional Arrays, Strings
STACKS: Stacks, Stacks Using Dynamic Arrays, Evaluation and conversion of Expressions
Text Book: Chapter-1:1.2 Chapter-2: 2.1 to 2.7 Chapter-3: 3.1,3.2,3.6
Reference Book 1: 1.1 to 1.4

Module-2 **8Hours**

QUEUES: Queues, Circular Queues, Using Dynamic Arrays, Multiple Stacks and queues.
LINKED LISTS : Singly Linked, Lists and Chains, Representing Chains in C, Linked Stacks and Queues, Polynomials
Text Book: Chapter-3: 3.3, 3.4, 3.7 Chapter-4: 4.1 to 4.4

Module-3 **8Hours**

LINKED LISTS : Additional List Operations, Sparse Matrices, Doubly Linked List.
TREES: Introduction, Binary Trees, Binary Tree Traversals, Threaded Binary Trees.
Text Book: Chapter-4: 4.5,4.7,4.8 Chapter-5: 5.1 to 5.3, 5.5

Module-4 **8Hours**

TREES(Cont..): Binary Search trees, Selection Trees, Forests, Representation of Disjoint sets, Counting Binary Trees,
GRAPHS: The Graph Abstract Data Types, Elementary Graph Operations
Text Book: Chapter-5: 5.7 to 5.11 Chapter-6: 6.1, 6.2

Module-5 **8Hours**

HASHING: Introduction, Static Hashing, Dynamic Hashing
PRIORITY QUEUES: Single and double ended Priority Queues, Leftist Trees
INTRODUCTION TO EFFICIENT BINARY SEARCH TREES: Optimal Binary Search Trees
Text Book: Chapter 8: 8.1 to 8.3 Chapter 9: 9.1, 9.2 Chapter 10: 10.1

Course outcome (Course Skill Set)

At the end of the course the student will be able to:
CO 1. Explain different data structures and their applications.
CO 2. Apply Arrays, Stacks and Queue data structures to solve the given problems.
CO 3. Use the concept of linked list in problem solving.
CO 4. Develop solutions using trees and graphs to model the real-world problem.
CO 5. Explain the advanced Data Structures concepts such as Hashing Techniques and Optimal Binary Search Trees.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Textbook:

1. Ellis Horowitz, Sartaj Sahni and Susan Anderson-Freed, Fundamentals of Data Structures in C, 2nd Ed, Universities Press, 2014

Reference Books:

1. Seymour Lipschutz, Data Structures Schaum's Outlines, Revised 1st Ed, McGraw Hill, 2014.
2. Gilberg & Forouzan, Data Structures: A Pseudo-code approach with C, 2nd Ed, Cengage Learning,2014.
3. Reema Thareja, Data Structures using C, 3rd Ed, Oxford press, 2012.
4. Jean-Paul Tremblay & Paul G. Sorenson, An Introduction to Data Structures with Applications, 2nd Ed, McGraw Hill, 2013
5. A M Tenenbaum, Data Structures using C, PHI, 1989
6. Robert Kruse, Data Structures and Program Design in C, 2nd Ed, PHI, 1996.

Web links and Video Lectures (e-Resources):

- http://elearning.vtu.ac.in/econtent/courses/video/CSE/06CS35.html
- https://nptel.ac.in/courses/106/105/106105171/
- http://www.nptelvideos.in/2012/11/data-structures-and-algorithms.html
- https://www.youtube.com/watch?v=3Xo6P_V-qns&t=201s
- https://ds2-iiith.vlabs.ac.in/exp/selection-sort/index.html
- https://nptel.ac.in/courses/106/102/106102064/
- https://ds1-iiith.vlabs.ac.in/exp/stacks-queues/index.html
- https://ds1-iiith.vlabs.ac.in/exp/linked-list/basics/overview.html
- https://ds1-iiith.vlabs.ac.in/List%20of%20experiments.html
- https://ds1-iiith.vlabs.ac.in/exp/tree-traversal/index.html
- https://ds1-iiith.vlabs.ac.in/exp/tree-traversal/depth-first-traversal/dft-practice.html
- https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_01350159542807756812559/overview

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Role Play
- Flipped classroom
- Assessment Methods for 25 Marks (opt two Learning Activities)
  - Case Study
  - Programming Assignment
  - Gate Based Aptitude Test
  - MOOC Assignment for selected Module

<table>
<tr><td colspan="4" align="center">DATA STRUCTURES LABORATORY
SEMESTER – III</td></tr>
<tr><td>Course Code</td><td>BCSL305</td><td>CIE Marks</td><td>50</td></tr>
<tr><td>Number of Contact Hours/Week</td><td>0:0:2</td><td>SEE Marks</td><td>50</td></tr>
<tr><td>Total Number of Lab Contact Hours</td><td>28</td><td>Exam Hours</td><td>03</td></tr>
<tr><td colspan="4" align="center">Credits – 1</td></tr>
<tr><td colspan="4">Course Learning Objectives:</td></tr>
<tr><td colspan="4">This laboratory course enables students to get practical experience in design, develop, implement, analyze and evaluation/testing of
● Dynamic memory management
● Linear data structures and their applications such as stacks, queues and lists
● Non-Linear data structures and their applications such as trees and graphs</td></tr>
<tr><td colspan="4">Descriptions (if any):</td></tr>
<tr><td colspan="4">● Implement all the programs in “C ” Programming Language and Linux OS.</td></tr>
<tr><td colspan="4">Programs List:</td></tr>
<tr><td>1.</td><td colspan="3">Develop a Program in C for the following:
a) Declare a calendar as an array of 7 elements (A dynamically Created array) to represent 7 days of a week. Each Element of the array is a structure having three fields. The first field is the name of the Day (A dynamically allocated String), The second field is the date of the Day (A integer), the third field is the description of the activity for a particular day (A dynamically allocated String).
b) Write functions create(), read() and display(); to create the calendar, to read the data from the keyboard and to print weeks activity details report on screen.</td></tr>
<tr><td>2.</td><td colspan="3">Develop a Program in C for the following operations on Strings.
a. Read a main String (STR), a Pattern String (PAT) and a Replace String (REP)
b. Perform Pattern Matching Operation: Find and Replace all occurrences of PAT in STR with REP if PAT exists in STR. Report suitable messages in case PAT does not exist in STR
Support the program with functions for each of the above operations. Don't use Built-in functions.</td></tr>
<tr><td>3.</td><td colspan="3">Develop a menu driven Program in C for the following operations on STACK of Integers (Array Implementation of Stack with maximum size MAX)
a. Push an Element on to Stack
b. Pop an Element from Stack
c. Demonstrate how Stack can be used to check Palindrome
d. Demonstrate Overflow and Underflow situations on Stack
e. Display the status of Stack
f. Exit
Support the program with appropriate functions for each of the above operations</td></tr>
</table>

4.	Develop a Program in C for converting an Infix Expression to Postfix Expression. Program should support for both parenthesized and free parenthesized expressions with the operators: +, -, *, /, % (Remainder), ^ (Power) and alphanumeric operands.
5.	Develop a Program in C for the following Stack Applications a. Evaluation of Suffix expression with single digit operands and operators: +, -, *, /, %, ^ b. Solving Tower of Hanoi problem with n disks

6.	Develop a menu driven Program in C for the following operations on Circular QUEUE of Characters (Array Implementation of Queue with maximum size MAX) a. Insert an Element on to Circular QUEUE b. Delete an Element from Circular QUEUE c. Demonstrate Overflow and Underflow situations on Circular QUEUE d. Display the status of Circular QUEUE e. Exit Support the program with appropriate functions for each of the above operations
7.	Develop a menu driven Program in C for the following operations on Singly Linked List (SLL) of Student Data with the fields: *USN, Name, Programme, Sem, PhNo* a. Create a SLL of N Students Data by using *front insertion*. b. Display the status of SLL and count the number of nodes in it c. Perform Insertion / Deletion at End of SLL d. Perform Insertion / Deletion at Front of SLL(Demonstration of stack) e. Exit
8.	Develop a menu driven Program in C for the following operations on Doubly Linked List (DLL) of Employee Data with the fields: *SSN, Name, Dept, Designation, Sal, PhNo* a. Create a DLL of N Employees Data by using *end insertion*. b. Display the status of DLL and count the number of nodes in it c. Perform Insertion and Deletion at End of DLL d. Perform Insertion and Deletion at Front of DLL e. Demonstrate how this DLL can be used as Double Ended Queue. f. Exit
9.	Develop a Program in C for the following operationson Singly Circular Linked List (SCLL) with header nodes a. Represent and Evaluate a Polynomial $P(x,y,z) = 6x^2y^2z-4yz^5+3x^3yz+2xy^5z-2xyz^3$ b. Find the sum of two polynomials POLY1(x,y,z) and POLY2(x,y,z) and store the result in POLYSUM(x,y,z) Support the program with appropriate functions for each of the above operations
10.	Develop a menu driven Program in C for the following operations on Binary Search Tree (BST) of Integers . a. Create a BST of N Integers: 6, 9, 5, 2, 8, 15, 24, 14, 7, 8, 5, 2 b. Traverse the BST in Inorder, Preorder and Post Order c. Search the BST for a given element (KEY) and report the appropriate message d. Exit
11.	Develop a Program in C for the following operations on Graph(G) of Cities a. Create a Graph of N cities using Adjacency Matrix. b. Print all the nodes reachable from a given starting node in a digraph using DFS/BFS method

12.	Given a File of N employee records with a set K of Keys (4-digit) which uniquely determine the records in file F. Assume that file F is maintained in memory by a Hash Table (HT) of m memory locations with L as the set of memory addresses (2-digit) of locations in HT. Let the keys in K and addresses in L are Integers. Develop a Program in C that uses Hash function H: K →L as H(K)=K mod m (remainder method), and implement hashing technique to map a given key K to the address space L. Resolve the collision (if any) using linear probing.
Laboratory Outcomes: The student should be able to:	

- Analyze various linear and non-linear data structures
- Demonstrate the working nature of different types of data structures and their applications
- Use appropriate searching and sorting algorithms for the give scenario.
- Apply the appropriate data structure for solving real world problems

Conduct of Practical Examination:

- Experiment distribution
  - For laboratories having only one part: Students are allowed to pick one experiment from the lot with equal opportunity.
  - For laboratories having PART A and PART B: Students are allowed to pick one experiment from PART A and one experiment from PART B, with equal opportunity.
- Change of experiment is allowed only once and marks allotted for procedure to be made zero of the changed part only.
- Marks Distribution *(Need to change in accordance with university regulations)*
  c) For laboratories having only one part – Procedure + Execution + Viva-Voce: 15+70+15 = 100 Marks
  d) For laboratories having PART A and PART B
    i. Part A – Procedure + Execution + Viva = 6 + 28 + 6 = 40 Marks
    ii. Part B – Procedure + Execution + Viva = 9 + 42 + 9 = 60 Marks

	Object Oriented Programming with JAVA		Semester	3
	Course Code	BCS306A	CIE Marks	50
	Teaching Hours/Week (L: T:P: S)	2:0:2	SEE Marks	50
	Total Hours of Pedagogy	28 Hours of Theory + 20 Hours of Practical	Total Marks	100
	Credits	03	Exam Hours	03
	Examination type (SEE)	Theory		

Note - Students who have undergone " Basics of Java Programming-BPLCK105C/205C" in first year are not eligible to opt this course

Course objectives:

- To learn primitive constructs JAVA programming language.
- To understand Object Oriented Programming Features of JAVA.
- To gain knowledge on: packages, multithreaded programing and exceptions.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes and make Teaching –Learning more effective

1. Use Online Java Compiler IDE: https://www.jdoodle.com/online-java-compiler/ or any other.
2. Demonstration of programing examples.
3. Chalk and board, power point presentations
4. Online material (Tutorials) and video lectures.

Module-1

An Overview of Java: Object-Oriented Programming (Two Paradigms, Abstraction, The Three OOP Principles), Using Blocks of Code, Lexical Issues (Whitespace, Identifiers, Literals, Comments, Separators, The Java Keywords).

Data Types, Variables, and Arrays: The Primitive Types (Integers, Floating-Point Types, Characters, Booleans), Variables, Type Conversion and Casting, Automatic Type Promotion in Expressions, Arrays, Introducing Type Inference with Local Variables.

Operators: Arithmetic Operators, Relational Operators, Boolean Logical Operators, The Assignment Operator, The ? Operator, Operator Precedence, Using Parentheses.

Control Statements: Java's Selection Statements (if, The Traditional switch), Iteration Statements (while, do-while, for, The For-Each Version of the for Loop, Local Variable Type Inference in a for Loop, Nested Loops), Jump Statements (Using break, Using continue, return).

Chapter 2, 3, 4, 5

Module-2

Introducing Classes: Class Fundamentals**,** Declaring Objects**,** Assigning Object Reference Variables**,** Introducing Methods**,** Constructors**,** The this Keyword**,** Garbage Collection.

Methods and Classes: Overloading Methods, Objects as Parameters, Argument Passing, Returning Objects, Recursion, Access Control, Understanding static, Introducing final, Introducing Nested and Inner Classes.

Chapter 6, 7

Module-3

Inheritance: Inheritance Basics, Using super, Creating a Multilevel Hierarchy, When Constructors Are Executed, Method Overriding, Dynamic Method Dispatch, Using Abstract Classes, Using final with Inheritance, Local Variable Type Inference and Inheritance, The Object Class.

Interfaces: Interfaces, Default Interface Methods, Use static Methods in an Interface, Private Interface Methods.

Chapter 8, 9

	Module-4
	Packages: Packages, Packages and Member Access, Importing Packages. **Exceptions:** Exception-Handling Fundamentals, Exception Types, Uncaught Exceptions, Using try and catch, Multiple catch Clauses, Nested try Statements, throw, throws, finally, Java's Built-in Exceptions, Creating Your Own Exception Subclasses, Chained Exceptions. **Chapter 9, 10**
	Module-5
	Multithreaded Programming: The Java Thread Model, The Main Thread, Creating a Thread, Creating Multiple Threads, Using isAlive() and join(), Thread Priorities, Synchronization, Interthread Communication, Suspending, Resuming, and Stopping Threads, Obtaining a Thread's State. **Enumerations, Type Wrappers and Autoboxing:** Enumerations (Enumeration Fundamentals, The values() and valueOf() Methods), Type Wrappers (Character, Boolean, The Numeric Type Wrappers), Autoboxing (Autoboxing and Methods, Autoboxing/Unboxing Occurs in Expressions, Autoboxing/Unboxing Boolean and Character Values). **Chapter 11, 12**

Course outcome (Course Skill Set)

At the end of the course, the student will be able to:

1. Demonstrate proficiency in writing simple programs involving branching and looping structures.
2. Design a class involving data members and methods for the given scenario.
3. Apply the concepts of inheritance and interfaces in solving real world problems.
4. Use the concept of packages and exception handling in solving complex problem
5. Apply concepts of multithreading, autoboxing and enumerations in program development

Programming Experiments (Suggested and are not limited to)

1. Develop a JAVA program to add TWO matrices of suitable order N (The value of N should be read from command line arguments).
2. Develop a stack class to hold a maximum of 10 integers with suitable methods. Develop a JAVA main method to illustrate Stack operations.
3. A class called Employee, which models an employee with an ID, name and salary, is designed as shown in the following class diagram. The method raiseSalary (percent) increases the salary by the given percentage. Develop the Employee class and suitable main method for demonstration.
4. A class called MyPoint, which models a 2D point with x and y coordinates, is designed as follows:
   - Two instance variables x (int) and y (int).
   - A default (or "no-arg") constructor that construct a point at the default location of (0, 0).
   - A overloaded constructor that constructs a point with the given x and y coordinates.
   - A method setXY() to set both x and y.
   - A method getXY() which returns the x and y in a 2-element int array.
   - A toString() method that returns a string description of the instance in the format "(x, y)".
   - A method called distance(int x, int y) that returns the distance from this point to another point at the given (x, y) coordinates
   - An overloaded distance(MyPoint another) that returns the distance from this point to the given MyPoint instance (called another)
   - Another overloaded distance() method that returns the distance from this point to the origin (0,0)

   Develop the code for the class MyPoint. Also develop a JAVA program (called TestMyPoint) to test all the methods defined in the class.
5. Develop a JAVA program to create a class named shape. Create three sub classes namely: circle, triangle and square, each class has two member functions named draw () and erase (). Demonstrate

polymorphism concepts by developing suitable methods, defining member data and main program.

6. Develop a JAVA program to create an abstract class Shape with abstract methods calculateArea() and calculatePerimeter(). Create subclasses Circle and Triangle that extend the Shape class and implement the respective methods to calculate the area and perimeter of each shape.
7. Develop a JAVA program to create an interface Resizable with methods resizeWidth(int width) and resizeHeight(int height) that allow an object to be resized. Create a class Rectangle that implements the Resizable interface and implements the resize methods
8. Develop a JAVA program to create an outer class with a function display. Create another class inside the outer class named inner with a function called display and call the two functions in the main class.
9. Develop a JAVA program to raise a custom exception (user defined exception) for DivisionByZero using try, catch, throw and finally.
10. Develop a JAVA program to create a package named mypack and import & implement it in a suitable class.
11. Write a program to illustrate creation of threads using runnable class. (start method start each of the newly created thread. Inside the run method there is sleep() for suspend the thread for 500 milliseconds).
12. Develop a program to create a class MyThread in this class a constructor, call the base class constructor, using super and start the thread. The run method of the class starts after this. It can be observed that both main thread and created child thread are executed concurrently.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

CIE for the theory component of the IPCC (maximum marks 50)

- IPCC means practical portion integrated with the theory of the course.
- CIE marks for the theory component are **25 marks** and that for the practical component is **25 marks**.
- 25 marks for the theory component are split into **15 marks** for two Internal Assessment Tests (Two Tests, each of 15 Marks with 01-hour duration, are to be conducted) and **10 marks** for other assessment methods mentioned in 22OB4.2. The first test at the end of 40-50% coverage of the syllabus and the second test after covering 85-90% of the syllabus.
- Scaled-down marks of the sum of two tests and other assessment methods will be CIE marks for the theory component of IPCC (that is for **25 marks)**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the theory component of IPCC.

CIE for the practical component of the IPCC

- **15 marks** for the conduction of the experiment and preparation of laboratory record, and **10 marks** for the test to be conducted after the completion of all the laboratory sessions.
- On completion of every experiment/program in the laboratory, the students shall be evaluated including viva-voce and marks shall be awarded on the same day.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to **15 marks**.
- The laboratory test **(duration 02/03 hours)** after completion of all the experiments shall be conducted for 50 marks and scaled down to **10 marks.**
- Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **25 marks**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the practical component of the IPCC.

SEE for IPCC

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored by the student shall be proportionally scaled down to 50 Marks

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper may include questions from the practical component.

Suggested Learning Resources:

Textbook

1. Java: The Complete Reference, Twelfth Edition, by Herbert Schildt, November 2021, McGraw-Hill, ISBN: 9781260463422

Reference Books

1. Programming with Java, 6th Edition, by E Balagurusamy, Mar-2019, McGraw Hill Education, ISBN: 9789353162337.
2. Thinking in Java, Fourth Edition, by Bruce Eckel, Prentice Hall, 2006 (https://sd.blackball.lv/library/thinking_in_java_4th_edition.pdf)

Web links and Video Lectures (e-Resources):

- Java Tutorial: https://www.geeksforgeeks.org/java/
- Introduction To Programming In Java (by Evan Jones, Adam Marcus and Eugene Wu): https://ocw.mit.edu/courses/6-092-introduction-to-programming-in-java-january-iap-2010/
- Java Tutorial: https://www.w3schools.com/java/
- Java Tutorial: https://www.javatpoint.com/java-tutorial

Activity Based Learning (Suggested Activities)/ Practical Based learning

1. Installation of Java (Refer: https://www.java.com/en/download/help/index_installing.html)
2. Demonstration of online IDEs like geeksforgeeks, jdoodle or any other Tools
3. Demonstration of class diagrams for the class abstraction, type visibility, composition and inheritance

Assessment Method

- Programming Assignment / Course Project

	Python Programming for Data Science		Semester	3
	Course Code	**BDS306B**	CIE Marks	50
	Teaching Hours/Week (L: T:P: S)	2:0:2:0	SEE Marks	50
	Total Hours of Pedagogy	28 Hours Theory + 20 Hours Practical	Total Marks	100
	Credits	03	Exam Hours	03
	Examination type (SEE)	Theory		

Note - Students who have undergone " Introduction to Python Programming- BPLCK105B/205B" in first year are not eligible to opt this course

Course Learning objectives:

CLO 1:To understand Python constructs and use them to build the programs.

CLO 2: To analyse different conditional statements and their applications in programs.

CLO 3: To learn and use basic data structures in python language.

CLO 4: To learn and demonstrate array manipulations by reading data from files

CLO 5: To understand and use different data in a data analytics context.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Chalk and board, power point presentations
2. Online material (Tutorials) and video lectures.
3. Demonstration of programing examples.

Module-1 **6 hr**

Introduction to python: Elements of python language, python block structure, variables and assignment statement, data types in python, operations, simple input/output print statements, formatting print statement.

Text Book 1: Chapter 3 (3.2, 3.3, 3.4, 3.6, 3.7, 3.9 and 3.10)

Module-2 **5 hr**

Decision structure: forming conditions, if statement, the if-else and nested if-else, looping statements: introduction to looping, python built in functions for looping, loop statements, jump statement.

Text Book 1: Chapter 4 (4.2 to 4.6) , Chapter 5 (5.1 to 5.4)

Module-3 **5 hr**

Lists: lists, operation on list, Tuples: introduction, creating,indexing and slicing, operations on tuples. sets: creating, operation in sets, introduction dictionaries, creating, operations, nested dictionary, looping over dictionary.

Text Book 1: Chapter 7 (7.2 to 7.3) , Chapter 8 (8.1 to 8.4) and Chapter 9(9.1 to 9.3, 9.7 to 9.12)

Module-4 **6 hr**

The NumPy Library: Ndarray: the heart of the library, Basic operations, indexing, slicing and iterating, conditions and boolean arrays, array manipulation, general concepts, reading and writing array data on files. **The pandas Library:** an introduction to Data structure, other functionalities on indexes, operations between data structures, function application and mapping.

	Text Book 2: Chapter 3 and Chapter 4.
	Module-5 **6 hr**
	The pandas : Reading and Writing data: i/o API tools, CSV and textual files, Reading data in CSV or text files, reading and writing HTML files, reading data from XML files, Microsoft excel files, JSON data, Pickle python object serialization. **Pandas in Depth : data manipulation:** data preparation, concatenating data transformation discretization binning, permutation, string manipulation, data aggregation group iteration. **Text Book 2: Chapter 5 and Chapter 6**

Course outcome (Course Skill Set)

At the end of the course, the student will be able to :
CO1: Describe the constructs of python programming
CO2: Use looping and conditional constructs to build programs.
CO3: Apply the concept of data structure to solve the real world problem.
CO4: Use the NumPy constructs for matrix manipulations
CO5: Apply the Panda constructs for data analytics.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks

Suggested Learning Resources:
Text Books:

1. S. Sridhar, J. Indumathi, V.M. Hariharan "Python Programming" Pearson publishers, 1st edition 2023.
2. Fabio Nelli, "**Python Data Analytics**", Apress, Publishing, 1st Edition, 2015.

Reference Book:

1. Paul Deitel and Harvey deitel,"**Intro to Python for Computer Science and Data science**", 1st edition Pearson Publisher 2020.

Web links and Video Lectures (e-Resources):

- Nptel: Introduction to Python for Data Sciencehttps://www.youtube.com/watch?v=tA42nHmmEKw&list=PLh2mXjKcTPSACrQxPM2_1Ojus5HX88ht7

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Assessment Methods
  - Programming Assignment (10 Marks)

Practical Component

Sl.NO	Experiments
1	Develop a python program to read **n** digit integer number, and separate the integer number and display each digit. [Hint: input:5678 output: 5 6 7 8, use: floor and mod operators)
2	Develop a python program to accept 4 numbers and display them in sorted order using a minimum number of **if else** statements.
3	Develop python scripts to Calculate the mean, median, mode, variance and standard deviation of **n** integer numbers.
4	Develop a program for checking if a given **n** digit number is palindrome or not. [hint: input 1221 output: palindrome, use //and % operator with loop statement]
5	Develop a python script to display a multiplication table for given integer **n**.
6	Develop a python script to rotate right about a given position in that list and display them. [hint: input [1,4,5,-10] position: 2, output: [-10,5,4,1]]
7	DevelopWrite a python script to interchange the digits of a given integer number. [hint: input: 23456, interchange: 3 and 5 output: 25436]

8	Develop a python program to capitalize a given list of strings. [hint: [hello, good, how, simple] output: [Hello, Good, How, Simple]
9	Using a dictionary, Develop a python program to determine and print the number of duplicate words in a sentence.
10	Develop python program to read Numpy array and print row (sum,mean std) and column (sum,mean,std)
11	Develop a python program to read and print in the console CSV file.
12	Develop a python program to read a HTML file with basic tags, and construct a dictionary and display the same in the console.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

CIE for the theory component of the IPCC (maximum marks 50)

- IPCC means practical portion integrated with the theory of the course.
- CIE marks for the theory component are **25 marks** and that for the practical component is **25 marks.**
- 25 marks for the theory component are split into **15 marks** for two Internal Assessment Tests (Two Tests, each of 15 Marks with 01-hour duration, are to be conducted) and **10 marks** for other assessment methods mentioned in 22OB4.2. The first test at the end of 40-50% coverage of the syllabus and the second test after covering 85-90% of the syllabus.
- Scaled-down marks of the sum of two tests and other assessment methods will be CIE marks for the theory component of IPCC (that is for **25 marks).**
- The student has to secure 40% of 25 marks to qualify in the CIE of the theory component of IPCC.

CIE for the practical component of the IPCC

- **15 marks** for the conduction of the experiment and preparation of laboratory record, and **10 marks** for the test to be conducted after the completion of all the laboratory sessions.
- On completion of every experiment/program in the laboratory, the students shall be evaluated including viva-voce and marks shall be awarded on the same day.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to **15 marks.**
- The laboratory test **(duration 02/03 hours)** after completion of all the experiments shall be conducted for 50 marks and scaled down to **10 marks.**
- Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **25 marks**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the practical component of the IPCC.

SEE for IPCC

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored by the student shall be proportionally scaled down to 50 Marks

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper may include questions from the practical component.

Data Analytics with R		Semester	3
Course Code	**BDS306C**	CIE Marks	50
Teaching Hours/Week (L: T:P: S)	2;0;2;0	SEE Marks	50
Total Hours of Pedagogy	28 Hours Theory + 20 Hours Practical	Total Marks	100
Credits	03	Exam Hours	03
Examination type (SEE)	Theory		

Course Learning objectives:

CLO 1: To Gain the knowledge of R Programming Concepts

CLO 2: To Explain the concepts of Data Visualization

CLO 3: To Explain the concept of Statistics in R.

CLO 4: To Work with R charts and Graphs

Teaching-Learning Process (General Instructions)

1. Chalk and board, power point presentations
2. Online material (Tutorials) and video lectures.
3. Demonstration of programing examples.

Module-1 **5 hours**

Basics of R

Introducing R, Initiating R, Packages in R, Environments and Functions, Flow Controls, Loops, Basic Data Types in R, Vectors

Chapter 1: 1.1 to 1.7 Chapter 2: 2.1,2.2

Module-2 **5 hours**

Basics of R Continued

Matrices and Arrays, Lists, Data Frames, Factors, Strings, Dates and Times

Chapter 2: 2.3,2.4,2.5,2.6,2.7.2.8.1,2.8.2

Module-3 **6 Hours**

Data Preparation

Datasets, Importing and Exporting files, Accessing Databases, Data Cleaning and Transformation

Chapter 3: 3.1,3.2,3.3,3.4

Module-4 **6 Hours**

Graphics using R

Exploratory Data Analysis, Main Graphical Packages, Pie Charts, Scatter Plots, Line Plots, Histograms, Box Plots, Bar Plots, Other Graphical packages

Chapter 4: 4.1 to 4.9

Module-5 **6 Hours**

Statistical Analysis using R

Basic Statistical Measures, Normal distribution, Binomial distribution, Correlation Analysis, Regression Analysis-Linear Regression Analysis of Variance

Chapter 5: 5.1, 5.3, 5.4, 5.5, 5.6.1, 5.7

Course outcome (Course Skill Set)

At the end of the course, the student will be able to :
CO1: Describe the structures of R Programming.
CO2: Illustrate the basics of Data Preparation with real world examples.
CO3: Apply the Graphical Packages of R for visualization.
CO4: Apply various Statistical Analysis methods for data analytics.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Text Books:

R Programming: An Approach to Data Analytics, G. Sudhamathy and C. Jothi Venkateswaran, MJP Publishers, 2019

Reference Books:

1..An Introduction to R, Notes on R: A Programming Environment for Data Analysis and Graphics. W. N. Venables, D.M. Smith and the R Development Core Team. Version 3.0.1 (2013-05-16)

2. Cotton, R. (2013). Learning R: A Step by Step Function Guide to Data Analysis. 1st ed. O'Reilly Media Inc
Web links and Video Lectures (e-Resources):
1. URL: https://cran.r-project.org/doc/manuals/r-release/R-intro.pdf 2. http://www.tutorialspoint.com/r/r_tutorial.pdf 3. https://users.phhp.ufl.edu/rlp176/Courses/PHC6089/R_notes/intro.html 4. https://cran.r-project.org/web/packages/explore/vignettes/explore_mtcars.html 5. https://www.w3schools.com/r/r_stat_data_set.asp 6. https://rpubs.com/BillB/217355
Activity Based Learning (Suggested Activities in Class)/ Practical Based learning ● Programming Assignment (10 Marks)

Practical Component

Sl.NO	Experiments
1	Demonstrate the steps for installation of R and R Studio. Perform the following: a) Assign different type of values to variables and display the type of variable. Assign different types such as Double, Integer, Logical, Complex and Character and understand the difference between each data type. b) Demonstrate Arithmetic and Logical Operations with simple examples. c) Demonstrate generation of sequences and creation of vectors. d) Demonstrate Creation of Matrices e) Demonstrate the Creation of Matrices from Vectors using Binding Function. f) Demonstrate element extraction from vectors, matrices and arrays
2	Assess the Financial Statement of an Organization being supplied with 2 vectors of data: Monthly Revenue and Monthly Expenses for the Financial Year. You can create your own sample data vector for this experiment) Calculate the following financial metrics: a. Profit for each month. b. Profit after tax for each month (Tax Rate is 30%). c. Profit margin for each month equals to profit after tax divided by revenue. d. Good Months – where the profit after tax was greater than the mean for the year. e. Bad Months – where the profit after tax was less than the mean for the year. f. The best month – where the profit after tax was max for the year. g. The worst month – where the profit after tax was min for the year. **Note:** a. All Results need to be presented as vectors b. Results for Dollar values need to be calculated with $0.01 precision, but need to be presented in Units of $1000 (i.e 1k) with no decimal points c. Results for the profit margin ratio need to be presented in units of % with no decimal point. d. It is okay for tax to be negative for any given month (deferred tax asset) e. Generate CSV file for the data.
3	Develop a program to create two 3 X 3 matrices A and B and perform the following operations a) Transpose of the matrix b) addition c) subtraction d) multiplication
4	Develop a program to find the factorial of given number using recursive function calls.

5 Develop an R Program using functions to find all the prime numbers up to a specified number by the method of Sieve of Eratosthenes.

6 The built-in data set mammals contain data on body weight versus brain weight. Develop R commands to:
a) Find the Pearson and Spearman correlation coefficients. Are they similar?
b) Plot the data using the plot command.
c) Plot the logarithm (log) of each variable and see if that makes a difference.

7 Develop R program to create a Data Frame with following details and do the following operations.

itemCode	**itemCategory**	**itemPrice**
1001	Electronics	700
1002	Desktop Supplies	300
1003	Office Supplies	350
1004	USB	400
1005	CD Drive	800

a) Subset the Data frame and display the details of only those items whose price is greater than or equal to 350.
b) Subset the Data frame and display only the items where the category is either “Office Supplies” or “Desktop Supplies”
c) Create another Data Frame called “item-details” with three different fields itemCode, ItemQtyonHand and ItemReorderLvl and merge the two frames

8 Let us use the built-in dataset air quality which has Daily air quality measurements in New York, May to September 1973. Develop R program to generate histogram by using appropriate arguments for the following statements.
a) Assigning names, using the air quality data set.
b) Change colors of the Histogram
c) Remove Axis and Add labels to Histogram
d) Change Axis limits of a Histogram
e) Add Density curve to the histogram

9 Design a data frame in R for storing about 20 employee details. Create a CSV file named “input.csv” that defines all the required information about the employee such as id, name, salary, start_date, dept. Import into R and do the following analysis.
a) Find the total number rows & columns
b) Find the maximum salary
c) Retrieve the details of the employee with maximum salary
d) Retrieve all the employees working in the IT Department.
e) Retrieve the employees in the IT Department whose salary is greater than 20000 and write these details into another file “output.csv”

10 Using the built in dataset mtcars which is a popular dataset consisting of the design and fuel consumption patterns of 32 different automobiles. The data was extracted from the 1974 Motor Trend US magazine, and comprises fuel consumption and 10 aspects of automobile design and performance for 32 automobiles (1973-74 models). Format A data frame with 32 observations on 11 variables : [1] mpg Miles/(US) gallon, [2] cyl Number of cylinders [3] disp Displacement (cu.in.), [4] hp Gross horsepower [5] drat Rear axle ratio,[6] wt Weight (lb/1000) [7] qsec 1/4 mile time, [8] vs V/S, [9] am Transmission (0 = automatic, 1 = manual), [10] gear Number of forward gears, [11] carb Number of carburetors

Develop R program, to solve the following:
a) What is the total number of observations and variables in the dataset?
b) Find the car with the largest hp and the least hp using suitable functions
c) Plot histogram / density for each variable and determine whether continuous variables are normally distributed or not. If not, what is their skewness?
d) What is the average difference of gross horse power(hp) between automobiles with 3 and 4 number of cylinders(cyl)? Also determine the difference in their standard deviations.
e) Which pair of variables has the highest Pearson correlation?

11	Demonstrate the progression of salary with years of experience using a suitable data set (You can create your own dataset). Plot the graph visualizing the best fit line on the plot of the given data points. Plot a curve of Actual Values vs. Predicted values to show their correlation and performance of the model. Interpret the meaning of the slope and y-intercept of the line with respect to the given data. Implement using lm function. Save the graphs and coefficients in files. Attach the predicted values of salaries as a new column to the original data set and save the data as a new CSV file.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

CIE for the theory component of the IPCC (maximum marks 50)

- IPCC means practical portion integrated with the theory of the course.
- CIE marks for the theory component are **25 marks** and that for the practical component is **25 marks**.
- 25 marks for the theory component are split into **15 marks** for two Internal Assessment Tests (Two Tests, each of 15 Marks with 01-hour duration, are to be conducted) and **10 marks** for other assessment methods mentioned in 22OB4.2. The first test at the end of 40-50% coverage of the syllabus and the second test after covering 85-90% of the syllabus.
- Scaled-down marks of the sum of two tests and other assessment methods will be CIE marks for the theory component of IPCC (that is for **25 marks)**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the theory component of IPCC.

CIE for the practical component of the IPCC

- **15 marks** for the conduction of the experiment and preparation of laboratory record, and **10 marks** for the test to be conducted after the completion of all the laboratory sessions.
- On completion of every experiment/program in the laboratory, the students shall be evaluated including viva-voce and marks shall be awarded on the same day.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to **15 marks**.
- The laboratory test **(duration 02/03 hours)** after completion of all the experiments shall be conducted for 50 marks and scaled down to **10 marks.**
- Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **25 marks**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the practical component of the IPCC.

SEE for IPCC

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored by the student shall be proportionally scaled down to 50 Marks

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper may include questions from the practical component.

BSCK307 – Social Connect & Responsibility 2022 Scheme & syllabus for 3rd sem		Semester	**3rd**
Course Code	**BSCK307**	CIE Marks	**100**
Teaching Hours/Week (L:T:P: S)	0:0:3:1	SEE Marks	------
Total Hours of Pedagogy	40 hour Practical Session +15 hour Planning	Total Marks	**100**
Examination nature (No SEE – Only CIE)	For CIE Assessment - Activities Report Evaluation by College NSS Officer / HOD / Sports Dept / Any Dept.		
Credits	01 - Credit		

Course objectives: The course will enable the students to:

1. Provide a formal platform for students to communicate and connect to the surrounding.
2. create a responsible connection with the society.
3. Understand the community in general in which they work.
4. Identify the needs and problems of the community and involve them in problem –solving.
5. Develop among themselves a sense of social & civic responsibility & utilize their knowledge in finding practical solutions to individual and community problems.
6. Develop competence required for group-living and sharing of responsibilities & gain skills in mobilizing community participation to acquire leadership qualities and democratic attitudes.

General Instructions - Pedagogy :

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. In addition to the traditional lecture method, different types of innovative teaching methods may be adopted so that the activities will develop students' theoretical and applied social and cultural skills.
2. State the need for activities and its present relevance in the society and Provide real-life examples.
3. Support and guide the students for self-planned activities.
4. You will also be responsible for assigning homework, grading assignments and quizzes, and documenting students' progress in real activities in the field.
5. Encourage the students for group work to improve their creative and analytical skills.

Contents :

The course is mainly activity-based that will offer a set of activities for the student that enables them to connect with fellow human beings, nature, society, and the world at large.

The course will engage students for interactive sessions, open mic, reading group, storytelling sessions, and semester-long activities conducted by faculty mentors.

In the following a set of activities planned for the course have been listed:

Social Connect & Responsibility - Contents

Part I:

Plantation and adoption of a tree:

Plantation of a tree that will be adopted for four years by a group of BE / B.Tech students. (ONE STUDENT ONE TREE) They will also make an excerpt either as a documentary or a photo blog describing the plant's origin, its usage in daily life, its appearance in folklore and literature - – Objectives, Visit, case study, report, outcomes.

Part II :

Heritage walk and crafts corner:

Heritage tour, knowing the history and culture of the city, connecting to people around through their history, knowing the city and its craftsman, photo blog and documentary on evolution and practice of various craft forms - – Objectives,Visit, case study, report, outcomes.

Part III :

Organic farming and waste management:

Usefulness of organic farming, wet waste management in neighboring villages, and implementation in the campus –

Objectives,Visit, case study, report, outcomes.

Part IV:

Water conservation:

Knowing the present practices in the surrounding villages and implementation in the campus, documentary or photoblog presenting the current practices – Objectives, Visit, case study, report, outcomes.

Part V :

Food walk:

City's culinary practices, food lore, and indigenous materials of the region used in cooking – Objectives, Visit, case study, report, outcomes.

Course outcomes (Course Skill Set):

At the end of the course, the student will be able to:

CO1: Communicate and connect to the surrounding.

CO2: Create a responsible connection with the society.

CO3: Involve in the community in general in which they work.

CO4: Notice the needs and problems of the community and involve them in problem –solving.

CO5: Develop among themselves a sense of social & civic responsibility & utilize their knowledge in finding practical solutions to individual and community problems.

CO6: Develop competence required for group-living and sharing of responsibilities & gain skills in mobilizing community participation to acquire leadership qualities and democratic attitudes.

Activities:

Jamming session, open mic, and poetry: Platform to connect to others. Share the stories with others. Share the experience of Social Connect. Exhibit the talent like playing instruments, singing, one-act play, art-painting, and fine art.

PEDAGOGY:

The pedagogy will include interactive lectures, inspiring guest talks, field visits, social immersion, and a course project. Applying and synthesizing information from these sources to define the social problem to address and take up the solution as the course project, with your group. Social immersionwith NGOs/social sections will be a key part of the course. Will all lead to the course project that will address the needs of the social sector?

COURSE TOPICS:

The course will introduce social context and various players in the social space, and present approaches to discovering and understanding social needs. Social immersion and inspiring conversional will culminate in developing an actual, idea for problem-based intervention, based on an in-depth understanding of a key social problem.

Duration :

A total of 40 - 50 hrs engagement per semester is required for the 3rd semester of the B.E. /B.Tech. program. The students will be divided into groups. Each group will be handled by faculty mentor. Faculty mentor will design the activities (particularly Jamming sessions open mic ,and poetry) Faculty mentors has to design the evaluation system as per VTU guidelines of scheme & syllabus.

Guideline for Assessment Process:

Continuous Internal Evaluation (CIE):

After completion of the course, the student shall prepare, with daily diary as reference, a comprehensive report in consultation with the mentor/s to indicate what he has observed and learned in the social connect period. The report should be signed by the mentor. The report shall

be evaluated on the basis of the following criteria and/or other relevant criteria pertaining to the activity completed. Marks allotted for the diary are out of 50. Planning and scheduling the social connect Information/Data collected during the social connect Analysis of the information/data and report writing Considering all above points allotting the marks as mentioned below

Excellent : 80 to 100
Good : 60 to 79
Satisfactory : 40 to 59
Unsatisfactory and fail : <39

Special Note :

NO SEE – Semester End Exam – Completely Practical and activities based evaluation

Pedagogy – Guidelines :

It may differ depending on local resources available for the study as well as environment and climatic differences, location and time of execution.

Sl No	Topic	Group size	Location	Activity execution	Reporting	Evaluation Of the Topic
1.	**Plantation and adoption of a tree:**	May be individual or team	Farmers land/ parks / Villages / roadside/ community area / College campus etc…..	Site selection /proper consultation/Continuous monitoring/ Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics Of scheme and syllabus by Faculty
2.	**Heritage walk and crafts corner:**	May be individual or team	Temples / monumental places / Villages/ City Areas / Grama panchayat/ public associations/Government Schemes officers/ campus etc…..	Site selection /proper consultation/Continuous monitoring/ Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics Of scheme and syllabus by Faculty
3.	**Organic farming and waste management:**	May be individual or team	Farmers land / parks / Villages visits / roadside/ community area / College campus etc…..	Group selection / proper consultation / Continuous monitoring / Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics Of scheme and syllabus by Faculty
4.	**Water conservation:** & conservation techniques	May be individual or team	Villages/ City Areas / Grama panchayat/ public associations/Government Schemes officers / campus etc…..	site selection / proper consultation/Continuous monitoring/ Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics Of scheme and syllabus by Faculty
5.	**Food walk: Practices in society**	May be individual or team	Villages/ City Areas / Grama panchayat/ public associations/Government Schemes officers/ campus etc…..	Group selection / proper consultation / Continuous monitoring / Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics Of scheme and syllabus by Faculty

Plan of Action (Execution of Activities)

Sl.NO	Practice Session Description
1	**Lecture session in field to start activities**
2	**Students Presentation on Ideas**
3	**Commencement of activity and its progress**
4	**Execution of Activity**
5	**Execution of Activity**
6	**Execution of Activity**
7	**Execution of Activity**
8	**Case study based Assessment, Individual performance**
9	**Sector/ Team wise study and its consolidation**
10	**Video based seminar for 10 minutes by each student At the end of semester with Report.**

- Each student should do activities according to the scheme and syllabus.
- At the end of semester student performance has to be evaluated by the faculty for the assigned activity progress and its completion.
- At last consolidated report of all activities from 1st to 5th, compiled report should be submitted as per the instructions and scheme.

Assessment Details for CIE (both CIE and SEE)

Weightage	**CIE – 100%**	
Field Visit, Plan, Discussion	10 Marks	• Implementation strategies of the project (NSS work). • The last report should be signed by NSS Officer, the HOD and principal. • At last report should be evaluated by the NSS officer of the institute. • Finally the consolidated marks sheet should be sent to the university and also to be made available at LIC visit.
Commencement of activities and its progress	20 Marks	
Case study based Assessment Individual performance with report	20 Marks	
Sector wise study & its consolidation 5*5 = 25	25 Marks	
Video based seminar for 10 minutes by each student At the end of semester with Report. **Activities 1 to 5, 5*5 = 25**	25 Marks	
Total marks for the course in each semester	**100 Marks**	
For each activity, 20 marks CIE will be evaluated for IA marks at the end of semester, Report and assessment copy should be made available in the department.		
Students should present the progress of the activities as per the schedule in the prescribed practical session in the field. There should be positive progress in the vertical order for the benefit of society in general through activities.		

Data Analytics with Excel		Semester	3
Course Code	BCS358A	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	0:0:2:0	SEE Marks	50
Credits	01	Exam Hours	100
Examination type (SEE)	Practical		

Course objectives:

- To Apply analysis techniques to datasets in Excel
- Learn how to use Pivot Tables and Pivot Charts to streamline your workflow in Excel
- Understand and Identify the principles of data analysis
- Become adept at using Excel functions and techniques for analysis
- Build presentation ready dashboards in Excel

Sl.NO	Experiments
1	**Getting Started with Excel**: Creation of spread sheets, Insertion of rows and columns, Drag & Fill, use of Aggregate functions.
2	**Working with Data** : Importing data, Data Entry & Manipulation, Sorting & Filtering.
3	**Working with Data:** Data Validation, Pivot Tables & Pivot Charts.
4	**Data Analysis Process**: Conditional Formatting, What-If Analysis, Data Tables, Charts & Graphs.
5	**Cleaning Data with Text Functions**: use of UPPER and LOWER, TRIM function, Concatenate.
6	**Cleaning Data Containing Date and Time Values:** use of DATEVALUE function, DATEADD and DATEDIF, TIMEVALUE functions.
7	**Conditional Formatting**: formatting, parsing, and highlighting data in spreadsheets during data analysis.
8	**Working with Multiple Sheets**: work with multiple sheets within a workbook is crucial for organizing and managing data, perform complex calculations and create comprehensive reports.
9	Create worksheet with following fields: Empno, Ename, Basic Pay(BP), Travelling Allowance(TA), Dearness Allowance(DA), House Rent Allowance(HRA), Income Tax(IT), Provident Fund(PF), Net Pay(NP). Use appropriate formulas to calculate the above scenario. Analyse the data using appropriate chart and report the data.
10	Create worksheet on Inventory Management: Sheet should contain Product code, Product name, Product type, MRP, Cost after % of discount, Date of purchase. Use appropriate formulas to calculate the above scenario. Analyse the data using appropriate chart and report the data.

11	Create worksheet on Sales analysis of Merchandise Store: data consisting of Order ID, Customer ID, Gender, age, date of order, month, online platform, Category of product, size, quantity, amount, shipping city and other details. Use of formula to segregate different categories and perform a comparative study using pivot tables and different sort of charts.
12	Generation of report & presentation using Autofilter &macro.

Course outcomes (Course Skill Set):

At the end of the course the student will be able to:

- Use advanced functions and productivity tools to assist in developing worksheets.
- Manipulate data lists using Outline and PivotTables.
- Use Consolidation to summarise and report results from multiple worksheets.
- Apply Macros and Autofilter to solve the given real world scenario.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation (CIE):

CIE marks for the practical course are **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment is to be evaluated for conduction with an observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments are designed by the faculty who is handling the laboratory session and are made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled down to **30 marks** (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct a test of 100 marks after the completion of all the experiments listed in the syllabus.
- In a test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability.
- The marks scored shall be scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and marks of a test is the total CIE marks scored by the student.

Semester End Evaluation (SEE):

- SEE marks for the practical course are 50 Marks.
- SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the Head of the Institute.
- The examination schedule and names of examiners are informed to the university before the conduction of the examination. These practical examinations are to be conducted between the schedule mentioned in the academic calendar of the University.

- All laboratory experiments are to be included for practical examination.
- (Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.
- Students can pick one question (experiment) from the questions lot prepared by the examiners jointly.
- Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.

- General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)
- Change of experiment is allowed only once and 15% of Marks allotted to the procedure part are to be made zero.

The minimum duration of SEE is 02 hours

Suggested Learning Resources:

- **Berk & Carey** - Data Analysis with Microsoft® Excel: Updated for Offi ce 2007®, Third Edition, © 2010 Brooks/Cole, Cengage Learning, ISBN-13: 978-0-495-39178-4
- **Wayne L. Winston** - Microsoft Excel 2019: Data Analysis And Business Modeling, PHI, ISBN: 9789389347180
- **Aryan Gupta** - Data Analysis in Excel: The Best Guide. (https://www.simplilearn.com/tutorials/excel-tutorial/data-analysis-excel)

Ethics and Public Policy for AI			Semester	
Course Code	**BAI358B**		CIE Marks	50
Teaching Hours/Week (L:T:P: S)	**1:0:0**		SEE Marks	50
Total Hours of Pedagogy	14		Total Marks	100
Credits	03		Exam Hours	2
Examination type (SEE)	Theory			

Course objectives:

- ***To understand Ethical Framework for a Good AI Society, establishing Rules for trustworthy AI***
- ***To Designing ethics for good society***
- ***To familiar with Tools, methods and practices for designing AI for social good***
- ***To familiar with Innovation and future AI***
- ***To understand the Case Study: Ai in health care, knowing Regulation and Governance of AI ethics***

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. **Chalk and Talk**
2. **Real time Examples**
3. **Natural Approaches**

Module-1

An Ethical Framework for a Good AI Society: opportunities, Risks, principles and Recommendations.
Establishing the rules for building trustworthy AI

Textbook1: Chapter 3, chapter 4

Module-2

Translating principles into practices of digital ethics: five risks of being Unethical
The Ethics of Algorithms: Key problems and Solution
How to Design AI for Social Good: Seven Essential Factors

Textbook1: Chapter 6, Chapter 8, Chapter 9

Module-3

How to design AI for social good: seven essential factors
From What to How: An Initial Review of publicly available AI Ethics tools, Methods and Research to Translate principles into Practices

Textbook1: Chapter 9, Chapter 10

Module-4

Innovating with Confidence: Embedding AI Governance and fairness in financial Services Risk management framework,
What the near future of AI could be.

Textbook1: Chapter 20, chapter 22

Module-5

Human-AI Relationship, AI and Workforce, Autonomous Machines and Moral Decisions,
AI in HealthCare: balancing Progress and Ethics,

	Regulation and Governance of AI Ethics Textbook2 : Chapter 5,Chapter 8, Chapter 9

Course outcome (Course Skill Set)

At the end of the course, the student will be able to :

1. ***Describe Ethical Framework for a Good AI Society, establishing Rules for trustworthy AI***
2. ***Explain ethics for good society***
3. ***Illustrate various Tools, methods and practices for designing AI for social good***
4. ***Describe the Innovation and future AI***
5. ***Illustrate Regulation and Governance of AI ethics in Healthcare domain.***

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Books

1. "Ethics, governance and Policies in Artificial Intelligence", Author-Editor : Luciano Floridi, Springer, 1st Edition 2021, vol 144, Oxford Internet Institute, University of ixford, UK, ISSN 0921-8599, e-ISSN 2542-8349 Philosophical Studies series, ISBN 978-3-030-81906-4 e-ISBN 978-3-030-81907-1, ://doi.orghttps/10.1007/978-3-030-81907-1, 2021.
2. "Ethics and AI: Navigating the Moral Landscape of Digital Age", Author: Aaron Aboagye,

Project Management with Git		Semester	3
Course Code	**BCS358C**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	0: 0 : 2: 0	SEE Marks	50
Credits	01	Exam Marks	100
Examination type (SEE)	Practical		

Course objectives:

- .To familiar with basic command of Git
- To create and manage branches
- To understand how to collaborate and work with Remote Repositories
- To familiar with virion controlling commands

Sl.NO	Experiments
1	**Setting Up and Basic Commands** Initialize a new Git repository in a directory. Create a new file and add it to the staging area and commit the changes with an appropriate commit message.
2	**Creating and Managing Branches** Create a new branch named "feature-branch." Switch to the "master" branch. Merge the "feature-branch" into "master."
3	**Creating and Managing Branches** Write the commands to stash your changes, switch branches, and then apply the stashed changes.
4	**Collaboration and Remote Repositories** Clone a remote Git repository to your local machine.
5	**Collaboration and Remote Repositories** Fetch the latest changes from a remote repository and rebase your local branch onto the updated remote branch.
6	**Collaboration and Remote Repositories** Write the command to merge "feature-branch" into "master" while providing a custom commit message for the merge.
7	**Git Tags and Releases** Write the command to create a lightweight Git tag named "v1.0" for a commit in your local repository.
8	**Advanced Git Operations**

	Write the command to cherry-pick a range of commits from "source-branch" to the current branch.
9	**Analysing and Changing Git History** Given a commit ID, how would you use Git to view the details of that specific commit, including the author, date, and commit message?
10	**Analysing and Changing Git History** Write the command to list all commits made by the author "JohnDoe" between "2023-01-01" and "2023-12-31."
11	**Analysing and Changing Git History** Write the command to display the last five commits in the repository's history.
12	**Analysing and Changing Git History** Write the command to undo the changes introduced by the commit with the ID "abc123".

Course outcomes (Course Skill Set):
At the end of the course the student will be able to:

- Use the basics commands related to git repository
- Create and manage the branches
- Apply commands related to Collaboration and Remote Repositories
- Use the commands related to Git Tags, Releases and advanced git operations
- Analyse and change the git history

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation (CIE):

CIE marks for the practical course are **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment is to be evaluated for conduction with an observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments are designed by the faculty who is handling the laboratory session and are made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled down to **30 marks** (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct a test of 100 marks after the completion of all the experiments listed in the syllabus.
- In a test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability.
- The marks scored shall be scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and marks of a test is the total CIE marks scored by the student.

Semester End Evaluation (SEE):

- SEE marks for the practical course are 50 Marks.
- SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the Head of the Institute.
- The examination schedule and names of examiners are informed to the university before the conduction of the examination. These practical examinations are to be conducted between the schedule mentioned in the academic calendar of the University.

- All laboratory experiments are to be included for practical examination.
- (Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.
- Students can pick one question (experiment) from the questions lot prepared by the examiners jointly.
- Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.
- General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)
- Change of experiment is allowed only once and 15% of Marks allotted to the procedure part are to be made zero.

The minimum duration of SEE is 02 hours

Suggested Learning Resources:

- Version Control with Git, 3rd Edition, by Prem Kumar Ponuthorai, Jon Loeliger Released October 2022, Publisher(s): O'Reilly Media, Inc.
- Pro Git book, written by Scott Chacon and Ben Straub and published by Apress, https://git-scm.com/book/en/v2
- https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_013094443347369984278 2_shared/overview
- https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_01330134712177459211926_shared/overview

Data Visualization with Python		Semester	III
Course Code	**BCS358D**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	0: 0: 2: 0	SEE Marks	50
Credits	01	Exam Hours	100
Examination type (SEE)	Practical		

Course objectives:

- CLO 1. Demonstrate the use of IDLE or PyCharm IDE to create Python Applications
- CLO 2. Using Python programming language to develop programs for solving real-world problems
- CLO 3. Implementation of Matplotlib for drawing different Plots
- CLO 4. Demonstrate working with Seaborn, Bokeh.
- CLO 5. Working with Plotly for 3D, Time Series and Maps.

	Experiments
Sl. No.	***PART A – List of problems for which student should develop program and execute in theLaboratory***
1	a) Write a python program to find the best of two test average marks out of three test's marks accepted from the user. b) Develop a Python program to check whether a given number is palindrome or not andalso count the number of occurrences of each digit in the input number. Datatypes: https://www.youtube.com/watch?v=gCCVsvgR2KU Operators: https://www.youtube.com/watch?v=v5MR5JnKcZI Flow Control: https://www.youtube.com/watch?v=PqFKRqpHrjwFor loop: https://www.youtube.com/watch?v=0ZvaDa8eT5s While loop: https://www.youtube.com/watch?v=HZARImviDxg Exceptions: https://www.youtube.com/watch?v=6SPDvPK38tw
2	a) Defined as a function F as Fn = Fn-1 + Fn-2. Write a Python program which accepts a value for N (where N >0) as input and pass this value to the function. Display suitable error message if the condition for input value is not followed. b) Develop a python program to convert binary to decimal, octal to hexadecimal using functions. Functions:https://www.youtube.com/watch?v=BVfCWuca9nw Arguments:https://www.youtube.com/watch?v=ijXMGpoMkhQ Return value: https://www.youtube.com/watch?v=nuNXiEDnM44
3	a) Write a Python program that accepts a sentence and find the number of words, digits, uppercase letters and lowercase letters. b) Write a Python program to find the string similarity between two given strings **Sample Output:** Original string: Python Exercises Python Exercises Similarity between two said strings: **Sample Output:** Original string: Python Exercises Python Exercise Similarity between two said strings:1.0 0.967741935483871 Strings: https://www.youtube.com/watch?v=lSItwlnF0eU String functions: https://www.youtube.com/watch?v=9a3CxJyTq00

4	a) Write a Python program to Demonstrate how to Draw a Bar Plot using Matplotlib. b) Write a Python program to Demonstrate how to Draw a Scatter Plot using Matplotlib. https://www.youtube.com/watch?v=RRHQ6Fs1b8w&list=PLjVLYmrlmjGcC0B_FP3bkJ-JIPkV5GuZR&index=3 https://www.youtube.com/watch?v=7ABCuhWO9II&list=PLjVLYmrlmjGcC0B_FP3bkJ-JIPkV5GuZR&index=4
5	a) Write a Python program to Demonstrate how to Draw a Histogram Plot using Matplotlib. b) Write a Python program to Demonstrate how to Draw a Pie Chart using Matplotlib. https://www.youtube.com/watch?v=Qk7caotaQUQ&list=PLjVLYmrlmjGcC0B_FP3bkJ-JIPkV5GuZR&index=6 https://www.youtube.com/watch?v=PSji21jUNO0&list=PLjVLYmrlmjGcC0B_FP3bkJ-JIPkV5GuZR&index=7
6	a) Write a Python program to illustrate Linear Plotting using Matplotlib. b) Write a Python program to illustrate liner plotting with line formatting using Matplotlib. https://www.youtube.com/watch?v=UO98lJQ3QGI&list=PL-osiE80TeTvipOqomVEeZ1HRrcEvtZB_
7	Write a Python program which explains uses of customizing seaborn plots with Aesthetic functions. https://www.youtube.com/watch?v=6GUZXDef2U0
8	Write a Python program to explain working with bokeh line graph using Annotations and Legends. a) Write a Python program for plotting different types of plots using Bokeh. https://www.youtube.com/watch?v=HDvxYoRadcA
9	Write a Python program to draw 3D Plots using Plotly Libraries. https://www.youtube.com/watch?v=cCck7hCanpw&list=PLE50-dh6JzC4onX-qkv9H3HtPbBVA8M94&index=4

10	a) Write a Python program to draw Time Series using Plotly Libraries. b) Write a Python program for creating Maps using Plotly Libraries. https://www.youtube.com/watch?v=xnJ2TNrGYik&list=PLE50-dh6JzC4onX-qkv9H3HtPbBVA8M94&index=5 https://www.youtube.com/watch?v=D35m2CdMhVs&list=PLE50-dh6JzC4onX-qkv9H3HtPbBVA8M94&index=6

Python (Full Course): https://www.youtube.com/watch?v=_uQrJ0TkZlc

Pedagogy	For the above experiments the following pedagogy can be considered. Problem based learning, Active learning, MOOC, Chalk &Talk

Course outcomes (Course Skill Set):
At the end of the course the student will be able to:

- CO 1. Demonstrate the use of IDLE or PyCharm IDE to create Python Applications
- CO 2. Use Python programming constructs to develop programs for solving real-world problems
- CO 3. Use Matplotlib for drawing different Plots
- CO 4. Demonstrate working with Seaborn, Bokeh for visualization.
- CO 5. Use Plotly for drawing Time Series and Maps.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation (CIE):

CIE marks for the practical course are **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment is to be evaluated for conduction with an observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments are designed by the faculty who is handling the laboratory session and are made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled down to **30 marks** (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct a test of 100 marks after the completion of all the experiments listed in the syllabus.
- In a test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability.
- The marks scored shall be scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and marks of a test is the total CIE marks scored by the student.

Semester End Evaluation (SEE):

SEE marks for the practical course are 50 Marks.

SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the Head of the Institute.

The examination schedule and names of examiners are informed to the university before the conduction of the examination. These practical examinations are to be conducted between the schedule mentioned in the academic calendar of the University.

All laboratory experiments are to be included for practical examination.

(Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.

Students can pick one question (experiment) from the questions lot prepared by the examiners jointly.

Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.

General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)

Change of experiment is allowed only once and 15% of Marks allotted to the procedure part are to be made zero.

The minimum duration of SEE is 02 hours

- **Weightage of marks for PART A is 80% and for PART B is 20%. General rubrics suggested to be followed for part A and part B.**
- **Change of experiment is allowed only once and Marks allotted to the procedure part to be made zero (Not allowed for Part B).**
- **The duration of SEE is 03 hours**

Rubrics suggested in Annexure-II of Regulation book

Textbooks:

1. **Al Sweigart, "Automate the Boring Stuff with Python",1stEdition, No Starch Press, 2015. (Available under CC-BY-NC-SA license at https://automatetheboringstuff.com/)**
2. **Reema Thareja "Python Programming Using Problem Solving Approach" Oxford University Press.**
3. **Allen B. Downey, "Think Python: How to Think Like a Computer Scientist", 2nd Edition, Green Tea Press, 2015. (Available under CC-BY-NC license at http://greenteapress.com/thinkpython2/thinkpython2.pdf)**
4. **Jake VanderPlas "Python Data Science Handbook" 1st Edition, O'REILLY.**

AV Mathematics-III for EC Engineering		Semester	3
Course Code	**BMATEC301**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03
Examination type (SEE)	Theory		

Course objectives:

- Learn to use the Fourier series to represent periodical physical phenomena in engineering analysis and to enable the student to express non-periodic functions to periodic functions using the Fourier series and Fourier transforms.
- Analyze signals in terms of Fourier transforms
- Develop the knowledge of solving differential equations and their applications in Electronics & Communication engineering.
- To find the association between attributes and the correlation between two variables

Teaching-Learning Process

Pedagogy (General Instructions):

These are sample Strategies, teachers can use to accelerate the attainment of the various course outcomes.

1. In addition to the traditional lecture method, different types of innovative teaching methods may be adopted so that the delivered lessons shall develop students' theoretical and applied Mathematical skills.
2. State the need for Mathematics with Engineering Studies and Provide real-life examples.
3. Support and guide the students for self–study.
4. You will assign homework, grading assignments and quizzes, and documenting students' progress.
5. Encourage the students to group learning to improve their creative and analytical skills.
6. Show short related video lectures in the following ways:
   - As an introduction to new topics (pre-lecture activity).
   - As a revision of topics (post-lecture activity).
   - As additional examples (post-lecture activity).
   - As an additional material of challenging topics (pre-and post-lecture activity).
   - As a model solution of some exercises (post-lecture activity).

Module-1: Fourier series and practical harmonic analysis

Periodic functions, Dirichlet's condition. Fourier series expansion of functions with period 2π and with arbitrary period: periodic rectangular wave, Half-wave rectifier, rectangular pulse, Saw tooth wave. Half-range Fourier series. Triangle and half range expansions, Practical harmonic analysis, variation of periodic current.**(8 hours)**

(RBT Levels: L1, L2 and L3)

Module-2: Infinite Fourier Transforms

Infinite Fourier transforms, Fourier cosine and sine transforms, Inverse Fourier transforms, Inverse Fourier cosine and sine transforms, discrete Fourier transform (DFT), Fast Fourier transform (FFT). **(8 hours)**

(RBT Levels: L1, L2 and L3)

Module-3: Z Transforms

Definition, Z-transforms of basic sequences and standard functions. Properties: Linearity, scaling, first and second shifting, multiplication by n. Initial and final value theorem. Inverse Z- transforms. Application to difference equations. **(8 hours)**

(RBT Levels: L1, L2 and L3)

Module-4: Ordinary Differential Equations of Higher Order
Higher-order linear ODEs with constant coefficients - Inverse differential operator, problems.Linear differential equations with variable Coefficients-Cauchy's and Legendre's differential equations–Problems. Application of linear differential equations to L-C circuit and L-C-R circuit.**(8 hours)** **(RBT Levels: L1, L2 and L3)**
Module-5: Curve fitting, Correlation, and Regressions
Principles of least squares, Curve fitting by the method of least squares in the form $y = a + bx$, $y = a + bx + cx^2$, and $y = ax^b$. Correlation, Coefficient of correlation, Lines of regression, Angle between regression lines, standard error of estimate, rank correlation. **(RBT Levels: L1, L2 and L3)(8 hours)**
Course outcome (Course Skill Set) At the end of the course, the student will be able to: 1. Demonstrate the Fourier series to study the behavior of periodic functions and their applications in system communications, digital signal processing, and field theory. 2. To use Fourier transforms to analyze problems involving continuous-time signals 3. To apply Z-Transform techniques to solve difference equations 4. Understand that physical systems can be described by differential equations and solve such equations 5. Make use of correlation and regression analysis to fit a suitable mathematical model for statistical data
Assessment Details (both CIE and SEE) The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). The student is declared as a pass in the course if he/she secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together. **Continuous Internal Evaluation:** ● There are 25 marks for the CIE's Assignment component and 25 for the Internal Assessment Test component. ● Each test shall be conducted for 25 marks. The first test will be administered after 40-50% of the coverage of the syllabus, and the second test will be administered after 85-90% of the coverage of the syllabus. The average of the two tests shall be scaled down to 25 marks ● Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The schedule for assignments shall be planned properly by the course teacher. The teacher should not conduct two assignments at the end of the semester if two assignments are planned. Each assignment shall be conducted for 25 marks. (If two assignments are conducted then the sum of the two assignments shall be scaled down to 25 marks) ● The final CIE marks of the course out of 50 will be the sum of the scale-down marks of tests and assignment/s marks.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Books (Name of the author/Title of the Book/Name of the publisher/Edition and Year)

Text Books:

1. **B. S. Grewal**: "Higher Engineering Mathematics", Khanna Publishers, 44thEd., 2021.
2. **E. Kreyszig**: "Advanced Engineering Mathematics", John Wiley & Sons, 10thEd., 2018.

Reference Books:

1. **V. Ramana:** "Higher Engineering Mathematics" McGraw-Hill Education, 11thEd., 2017
2. **Srimanta Pal & Subodh C.Bhunia**: "Engineering Mathematics" Oxford University Press, 3rdEd., 2016.
3. **N.P Bali and Manish Goyal**: "A Textbook of Engineering Mathematics" Laxmi Publications, 10thEd., 2022.
4. **C. Ray Wylie, Louis C. Barrett:** "Advanced Engineering Mathematics" McGraw–Hill Book Co., New York, 6thEd., 2017.
5. **Gupta C.B, Sing S.R and Mukesh Kumar:** "Engineering Mathematic for Semester I and II", McGraw Hill Education(India) Pvt. Ltd 2015.
6. **H.K. Dass and Er. Rajnish Verma:** "Higher Engineering Mathematics" S.Chand Publication, 3rdEd.,2014.
7. **James Stewart: "**Calculus" Cengage Publications, 7thEd., 2019.

Web links and Video Lectures (e-Resources):

- http://nptel.ac.in/courses.php?disciplineID=111
- http://www.class-central.com/subject/math(MOOCs)
- http://academicearth.org/
- VTU e-Shikshana Program
- VTU EDUSAT Program.

Activity-Based Learning (Suggested Activities in Class)/Practical-Based Learning

- Quizzes
- Assignments
- Seminar

Digital System Design using Verilog		Semester	3
Course Code	**BEC302**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:2	SEE Marks	50
Total Hours of Pedagogy	40 hours Theory + 8-10 Lab slots	Total Marks	100
Credits	04	Exam Hours	03
Examination nature (SEE)	Theory/Practical		

Course objectives:

This course will enable students to:

- To impart the concepts of simplifying Boolean expression using K-map techniques and Quine-McCluskey minimization techniques.
- To impart the concepts of designing and analyzing combinational logic circuits.
- To impart design methods and analysis of sequential logic circuits.
- To impart the concepts of Verilog HDL-data flow and behavioural models for the design of digital systems.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

- Lecture method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.
- Show Video/animation films to explain the different concepts of Linear Algebra & Signal Processing.
- Encourage collaborative (Group) Learning in the class.
- Ask at least three HOTS (Higher order Thinking)questions in the class, which promotes critical thinking.
- Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
- Topics will be introduced in a multiple representation.
- Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
- Discuss how every concept can be applied to the real world-and when that's possible, it helps improve the students' understanding.
- Adopt Flipped class technique by sharing the materials/Sample Videos prior to the class and have discussions on the topic in the succeeding classes.
- Give Programming Assignments.

MODULE-1

Principles of Combinational Logic: Definition of combinational logic, Canonical forms, Generation of switching equations from truth tables, Karnaugh maps-up to 4 variables, Quine-McCluskey Minimization Technique. Quine-McCluskey using Don't CareTerms.(Section3.1to3.5ofText1).

MODULE-2

Logic Design with MSI Components and Programmable Logic Devices: Binary Adders and Subtractors, Comparators, Decoders, Encoders, Multiplexers, Programmable Logic Devices(PLDs) (Section5.1to5.7 ofText2)

MODULE-3

Flip-Flops and its Applications: The Master-Slave Flip-flops(Pulse-Triggered flip-flops):SR flip-flops, JK flip flops, Characteristic equations, Registers, Binary Ripple Counters, Synchronous Binary Counters, Counters based on Shift Registers, Design of Synchronous mod-n Counter using clocked T, J K, D and SR flip-flops.(Section 6.4, 6.6 to 6.9 (Excluding 6.9.3)of Text2)
MODULE-4
Introduction to Verilog: Structure of Verilog module, Operators, Data Types, Styles of Description. (Section1.1to1.6.2, 1.6.4 (only Verilog),2 of Text 3) **Verilog Data flow description:** Highlights of Data flow description, Structure of Data flow description.(Section2.1to2.2(only Verilog) of Text3)
MODULE-5
Verilog Behavioral description: Structure, Variable Assignment Statement, Sequential Statements, Loop Statements, Verilog Behavioral Description of Multiplexers (2:1, 4:1, 8:1). (Section 3.1 to 3.4 (onlyVerilog)of Text 3) **Verilog Structural description**: Highlights of Structural description, Organization of structural description, Structural description of ripple carry adder.(Section4.1 to 4.2 of Text 3)

PRACTICAL COMPONENT OF IPCC *(Experiments can be conducted either using any circuit simulation software or discrete components)*

Sl.N	Experiments
1	To simplify the given Boolean expressions and realize using Verilog program
2	To realize Adder/Subtractor(Full/half)circuits using Verilog data flow description.
3	To realize 4-bit ALU using Verilog program.
4	To realize the following Code converters using Verilog Behavioral description a)Gray to binary and vice versa b)Binary to excess3 and vice versa
5	To realize using Verilog Behavioral description:8:1mux, 8:3encoder, Priority encoder
6	To realize using Verilog Behavioral description:1:8Demux, 3:8 decoder,2 –bit Comparator
7	To realize using Verilog Behavioral description: Flip-flops: a)JK type b)SR type c)T type and d)D type
8	To realize Counters-up/down (BCD and binary)using Verilog Behavioral description.
Demonstration Experiments (For CIE only–not to be included for SEE) Use FPGA/CPLD kits for down loading Verilog codes and check the output for interfacing experiments.	
9	Verilog Program to interface a Stepper motor to the FPGA/CPLD and rotate the motor in the specified direction (by N steps).
10	Verilog programs to interface Switches and LEDs to the FPGA/CPLD and demonstrate its working.

Course outcomes (Course Skill Set):

At the end of the course the student will be able to:

1. Simplify Boolean functions using K-map and Quine-McCluskey minimization technique.
2. Analyze and design for combinational logic circuits.
3. Analyze the concepts of Flip Flops(SR, D,T and JK) and to design the synchronous sequential circuits using Flip Flops.
4. Model Combinational circuits (adders, subtractors, multiplexers) and sequential circuits using Verilog descriptions.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). The student is declared as a pass in the course if he/she secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

The IPCC means the practical portion integrated with the theory of the course. CIE marks for the theory component are **25 marks** and that for the practical component is **25 marks**.

CIE for the theory component of the IPCC

- 25 marks for the theory component are split into **15 marks** for two Internal Assessment Tests (Two Tests, each of 15 Marks with 01-hour duration, are to be conducted) and **10 marks** for other assessment methods mentioned in 22OB4.2. The first test at the end of 40-50% coverage of the syllabus and the second test after covering 85-90% of the syllabus.
- Scaled-down marks of the sum of two tests and other assessment methods will be CIE marks for the theory component of IPCC (that is for **25 marks**).
- The student has to secure 40% of 25 marks to qualify in the CIE of the theory component of IPCC.

CIE for the practical component of the IPCC

- **15 marks** for the conduction of the experiment and preparation of laboratory record, and **10 marks** for the test to be conducted after the completion of all the laboratory sessions.
- On completion of every experiment/program in the laboratory, the students shall be evaluated including viva-voce and marks shall be awarded on the same day.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to **15 marks**.
- The laboratory test **(duration 02/03 hours)** after completion of all the experiments shall be conducted for 50 marks and scaled down to **10 marks.**
- Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **25 marks**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the practical component of the IPCC.

SEE for IPCC

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored by the student shall be proportionally scaled down to 50 Marks

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper may include questions from the practical component.

- The minimum marks to be secured in CIE to appear for SEE shall be 10 (40% of maximum marks-25) in the theory component and 10 (40% of maximum marks -25) in the practical component. The laboratory component of the IPCC shall be for CIE only. However, in SEE, the questions from the laboratory component shall be included**.** The maximum of 04/05 sub-questions are to be set from the practical component of IPCC, the total marks of all questions should not be more than 20 marks.

- SEE will be conducted for 100 marks and students shall secure 35% of the maximum marks to qualify for the SEE. Marks secured will be scaled down to 50.
- The student is declared as a pass in the course if he/she secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Suggested Learning Resources:

Books

1. Digital Logic Applications and Design by John MYarbrough,Thomson Learning,2001.
2. Digital Principles and Design by Donald DGivone,McGrawHill, 2002.
3. HDL Programming VHDL and Verilog by Nazeih M Botros, 2009 reprint, Dream techpress.

ReferenceBooks:

1. Fundamentals of logic design, by Charles H Roth Jr., Cengage Learning
2. Logic Design, by Sudhakar Samuel, Pearson/Sanguine, 2007
3. Fundamentals of HDL,by Cyril PR, Pearson/Sanguine2010

Web links and Video Lectures (e-Resources):

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

Programming Assignments/Mini Projects can be given to improve programming skills.

Electronic Principles and Circuits		Semester	3
Course Code	**BEC303**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:2	SEE Marks	50
Total Hours of Pedagogy	40 hours Theory + 8-10 Lab slots	Total Marks	100
Credits	04	Exam Hours	3
Examination nature (SEE)	Theory/Practical		

Course objectives:

This course will enable students to

- Design and analyse the BJT circuits as an amplifier and voltage regulation.
- Design of MOSFET Amplifiers and analyse the basic amplifier configurations using small signal equivalent circuit models
- Design of operational amplifiers circuits as Comparators, DAC and filters.
- Understand the concept of positive and negative feedback.
- Analyze Power amplifier circuits in different modes of operation.
- Construct Feedback and Oscillator circuits using FET.
- Understand the thyristor operation and the different types of thyristors.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Lecture method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.
2. Show Video/animation films to explain evolution of communication technologies.
3. Encourage collaborative (Group) Learning in the class
4. Ask at least three HOTS (Higher order Thinking) questions in the class, which promotes critical thinking
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
6. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
7. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

MODULE-1

BJT AC models: Base Biased Amplifier, Emitter Biased Amplifier, Small Signal Operation, AC Beta, AC Resistance of the emitter diode, Two transistor models, Analyzing an amplifier.

Voltage Amplifiers: Voltage gain, Multistage Amplifiers.

CC and CB Amplifiers: CC Amplifier, Output Impedance, Cascading CE and CC, Darlington Connections, Voltage regulation, The Common base Amplifier.

[Text1]

MODULE-2

MOSFET Biasing in MOS amplifier circuits: Fixing VGS, Fixing VG, Drain to Gate feedback resistor. Small signal operation and modelling: The DC bias point, signal current in drain, voltage gain, small signal equivalent circuit models, transconductance, The T equivalent circuit model. MOSFET Amplifier configuration: Basic configurations, characterizing amplifiers, CS amplifier with and without source resistance, The Common Gate Amplifier, Source follower.
MODULE-3
Linear Opamp Circuits: Summing Amplifier and D/A Converter, Nonlinear Op-amp Circuits: Comparator with zero reference, Comparator with non-zero references. Comparator with Hysteresis. **Oscillator:** Theory of Sinusoidal Oscillation, The Wein-Bridge Oscillator, RC Phase Shift Oscillator, The Colpitts Oscillator, Hartley Oscillator, Crystal Oscillator. **The 555 timer**: Monostable Operation, Astable Operation. [Text1]
MODULE-4
Negative Feedback: Four Types of Negative Feedback, VCVS Voltage gain, Other VCVS Equations, ICVS Amplifier, VCIS Amplifier, ICIS Amplifier (No Mathematical Derivation). **Active Filters:** Ideal Responses, First Order Stages, VCVS Unity Gain Second Order Low pass Filters, VCVS Equal Component Low Pass Filters, VCVS High Pass Filters, MFB Bandpass Filters, Bandstop Filters. [Text1]
MODULE-5
Power Amplifiers: Amplifier terms, Two load lines, Class A Operation, Class B operation, Class B push pull emitter follower, Class C Operation. **Thyristors:** The four layer Diode, SCR, SCR Phase control, Bidirectional Thyristors, IGBTs, Other Thyristors. [Text1]

PRACTICAL COMPONENT OF IPCC *(Experiments can be conducted either using any circuit simulation software or discrete components)*

Sl.NO	Experiments
1	Design and Test (i) Bridge Rectifier with Capacitor Input Filter (ii) Zener voltage regulator
2	Design and Test Biased Clippers – a)Positive, b) Negative , c) Positive-Negative Positive and Negative Clampers with and without Reference.
3	Plot the transfer and drain characteristics of a JFET and calculate its drain resistance, mutual conductance and amplification factor.
4	Plot the transfer and drain characteristics of n-channel MOSFET and calculate its parameters, namely; drain resistance, mutual conductance and amplification factor.
5	Design and test (i) Emitter Follower , (ii) Darlington Connection
6	Design and plot the frequency response of Common Source JFET/MOSFET amplifier
7	Test the Opamp Comparator with zero and non zero reference and obtain the Hysteresis curve.
8	Design and test Full wave Controlled rectifier using RC triggering circuit.
9	Design and test Precision Half wave and full wave rectifiers using Opamp
10	Design and test RC phase shift oscillator

Course outcomes (Course Skill Set):

At the end of the course, the student will be able to:

1. Understand the characteristics of BJTs and FETs for switching and amplifier circuits.
2. Design and analyze amplifiers and oscillators with different circuit configurations and biasing conditions.
3. Understand the feedback topologies and approximations in the design of amplifiers and oscillators.
4. Design of circuits using linear ICs for wide range applications such as ADC, DAC, filters and timers.
5. Understand the power electronic device components and its functions for basic power electronic circuits.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). The student is declared as a pass in the course if he/she secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

The IPCC means the practical portion integrated with the theory of the course. CIE marks for the theory component are **25 marks** and that for the practical component is **25 marks**.

CIE for the theory component of the IPCC

- 25 marks for the theory component are split into **15 marks** for two Internal Assessment Tests (Two Tests, each of 15 Marks with 01-hour duration, are to be conducted) and **10 marks** for other assessment methods mentioned in 22OB4.2. The first test at the end of 40-50% coverage of the syllabus and the second test after covering 85-90% of the syllabus.

- Scaled-down marks of the sum of two tests and other assessment methods will be CIE marks for the theory component of IPCC (that is for **25 marks)**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the theory component of IPCC.

CIE for the practical component of the IPCC

- **15 marks** for the conduction of the experiment and preparation of laboratory record, and **10 marks** for the test to be conducted after the completion of all the laboratory sessions.
- On completion of every experiment/program in the laboratory, the students shall be evaluated including viva-voce and marks shall be awarded on the same day.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to **15 marks**.
- The laboratory test **(duration 02/03 hours)** after completion of all the experiments shall be conducted for 50 marks and scaled down to **10 marks.**
- Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **25 marks**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the practical component of the IPCC.

SEE for IPCC

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored by the student shall be proportionally scaled down to 50 Marks

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper may include questions from the practical component.

- The minimum marks to be secured in CIE to appear for SEE shall be 10 (40% of maximum marks-25) in the theory component and 10 (40% of maximum marks -25) in the practical component. The laboratory component of the IPCC shall be for CIE only. However, in SEE, the questions from the laboratory component shall be included. The maximum of 04/05 sub-questions are to be set from the practical component of IPCC, the total marks of all questions should not be more than 20 marks.
- SEE will be conducted for 100 marks and students shall secure 35% of the maximum marks to qualify for the SEE. Marks secured will be scaled down to 50.
- The student is declared as a pass in the course if he/she secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Suggested Learning Resources: **Books** 1. Albert Malvino, David J Bates, Electronic Principles, 7th Edition, Mc Graw Hill Education, 2017, ISBN:978-0-07-063424-4. 2. Microelectronic Circuits, Theory and Applications, Adel S Sedra, Kenneth C Smith, 6thEdition, Oxford, 2015.ISBN:978-0-19-808913-1
Web links and Video Lectures (e-Resources): 1. Integrated Electronics: Analog and Digital Circuits and Systems, Jacob Millman, Christos C. Halkias, McGraw-Hill, 2015. 2. Electronic Devices and Circuit, Boylestad & Nashelsky, Eleventh Edition, Pearson, January 2015.
Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

Network Analysis		Semester	3
Course Code	**BEC304**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	3
Examination type (SEE)	Theory		

Course objectives:

1. Apply mesh and nodal techniques to solve an electrical network.
2. Solve different problems related to Electrical circuits using Network Theorems and Two port network.
3. Familiarize with the use of Laplace transforms to solve network problems.
4. Study two port network parameters and their applications.
5. Study of RLC Series and parallel tuned circuit.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

- Lecture method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.
- Encourage collaborative (Group)Learning in the class.
- Ask at least three HOTS(Higher order Thinking)questions in the class, which promotes critical thinking.
- Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
- Topics will be introduced in a multiple representation.
- Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
- Discuss how every concept can be applied to the real world-and when that's possible, it helps improve the students' understanding.
- Adopt Flipped class technique by sharing the materials/Sample Videos prior to the class and have discussions on the topic in the succeeding classes.

Module-1

Basic Concepts: Practical sources, Source transformations, Network reduction using Star - Delta transformation, Loop and node analysis with linearly dependent and independent sources for DC and AC networks.

Module-2

Network Theorems: Superposition, Millman's theorems, Thevenin's and Norton's theorems, Maximum Power transfer theorem.

Module-3

Transient behavior and initial conditions: Behavior of circuit elements under switching condition and their Representation, evaluation of initial and final conditions in RL, RC and

RLC circuits for AC and DC excitations.
Module-4
Laplace Transformation &Applications: Solution of networks, step, ramp and impulse responses, waveform Synthesis.
Module-5
Two port network parameters: Definition of Z,Y, h and Transmission parameters, modelling with these parameters, relationship between parameters sets. **Resonance:** **Series Resonance:** Variation of Current and Voltage with Frequency, SelectivityandBandwidth,Q-Factor,CircuitMagnificationFactor,Selectivity with Variable Capacitance, Selectivity with Variable Inductance. **Parallel Resonance:** Selectivity and Bandwidth, Maximum Impedance Conditions with C, Land f Variable, current in Anti-Resonant Circuit, The General Case-Resistance Present in both Branches.

Course outcome (Course Skill Set)

At the end of the course, the student will be able to :

1. Determine currents and voltages using source transformation/ source shifting/ mesh/ nodal analysis and reduce given network using star- delta transformation.
2. Solve problems by applying Network Theorems and electrical laws to reduce circuit complexities and to arrive at feasible solutions.
3. Analyse the circuit parameters during switching transients and apply Laplace transform to solve the given network
4. Evaluate the frequency response for resonant circuits and the network parameters for two port networks

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). The student is declared as a pass in the course if he/she secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- There are 25 marks for the CIE's Assignment component and 25 for the Internal Assessment Test component.
- Each test shall be conducted for 25 marks. The first test will be administered after 40-50% of the coverage of the syllabus, and the second test will be administered after 85-90% of the coverage of the syllabus. The average of the two tests shall be scaled down to 25 marks
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The schedule for assignments shall be planned properly by the course teacher. The teacher should not conduct two assignments at the end of the semester if two assignments are planned. Each assignment shall be conducted for 25 marks. (If two assignments are conducted then the sum of the two assignments shall be scaled down to 25 marks)
- The final CIE marks of the course out of 50 will be the sum of the scale-down marks of tests and assignment/s marks.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module

Suggested Learning Resources:

Books

1. M.E.Van Valkenburg (2000), Network Analysis, Prentice Hall of India, 3rd edition, 2000, ISBN:9780136110958.
2. Roy Choudhury-Networks and Systems, 2nd edition, New Age International Publications, 2006, ISBN: 9788122427677

ReferenceBooks:

3. Hayt, Kemmerly and Durbin-Engineering Circuit Analysis, **TMH**7th Edition, 2010.
4. **J.**David Irwin/ R.Mark Nelms- Basic Engineering Circuit Analysis JohnWiley,8th ed,2006.
5. Charles K Alexander and Mathew NO Sadiku-Fundamentals of Electric Circuits, Tata McGraw-Hill,3rc1 Ed,2009.

Web links and Video Lectures (e-Resources):
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Activity Based Learning (Suggested Activities in Class)/ Practical Based learning
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13.09.2023

Analog and Digital Systems Design Laboratory		Semester	**3**
Course Code	**BECL305**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	0:0:2	SEE Marks	50
Credits	01	Total	100
		Exam Hours	3
Examination type (SEE)	Practical		

Course objectives:

This laboratory course enables students to

- Understand the electronic circuit schematic and its working
- Realize and test amplifier and oscillator circuits for the given specifications
- Realize the opamp circuits for the applications such as DAC, implement mathematical functions and precision rectifiers.
- Study the static characteristics of SCR and test the RC triggering circuit.
- Design and test the combinational and sequential logic circuits for their functionalities.
- Use the suitable ICs based on the specifications and functions.

Sl.NO	**Experiments** (*All the experiments has to be conducted using discrete components*)
1	Design and set up the BJT common emitter voltage amplifier with and without feedback and determine the gain-bandwidth product, input and output impedances.
2	Design and set-up BJT/FET i) Colpitts Oscillator, ii) Crystal Oscillator
3	Design and set up the circuits using opamp: i) Adder, ii) Integrator, iii) Differentiator and iv) Comparator
4	Design 4-bit R – 2R Op-Amp Digital to Analog Converter (i) for a 4-bit binary input using toggle switches (ii) by generating digital inputs using mod-16
5	Design and implement (a) Half Adder & Full Adder using basic gates and NAND gates, (b) Half subtractor& Full subtractor using NAND gates, (c) 4-variable function using IC74151(8:1MUX).
6	Realize (i) Binary to Gray code conversion & vice-versa (IC74139), (ii) BCD to Excess-3 code conversion and vice versa
7	a) Realize using NAND Gates: i) Master-Slave JK Flip-Flop, ii) D Flip-Flop and iii) T Flip-Flop b) Realize the shift registers using IC7474/7495: (i) SISO (ii) SIPO (iii) PISO (iv) PIPO (v) Ring counter and (vi) Johnson counter.
8	Realize a) Design Mod – N Synchronous Up Counter & Down Counter using 7476 JK Flip-flop b) Mod-N Counter using IC7490 / 7476 c) Synchronous counter using IC74192
	Demonstration Experiments (For CIE)
9	Design and Test the second order Active Filters and plot the frequency response, i) Low pass Filter ii) High pass Filter
10	Design and test the following using 555 timer i) MonostableMultivibraator ii) AstableMultivibrator
11	Design and Test a Regulated Power supply
12	Design and test an audio amplifier by connecting a microphone input and observe the output using a loud speaker.

Course outcomes (Course Skill Set):
At the end of the course the student will be able to:
1. Design and analyze the BJT/FET amplifier and oscillator circuits.
2. Design and test Opamp circuits to realize the mathematical computations, DAC and precision rectifiers.
3. Design and test the combinational logic circuits for the given specifications.
4. Test the sequential logic circuits for the given functionality.
5. Demonstrate the basic circuit experiments using 555 timer.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation (CIE):
CIE marks for the practical course are **50 Marks**.
The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.
- Each experiment is to be evaluated for conduction with an observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments are designed by the faculty who is handling the laboratory session and are made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled down to **30 marks** (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct a test of 100 marks after the completion of all the experiments listed in the syllabus.
- In a test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability.
- The marks scored shall be scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and marks of a test is the total CIE marks scored by the student.

Semester End Evaluation (SEE):
- SEE marks for the practical course are 50 Marks.
- **SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the Head of the Institute**.
- The examination schedule and names of examiners are informed to the university before the conduction of the examination. These practical examinations are to be conducted between the schedule mentioned in the academic calendar of the University.
- All laboratory experiments are to be included for practical examination.
- (Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.
- Students can pick one question (experiment) from the questions lot prepared by the examiners jointly.
- Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.

General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled

down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)
Change of experiment is allowed only once and 15% of Marks allotted to the procedure part are to be made zero.
The minimum duration of SEE is 02 hours

Suggested Learning Resources:

1. David A Bell, “Fundamentals of Electronic Devices and Circuits Lab Manual”, 5th Edition, 2009, Oxford University Press.
2. Albert Malvino, David J Bates, Electronic Principles, 7th Edition, McGraw Hill Education, 2017.
3. Fundamentals of Logic Design, Charles H Roth Jr., Larry L Kinney, Cengage Learning, 7th Edition.

Electronic Devices		Semester	3
Course Code	**BEC306A**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	3
Examination type (SEE)	Theory		

Course objectives: This course will enable students to:

- Understand the basics of semiconductor physics and electronic devices.
- Describe the mathematical models BJTs and FETs along with the constructional details.
- Understand the construction and working principles of optoelectronic devices
- Understand the fabrication process of semiconductor devices and CMOS process integration.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

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- Lecture method(L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.
- Encourage collaborative(Group)Learning in the class.
- Ask at least three HOTS(Higher order Thinking)questions in the class, which promotes critical thinking.
- Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
- Topics will be introduced in a multiple representation.
- Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
- Discuss how every concept can be applied to the realworld-and when that's possible, it helps improve the students' understanding.
- Adopt Flipped class technique by sharing the materials/Sample Videos prior to the class and have discussions on the topic in the succeeding classes.

Module-1

Semiconductors

Bonding forces in solids, Energy bands, Metals, Semiconductors and Insulators, Direct and Indirect semiconductors, Electrons and Holes, Intrinsic and Extrinsic materials, Conductivity and Mobility, Drift and Resistance, Effects of temperature and doping on mobility, Hall Effect.

(Text1:3.1.1,3.1.2,3.1.3,3.1.4,3.2.1,3.2.3,3.2.4,3.4.1,3.4.2,3.4.3,3.4.5).

Module-2

PN Junctions

Forward and Reverse biased junctions-Qualitative description of Current flow at a junction, reverse bias, Reverse bias breakdown- Zener breakdown, avalanche breakdown, Rectifiers.**(Text1:5.3.1,5.3.3,5.4,5.4.1,5.4.2,5.4.3)** Optoelectronic Devices Photodiodes: Current and Voltage in an Illuminated Junction, Solar Cells, Photodetectors. Light Emitting Diode: Light Emitting materials.

(Text1:8.1.1,8.1.2,8.1.3,8.2,8.2.1),

Module-3

Bipolar Junction Transistor

Fundamentals of BJT operation, Amplification with BJTS,BJT Fabrication, The coupled Diode model(Ebers-Moll Model),Switching operation of a transistor, Cutoff, saturation, switching cycle, specifications, Drift in the base region, Base narrowing, Avalanche breakdown.

(Text1:7.1,7.2,7.3,7.5.1,7.6,7.7.1,7.7.2, 7.7.3)

Module-4

Field Effect Transistors

Basic pn JFET Operation, Equivalent Circuit and Frequency Limitations, MOSFET-Two terminal MO Sstructure-Energy band diagram, Ideal Capacitance

-Voltage Characteristics and Frequency Effects, Basic MOSFET Operation- MOSFET structure, Current-Voltage Characteristics.

(Text2:9.1.1,9.4,9.6.1,9.6.2,9.7.1,9.7.2,9.8.1,9.8.2).

Module-5

Fabrication of p-n junctions

Thermal Oxidation, Diffusion, Rapid Thermal Processing, Ion implantation, chemical vapour deposition, photolithography, Etching, metallization. **(Text 1: 5.1)**

Integrated Circuits

Background, Evolution of ICs, CMOS Process Integration, Integration of Other Circuit Elements.**(Text 1:9.1,9.2,9.3.1,9.3.3).**

Course outcome (Course Skill Set)

At the end of the course, the student will be able to :

1. Understand the principles of semiconductor Physics
2. Understand the principles and characteristics of different types of semiconductor devices
3. Understand the fabrication process of semiconductor devices
4. Utilize the mathematical models of semiconductor junctions for circuits and systems.
5. Identify the mathematical models of MOS transistors for circuits and systems.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). The student is declared as a pass in the course if he/she secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- There are 25 marks for the CIE's Assignment component and 25 for the Internal Assessment Test component.
- Each test shall be conducted for 25 marks. The first test will be administered after 40-50% of the coverage of the syllabus, and the second test will be administered after 85-90% of the coverage of the syllabus. The average of the two tests shall be scaled down to 25 marks
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The schedule for assignments shall be planned properly by the course teacher. The teacher should not conduct two assignments at the end of the semester if two assignments are planned. Each assignment shall be conducted for 25 marks. (If two assignments are conducted then the sum of the two assignments shall be scaled down to 25 marks)
- The final CIE marks of the course out of 50 will be the sum of the scale-down marks of tests and assignment/s marks.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Books

1. Ben. G. Streetman, Sanjay Kumar Banerjee, "Solid State Electronic Devices",7th Edition,Pearson Education,2016,ISBN978-93-325-5508-2.
2. Donald A Neamen, Dhrubes Biswas, "Semiconductor Physics and Devices", 4th Edition,McGraw **Hill** Education, 2012,ISBN 978-0-07- 107010-2.

ReferenceBooks:

3. S.M.Sze,KwokK.Ng,"PhysicsofSemiconductorDevices",3rd Edition, Wiley,2018.
4. AdirBar-Lev,"SemiconductorandElectronicDevices",3rd Edition,PHI, 1993

Web links and Video Lectures (e-Resources):

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Activity Based Learning (Suggested Activities in Class)/ Practical Based learning •

Sensors and Instrumentation		Semester	3
Course Code	**BEC306B**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	3
Examination type (SEE)	Theory		

Course objectives:

- Understand various technologies associated in manufacturing of sensors
- Acquire knowledge about types of sensors used in modern digital systems
- Get acquainted about material properties required to make sensors
- Understand types of instrument errors and circuits for multirange Ammeters and Voltmeters.
- Describe principle of operation of digital measuring instruments and Bridges.
- Understand the operations of transducers and instrumentation amplifiers.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

- Lecture method(L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.
- Encourage collaborative(Group)Learning in the class.
- Ask at least three HOTS(Higher order Thinking)questions in the class, which promotes critical thinking.
- Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
- Topics will be introduced in a multiple representation.
- Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
- Discuss how every concept can be applied to the realworld-and when that's possible, it helps improve the students' understanding.
- Adopt Flipped class technique by sharing the materials/Sample Videos prior to the class and have discussions on the topic in the succeeding classes.

Module-1

Introduction to sensor based measurement systems:
General concepts and terminology, sensor classification, Primary Sensors, material for sensors, microsensor technology. (Text 1)

Module-2

Self-generating Sensors-Thermoelectric sensors, piezoelectric sensors, pyroelectric sensors, photovoltaic sensors, electrochemical sensors. (Text 1)

Module-3

Principles of Measurement: Static Characteristics, Error in Measurement, Types of Static Error.(Text 2: 1.2-1.6)

Multirange Ammeters, Multirange voltmeter.(Text2:3.2,4.4)

Digital Voltmeter: Ramp Technique, Dual slope integrating Type DVM, Direct Compensation type and Successive Approximations type DVM (Text 2: 5.1-5.3, 5.5,5.6)

Module-4

Digital Multimeter: Digital Frequency Meter and Digital Measurement of Time, Function Generator.

Bridges: Measurement of resistance: Wheatstone's Bridge, AC Bridges - Capacitance and Inductance Comparison bridge, Wien's bridge.

(Text2:refer 6.2,6.3 up to 6.3.2, 6.4 up to 6.4.2, 8.8, 11.2, 11.8 -11.10, 11.14).

Module-5

Transducers: Introduction,ElectricalTransducer,ResistiveTransducer,Resistive position Transducer, Resistance Wire Strain Gauges, Resistance Thermometer, Thermistor, LVDT.
(Text2:13.1-13.3,13.5, 13.6 up to 13.6.1,13.7,13.8,13.11).
Instrumentation Amplifier using Transducer Bridge, Temperature indicators using Thermometer, Analog Weight Scale(Text2:14.3.3, 14.4.1, 14.4.3).

Course outcome (Course Skill Set)

At the end of the course, the student will be able to :

1. Understand the material properties required to make sensors
2. Understand the principle of transducers for measuring physical parameters.
3. Describe the manufacturing process of sensors
4. Analyze the instrument characteristics and errors.
5. Describe the principle of operation and develop circuits for multirange Ammeters, Voltmeters and Bridges to measure passive component values and frequency.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). The student is declared as a pass in the course if he/she secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- There are 25 marks for the CIE's Assignment component and 25 for the Internal Assessment Test component.
- Each test shall be conducted for 25 marks. The first test will be administered after 40-50% of the coverage of the syllabus, and the second test will be administered after 85-90% of the coverage of the syllabus. The average of the two tests shall be scaled down to 25 marks
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The schedule for assignments shall be planned properly by the course teacher. The teacher should not conduct two assignments at the end of the semester if two assignments are planned. Each assignment shall be conducted for 25 marks. (If two assignments are conducted then the sum of the two assignments shall be scaled down to 25 marks)
- The final CIE marks of the course out of 50 will be the sum of the scale-down marks of tests and assignment/s marks.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Books

1. "Sensors and Signal Conditioning", Ramon Pallas Areny, JohnG. Webster,2nd edition, John Wiley and Sons,2000
2. H.S.Kalsi, "Electronic Instrumentation", Mc Graw Hill,3rdEdition,2012,ISBN:9780070702066.

Reference Books

1. DavidA. Bell,"Electronic Instrumentation & Measurements", Oxford University Press PHI 2ndEdition, 2006,ISBN 81-203-2360-2.
2. D. HelfrickandW.D. Cooper, "Modern Electronic Instrumentation and Measuring Techniques", Pearson, 1stEdition, 2015, ISBN: 9789332556065.

Web links and Video Lectures (e-Resources):

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Activity Based Learning (Suggested Activities in Class)/ Practical Based learning •

Computer Organization and Architecture		Semester	3
Course Code	**BEC306C**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	3
Examination type (SEE)	Theory		

Course objectives: This course will enable students to:

- Explain the basic sub systems of a computer, their organization, structure and operation.
- Illustrate the concept of programs as sequences of machine instructions.
- Demonstrate different ways of communicating with I/O devices
- Describe memory hierarchy and concept of virtual memory.
- Illustrate organization of simple pipelined processor and other computing systems.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

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- Lecture method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.
- Encourage collaborative (Group) Learning in the class.
- Ask at least three HOTS(Higher order Thinking)questions in the class, which promotes critical thinking.
- Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
- Topics will be introduced in a multiple representation.
- Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
- Discuss how every concept can be applied to the real world-and when that's possible, it helps improve the students' understanding.
- Adopt Flipped class technique by sharing the materials/Sample Videos prior to the class and have discussions on the topic in the succeeding classes.

Module-1

Basic Structure of Computers: Computer Types, Functional Units, Basic Operational Concepts, Bus Structures, Software, Performance -Processor Clock, Basic Performance Equation**(upto1.6.2ofChap1ofText).**

Machine Instructions and Programs: Numbers, Arithmetic Operations and Characters, IEEE standard for Floating point Numbers, Memory Location and Addresses, Memory Operations, Instructions and Instruction Sequencing **(up to 2.4.6 of Chap 2 and 6.7.1 of Chap 6 of Text).**

Module-2

Addressing Modes, Assembly Language, Basic Input and Output Operations, Stacks and Queues, Subroutines, Additional Instructions **(from2.4.7ofChap2, except 2.9.3, 2.11 & 2.12 of Text).**
Module-3
Input/ Output Organization: Accessing I/O Devices, Interrupts -Interrupt Hardware, Enabling and Disabling Interrupts, Handling Multiple Devices, Controlling Device Requests, Direct Memory Access (upto4.2.4and4.4except4.4.1ofChap4ofText).
Module-4
Memory System: Basic Concepts, Semiconductor RAM Memories-Internal organization of memory chips, Static memories, Asynchronous DRAMS, Read Only Memories, Cash Memories, Virtual Memories, Secondary Storage- Magnetic Hard Disks **(5.1,5.2,5.2.1,5.2.2,5.2.3,5.3,5.5(except 5.5.1 to** 5.5.4), 5.7 (except5.7.1), 5.9, 5.9.1 of Chap 5 of Text).
Module-5
Basic Processing Unit: Some Fundamental Concepts, Execution of a Complete Instruction, Multiple Bus Organization, Hardwired Control, Microprogrammed Control **(up to 7.5 except 7.5.1 to7.5.6 of Chap 7 of Text).**

Course outcome (Course Skill Set)

At the end of the course, the student will be able to :

1. Explain the basic organization of a computer system.
2. Describe the addressing modes, instruction formats and program control statement.
3. Explain different ways of accessing an input/ output device including interrupts.
4. Illustrate the organization of different types of semiconductor and other secondary storage memories.
5. Illustrate simple processor organization based on hard wired control and micro-programmed control.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). The student is declared as a pass in the course if he/she secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- There are 25 marks for the CIE's Assignment component and 25 for the Internal Assessment Test component.
- Each test shall be conducted for 25 marks. The first test will be administered after 40-50% of the coverage of the syllabus, and the second test will be administered after 85-90% of the coverage of the syllabus. The average of the two tests shall be scaled down to 25 marks
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The schedule for assignments shall be planned properly by the course teacher. The teacher should not conduct two assignments at the end of the semester if two assignments are planned. Each assignment shall be conducted for 25 marks. (If two assignments are conducted then the sum of the two assignments shall be scaled down to 25 marks)
- The final CIE marks of the course out of 50 will be the sum of the scale-down marks of tests and assignment/s marks.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

Suggested Learning Resources:

Book

1. Carl Hamacher, Zvonko Vranesic, Safwat Zaky: Computer Organization, 5th Edition,Tata McGrawHill,2002.

ReferenceBooks:

2. David A. Patterson, John L. Hennessy: Computer Organization and Design-The Hardware/ Software InterfaceARM Edition, 4th Edition, Elsevier,2009.
3. William Stallings: Computer Organization &Architecture,7th Edition, PHI, 2006.
4. Vincent P. Heuring & Harry F. Jordan: Computer Systems Design and Architecture, 2nd Edition, Pearson Education, 2004.

Web links and Video Lectures (e-Resources):
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Activity Based Learning (Suggested Activities in Class)/ Practical Based learning •

Applied Numerical Methods for EC Engineers		Semester	3
Course Code	**BEC306D**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03
Examination type (SEE)	**Theory**		

Course objectives:

- To provide the knowledge and importance of error analysis in engineering problems
- To represent and solve an application problem using a system of linear equations
- Analyzeregression **data** to choose the most appropriate model for a situation.
- Familiarize with the ways of solving complicated mathematical problems numerically
- Prepare **to solve** mathematical models represented by initial or boundary value problems

Teaching-Learning Process

Pedagogy (General Instructions):

These are sample Strategies, teachers can use to accelerate the attainment of the various course outcomes.

1. In addition to the traditional lecture method, different innovative teaching methods may be adopted so that the delivered lessons shall develop students' theoretical and applied Mathematical skills.
2. State the need for Mathematics with Engineering Studies and Provide real-life examples.
3. Support and guide the students for self–study.
4. You will assign homework, grading assignments and quizzes, and documenting students' progress.
5. Encourage the students to group learning to improve their creative and analytical skills.
6. Show short related video lectures in the following ways:
   - As an introduction to new topics (pre-lecture activity).
   - As a revision of topics (post-lecture activity).
   - As additional examples (post-lecture activity).
   - As an additional material of challenging topics (pre-and post-lecture activity).
   - As a model solution of some exercises (post-lecture activity).

Module-1: Errors in computations and Root of the equations

Approximations and Round Off -Errors in computation: Error definitions, Round-Offerrors, Truncation errors and the Taylor series-The Taylor series, Error Propagation, Total numerical error,Absolute,Relative and percentage errors,Blunders, Formulation errors and data uncertainty. Roots of equations: Simple fixed point iteration methods. Secant Method, Muller's method, and Graeffe's Roots Squaring Method. Aitkin's Method. **(8 hours)**

(RBT Levels: L1, L2 and L3)

Module-2: Solution of System of Linear Equations

Rank of the matrix, Echelon form, Linearly dependent and independent equations, Solutions for linear equations, Partition method, Croute's Triangularisation method. Relaxation method. Solution of non-linear simultaneous equations by Newton-Raphson method. Eigen Values and properties, Eigen Vectors, Bounds on Eigen Values, Jacobi's method, Given's method for symmetric matrices. **(8 hours)**

(RBT Levels: L1, L2 L3)

Module-3: Curve Fitting
Least-Squares Regression: Linear Regressions, Polynomial regressions, Multiple Linear regressions, General Linear Least squares, Nonlinear Regressions, QR Factorization. Curve Fitting with Sinusoidal Functions Introduction to Splines,Linear Splines, Quadratic Splines, Cubic Splines. Bilinear Interpolation. **(8 hours)** **(RBT Levels: L1, L2 L3)**
Module-4: Numerical integration, Difference equations and Boundary Value Problems
Romberg's method, Euler-Maclaurin formula, Gaussian integration for n = 2 and n=3. Numerical double integration by trapezoidal and Simpson's 1/3 rd rule. Solution of linear difference equations. Boundary-Value Problems, Introduction. The Shooting Method, Finite-Difference Methods **(8 hours)** **(RBT Levels: L1, L2 and L3)**
Module-5: Numerical solution of partial differential equations
Classifications of second-order partial differential equations,Finite difference approximations to partial derivatives. Solution of:Laplace equation, Poisson equations, one-dimensional heat equation and wave equations. **(8 hours)** **(RBT Levels: L1, L2 and L3)**
Course outcome (Course Skill Set) At the end of the course, the student will be able to: 1. Explain and measure errors in numerical computations 2. Test for consistency and solve a system of linear equations. 3. Construct a function which closely fits given n- n-points of an unknown function. 4. Understand and apply the basic concepts related to solving problems by numericaldifferentiation and numerical integration. 5. Use appropriate numerical methods to study phenomena modelled as partial differential equations.
Assessment Details (both CIE and SEE) The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE, the minimum passing mark is 35% of the maximum marks (18 out of 50 marks). The student is declared as a pass in the course if he/she secures a minimum of 40% (40 marks out of 100) in the sum total of the **CIE** (Continuous Internal Evaluation) and **SEE** (Semester End Examination) taken together.

Continuous Internal Evaluation:

- There are 25 marks for the CIE's Assignment component and 25 for the Internal Assessment Test component.
- Each test shall be conducted for 25 marks. The first test will be administered after 40-50% of the coverage of the syllabus, and the second test will be administered after 85-90% of the coverage of the syllabus. The average of the two tests shall be scaled down to 25 marks
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The schedule for assignments shall be planned properly by the course teacher. The teacher should not conduct two assignments at the end of the semester if two assignments are planned. Each assignment shall be conducted for 25 marks. (If two assignments are conducted then the sum of the two assignments shall be scaled down to 25 marks)
- The final CIE marks of the course out of 50 will be the sum of the scale-down marks of tests and assignment/s marks.

The Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Books (Name of the author/Title of the Book/Name of the publisher/Edition and Year)

Text Books:

1. **Steven C. Chapra & Raymond P. Canale: "**Numerical Methods for Engineers and Scientists", McGraw Hill, 8th Edition, 2020.
2. **Steven C. Chapra**: "Applied Numerical Methods with MATLAB for Engineers and Scientists", McGraw Hill, Fifth Edition, 2023.
3. **B. S. Grewal**: "Numerical Methods in Engineering & Science with programs in C, C++ and MATLAB", Khanna Publishers, 10^{h}Ed., 2015.

Reference Books:

1. **John H. Mathews & Kurtis D. Frank**: "Numerical Methods Using MATLAB", PHI Publications, 4th Edition, 2005.
2. **Won Young Yang, Wenwu Cao, Tae Sang Chung, John Morris: "**Applied Numerical Methods Using MATLAB**",** WILEY Interscience**,** Latest Edition, 2005.

Web links and Video Lectures (e-Resources):

- http://nptel.ac.in/courses.php?disciplineID=111
- http://www.class-central.com/subject/math(MOOCs)
- http://academicearth.org/
- VTU e-Shikshana Program
- VTU EDUSAT Program.

Activity-Based Learning (Suggested Activities in Class)/Practical-Based Learning

- Quizzes
- Assignments
- Seminar

Lab VIEW Programming		Semester	3
Course Code	**BEC358A**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	0:0:2	SEE Marks	50
Credits	01	Total	100
		Exam Hours	2
Examination type (SEE)	Practical		

Course objectives:

- Aware of various front panel controls and indicators.
- Connect and manipulate nodes and wires in the block diagram.
- Locate various tool bars and pull-down menus for the purpose of implementing specific functions.
- Locate and utilize the context help window.
- Familiar with LabVIEW and different applications using it.

Sl.NO	VI Programs(using LabVIEW software)to realize the following:
1	Basic arithmetic operations: addition, subtraction, multiplication and division
2	Boolean operations: AND, OR, XOR, NOT and NAND
3	Sum of 'n' numbers using 'for' loop
4	Factorial of a given number using 'for' loop
5	Determine square of a given number
6	Factorial of a given number using 'while' loop
7	Sorting even numbers using 'while' loop in an array
8	Finding the array maximum and array minimum
	Demonstration Experiments (For CIE)
9	Build a Virtual Instrument that simulates a heating and cooling system. The system must be able to be controlled manually or automatically.
10	Build a Virtual Instrument that simulates a Basic Calculator (using formula node).
11	Build a Virtual Instrument that simulates a Water Level Detector.
12	DemonstratehowtocreateabasicVIwhichcalculatestheareaandperimeterofacircle.

Course outcomes (Course Skill Set):

At the end of the course the student will be able to:

- Use LabVIEW to create data acquisition, analysis and display operations
- Create user interfaces with charts, graph and buttons
- Use the programming structures and data types that exist in LabVIEW
- Use various editing and debugging techniques.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation (CIE):

CIE marks for the practical course are **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment is to be evaluated for conduction with an observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments are designed by the faculty who is handling the laboratory session and are made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled down to **30 marks** (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct a test of 100 marks after the completion of all the experiments listed in the syllabus.
- In a test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability.
- The marks scored shall be scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and marks of a test is the total CIE marks scored by the student.

Semester End Evaluation (SEE):

- SEE marks for the practical course are 50 Marks.
- **SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the Head of the Institute**.
- The examination schedule and names of examiners are informed to the university before the conduction of the examination. These practical examinations are to be conducted between the schedule mentioned in the academic calendar of the University.
- All laboratory experiments are to be included for practical examination.
- (Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.
- Students can pick one question (experiment) from the questions lot prepared by the examiners jointly.
- Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.

General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)

Change of experiment is allowed only once and 15% of Marks allotted to the procedure part are to be made zero.

The minimum duration of SEE is 02 hours

Suggested Learning Resources:

1. VirtualInstrumentationusingLABVIEW,JovithaJerome,PHI,2011
2. VirtualInstrumentationusingLABVIEW,SanjayGupta,JosephJohn,TMH,McGrawHill,SecondEdition,2011.

MATLAB Programming		Semester	3
Course Code	**BEC358B**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	1:0:0	SEE Marks	50
Total Hours of Pedagogy	14	Total Marks	100
Credits	01	Exam Hours	1
Examination type (SEE)	Theory		

Course objectives:

- Understand the MATLAB commands and functions.
- Create and Execute the script and function files
- Work with built in function, saving and loading data and create plots.
- Work with the arrays, matrices, symbolic computations, files and directories.
- Learn MATLAB programming with script, functions and language specific features.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Adopt Problem Based Learning (PBL), which fosters students' analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
2. Give programming assignments.

Module-1

Introduction: Basics of MATLAB, Simple arithmetic calculations, Creating and working with arrays and numbers.

Module-2

Creating and printing simple plots, Creating, saving and executing a script file, Creating and executing a function file, Working with arrays and matrices.

Module-3

Working with anonymous functions, Symbolic Computations, Importing and exporting data, Working with files and directories.

Module-4

Interactive computations: Matrices and vectors, Matrix and array operations, Character strings, Command line functions, Built-in functions, Saving and loading data, Plotting simple plots.

Module-5

Programming in MATLAB: Script Files, Function Files, Language specific Features.

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

1. Understand the syntax of MATLAB for arithmetic computations, arrays, matrices.
2. Understand the built in function, saving and loading data, and create plots
3. Create program using symbolic computations, Importing and exporting data and files
4. Create program using character strings, Command line functions and Built-in functions.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). The student is declared as a pass in the course if he/she secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous internal Examination (CIE)

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examinations (SEE)

SEE paper shall be set for 50 questions, each of the 01 marks. The pattern of the question paper is MCQ (multiple choice questions). The time allotted for SEE is **01 hour.** The student has to secure a minimum of 35% of the maximum marks meant for SEE.

OR

MCQ (Multiple Choice Questions) are preferred for 01 credit courses, however, if course content demands the general question paper pattern that followed for 03 credit course, then

1. The question paper will have ten questions. Each question is set for 10 marks.
2. There will be 2 questions from each module. Each of the two questions under a module may or may not have the sub-questions (with maximum sub-questions of 02, with marks distributions 5+5, 4+6, 3+7).
3. The students have to answer 5 full questions, selecting one full question from each module.
4. **The duration of the examinations shall be defined by the concerned board of studies**

Suggested Learning Resources:

Book

1. Rudra Pratap, Getting Started with MATLAB – A quick Introduction for scientists and Engineers, Oxford University Press, 2010.

Web links and Video Lectures (e-Resources):

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Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

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C++ Basics		Semester	4
Course Code	**BEC358C**	CIE Marks	50
Teaching Hours/Week (L: T:P: S)	0:0:2:0	SEE Marks	50
Total Hours of Pedagogy	24	Total Marks	100
Credits	1	Exam Hours	02
Examination nature (SEE)	Practical		

Course objectives:

- Understand object-oriented programming concepts, and apply them in solving problems.
- To create, debug and run simple C++ programs.
- Introduce the concepts of functions, friend functions, inheritance, polymorphism and function overloading.
- Introduce the concepts of exception handling and multithreading.

Sl.No	Experiments
1	Write a C++ program to find largest, smallest & second largest of three numbers using inline functions MAX & Min.
2	Write a C++ program to calculate the volume of different geometric shapes like cube, cylinder and sphere using function overloading concept.
3	Define a STUDENT class with USN, Name & Marks in 3 tests of a subject. Declare an array of 10 STUDENT objects. Using appropriate functions, find the average of the two better marks for each student. Print the USN, Name & the average marks of all the students.
4	Write a C++ program to create class called MATRIX using two-dimensional array of integers, by overloading the operator == which checks the compatibility of two matrices to be added and subtracted. Perform the addition and subtraction by overloading + and – operators respectively. Display the results by overloading the operator <<. If (m1 == m2) then m3 = m1 + m2 and m4 = m1 – m2 else display error
5	Demonstrate simple inheritance concept by creating a base class FATHER with data members: *First Name, Surname, DOB & bank Balance* and creating a derived class SON, which inherits: Surname & Bank Balance feature from base class but provides its own feature: First Name & DOB. Create & initialize F1 & S1 objects with appropriate constructors & display the FATHER & SON details.
6	Write a C++ program to define class name FATHER & SON that holds the income respectively. Calculate & display total income of a family using Friend function.
7	Write a C++ program to accept the student detail such as name & 3 different marks by get_data() method & display the name & average of marks using display() method. Define a friend function for calculating the average marks using the method mark_avg().
8	Write a C++ program to explain virtual function (Polymorphism) by creating a base class polygon which has virtual function areas two classes rectangle & triangle derived from polygon & they have area to calculate & return the area of rectangle & triangle respectively.
9	Design, develop and execute a program in C++ based on the following requirements: An EMPLOYEE class containing data members & members functions: i) Data members: employee number (an integer), Employee_ Name (a string of characters), Basic_ Salary (in integer), All_ Allowances (an integer), Net_Salary (an integer). (ii) Member functions: To read the data of an employee, to calculate Net_Salary & to print the values of all the data members. (All_Allowances = 123% of Basic, Income Tax (IT) =30% of gross salary (=basic_ Salary_All_Allowances_IT).
10	Write a C++ program with different class related through multiple inheritance & demonstrate the use of different access specified by means of members variables & members functions.
11	Write a C++ program to create three objects for a class named count object with data members

	such as roll_no & Name. Create a members function set_data ( ) for setting the data values & display ( ) member function to display which object has invoked it using „this‟ pointer.
12	Write a C++ program to implement exception handling with minimum 5 exceptions classes including two built in exceptions.

Course outcomes (Course Skill Set):

At the end of the course the student will be able to:

1. Write C++ program to solve simple and complex problems
2. Apply and implement major object-oriented concepts like message passing, function overloading, operator overloading and inheritance to solve real-world problems.
3. Use major C++ features such as Templates for data type independent designs and File I/O to deal with large data set.
4. Analyze, design and develop solutions to real-world problems applying OOP concepts of C++

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. The student has to secure not less than 35% (18 Marks out of 50) in the semester-end examination (SEE).

Continuous Internal Evaluation (CIE):

CIE marks for the practical course is **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment to be evaluated for conduction with observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments designed by the faculty who is handling the laboratory session and is made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled downed to 30 marks (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct 02 tests for 100 marks, the first test shall be conducted after the 8th week of the semester and the second test shall be conducted after the 14th week of the semester.
- In each test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability. Rubrics suggested in Annexure-II of Regulation book
- The average of 02 tests is scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and average marks of two tests is the total CIE marks scored by the student.

Semester End Evaluation (SEE):

SEE marks for the practical course is 50 Marks.

SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the University

All laboratory experiments are to be included for practical examination.

(Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.

Students can pick one question (experiment) from the questions lot prepared by the internal /external examiners jointly.

Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.

General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and

result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)
Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.
The duration of SEE is 03 hours

Rubrics suggested in Annexure-II of Regulation book

Suggested Learning Resources:

1. Object oriented programming in TURBO C++, Robert Lafore, Galgotia Publications, 2002
2. The Complete Reference C++, Herbert Schildt, 4th Edition, Tata McGraw Hill, 2003.
3. Object Oriented Programming with C++, E Balaguruswamy, 4th Edition, Tata McGraw Hill, 2006.

IoT for Smart Infrastructure		Semester	3
Course Code	**BEC358D**	CIE Marks	50
Teaching Hours/Week (L: T:P: S)	1:0:0:0	SEE Marks	50
Total Hours of Pedagogy	14	Total Marks	100
Credits	01	Exam Hours	1
Examination type (SEE)	Theory/Practical		

Course objectives:

To provide an understanding of the concepts, principles, and applications of IoT in the context of smart infrastructure.

To explore the role of IoT technologies in transforming infrastructure into smart, efficient, and sustainable systems and analyse the challenges, opportunities, and considerations in implementing IoT for smart infrastructure.

To examine real-world case studies and successful implementations of IoT in smart cities, buildings, transportation, and energy management and explore future trends and emerging technologies shaping the field of IoT for smart infrastructure.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

- **Interactive Lectures:** Conduct interactive lectures to present the theoretical concepts and foundational knowledge of IoT for smart infrastructure.
- **Case Studies and Group Discussions:** Utilize case studies to analyse real-world implementations of IoT in smart infrastructure projects. Divide students into groups and assign them specific cases to discuss and analyse.
- **Hands-on Workshops and Simulations:** Organize hands-on workshops or simulations where students can interact with IoT devices and technologies relevant to smart infrastructure.
- **Guest Lectures and Industry Experts:** Invite guest speakers or industry experts who have hands-on experience in implementing IoT in smart infrastructure projects. They can share their insights, challenges, and success stories, providing students with a real-world perspective
- **Project-Based Learning:** Assign students to work on individual or group projects related to IoT for smart infrastructure. Provide a project brief with specific objectives and deliverables. Students can apply their knowledge and skills to design, develop, or analyse IoT solutions for smart infrastructure challenges.

Module-1

Introduction to IoT and Smart Infrastructure

Introduction to IoT: Definition of IoT and its basic components, Overview of IoT applications in various industries, Importance of IoT in transforming infrastructure.

Smart Infrastructure Overview: Introduction to smart infrastructure and its key components, Benefits and challenges of implementing smart infrastructure, Case studies showcasing successful smart infrastructure projects.

IoT Technologies for Smart Infrastructure: Sensors and actuators: Types, functionalities, and applications; Communication protocols: Wi-Fi, Bluetooth, cellular networks, and their use in IoT;

Cloud computing and data analytics in IoT for infrastructure; Edge computing: Real-time decision-making at the edge. Security and Privacy in IoT for Smart Infrastructure: Security challenges and threats in IoT,Privacy considerations and data protection in smart infrastructure, best practices and solutions for ensuring IoT security and privacy.
Module-2
IoT Applications in Smart Cities Introduction to Smart Cities - Definition and key features of smart cities, Role of IoT in transforming cities into smart cities, Benefits and challenges of smart city implementations. IoT Applications in Smart City Infrastructure - Smart transportation: Intelligent traffic management and transportation systems, Smart buildings: Energy management and occupant comfort; Smart grids: Optimizing energy distribution and consumption; Waste management, water management, and environmental monitoring. Case Studies of Smart City Implementations: Showcase of successful smart city projects around the world; Analysis of the IoT technologies and strategies implemented; Lessons learned from these case studies. Future Trends in Smart Cities: Emerging technologies shaping the future of smart cities, Role of IoT, AI, and 5G in advancing smart city infrastructure, Opportunities and challenges for future smart city developments.
Module-3
IoT Applications in Smart Buildings Introduction to Smart Buildings: Definition and key features of smart buildings, Benefits of IoT in improving energy efficiency and occupant comfort, Challenges and considerations in implementing smart building technologies. IoT Technologies for Smart Buildings: Building automation systems and controls; Energy management and monitoring using IoT devices; Indoor environmental quality monitoring and optimization; Smart lighting and HVAC systems. Case Studies of Smart Building Implementations: Showcase of successful smart building projects; Analysis of IoT technologies and solutions deployed; Lessons learned from these case studies. Future Trends in Smart Buildings: Emerging technologies for smart buildings; Integration of IoT with AI and machine learning; Potential impact of 5G on smart building applications.
Module-4
IoT Applications in Smart Transportation Introduction to Smart Transportation: Definition and key features of smart transportation; Role of IoT in intelligent traffic management and transportation systems; Challenges and opportunities in implementing smart transportation solutions. IoT Technologies for Smart Transportation: Traffic sensors and monitoring systems; Intelligent transportation systems (ITS); Vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) communication; Real-time data analysis and predictive analytics.

Case Studies of Smart Transportation Implementations: Showcase of successful smart transportation projects; Analysis of IoT technologies and solutions deployed; Lessons learned from these case studies.
Future Trends in Smart Transportation: Emerging technologies shaping the future of smart transportation; Role of IoT, AI, and autonomous vehicles; Potential impact of 5G on smart transportation applications.

Module-5

IoT for Smart Grids and Energy Management

Introduction to Smart Grids: Definition and key features of smart grids: Role of IoT in optimizing energy distribution and consumption; Benefits and challenges of smart grid implementations. IoT Technologies for Smart Grids: Smart meters and energy monitoring devices; Demandresponse and load management; Grid optimization and fault detection using IoT; Renewableenergy integration and grid stability.
Case Studies of Smart Grid Implementations: Showcase of successful smart grid projects, Analysis of IoT technologies and solutions deployed, Lessons learned from these case studies.
Future Trends in Smart Grids and Energy Management: Emerging technologies for smart grids; Integration of IoT, AI, and blockchain in energy management; Potential impact of 5G on smart grid applications.

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

- Define and explain the core concepts and components of IoT and its relevance to smart infrastructure. Identify and evaluate the key technologies and communication protocols used in IoT for smart infrastructure.
- Assess the benefits, challenges, and ethical considerations associated with implementing IoT in smart infrastructure projects and analyse & compare different IoT applications in smart cities, buildings, transportation, and energy management.
- Examine real-world case studies of successful IoT implementations in smart infrastructure and extract lessons learned. Demonstrate an understanding of security and privacy considerations in IoT for smart infrastructure.
- Discuss the impact of emerging technologies, such as artificial intelligence and 5G, on the future of IoT in smart infrastructure. Apply knowledge and critical thinking skills to propose IoT-based solutions for smart infrastructure challenges.
- Work effectively in teams to analyse, design, and present IoT projects related to smart infrastructure and communicate effectively and articulate the potential benefits and limitations of IoT for smart infrastructure.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous internal Examination (CIE)

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's
taxonomy as per the outcome defined for the course.

Semester End Examinations (SEE)

SEE paper shall be set for 50 questions, each of the 01 marks. The pattern of the question paper is MCQ (multiple choice questions). The time allotted for SEE is **01 hour.** The student has to securea minimum of 35% of the maximum marks meant for SEE.

OR

MCQ (Multiple Choice Questions) are preferred for 01 credit courses, however, if course content demands the general question paper pattern that followed for 03 credit course, then

1. The question paper will have ten questions. Each question is set for 10 marks.
2. There will be 2 questions from each module. Each of the two questions under a module may or may not have the sub-questions (with maximum sub-questions of 02, with marks distributions 5+5, 4+6, 3+7).
3. The students have to answer 5 full questions, selecting one full question from each module.

Suggested Learning Resources:

1. MindMatrix.io
2. "Internet of Things (A Hands-on-Approach)" by Arshdeep Bahga and Vijay Madisetti
3. "Building the Internet of Things: Implement New Business Models, Disrupt Competitors, Transform Your Industry" by Maciej Kranz
4. "Smart Cities: Big Data, Civic Hackers, and the Quest for a New Utopia" by Anthony M. Townsend

5. "Internet of Things for Architects: Architecting IoT solutions by implementing sensors, communication infrastructure, edge computing, analytics, and security" by Perry Lea.

Web links and Video Lectures (e-Resources):

- makes.mindmatrix.io

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Sensor Deployment and Data Collection: Organize a hands-on activity where participants work in groups to deploy sensors in a simulated smart infrastructure environment.
- Smart City Simulation Game: Develop a simulation game where participants take on different roles representing stakeholders in a smart city.
- IoT Solution Design Challenge: Assign participants to design an IoT-based solution for a specific smart infrastructure problem. They can work individually or in teams to identify the problem, propose an IoT solution, outline the required components and technologies, and create a prototype or presentation.
- Security and Privacy Risk Assessment: Conduct a group activity where participants analyse the security and privacy risks associated with IoT deployments in smart infrastructure.
- Field Visit to Smart Infrastructure Project: Organize a field visit to a smart infrastructure project, such as a smart building, smart city district, or IoT-enabled transportation system.

Engineering Electromagnetics		Semester	4
Course Code	**BEC401**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	3
Examination type (SEE)	Theory		

Course objectives:

This course will enable students to:

- Study the different coordinate systems, Physical significance of Divergence, Curl and Gradient.
- Understand the applications of Coulomb's law and Gauss law to different charge distributions and the applications of Laplace's and Poisson's Equations to solve real time problems on capacitance of different charge distributions.
- Understand the physical significance of Biot-Savart's, Ampere's Law and Stokes' theorem for different current distributions.
- Infer the effects of magnetic forces, materials and inductance.
- Knowthephysicalinterpretationof Maxwell'sequationsandapplications for Plane waves for their behavior in different media.
- Acquire knowledge of Poynting theorem and its application of power flow.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

- Lecturemethod(L)doesnotmeanonlytraditionallecturemethod,butdifferenttypeofteachingmethodsmaybe adopted to develop the outcomes.
- Encourage collaborative (Group) Learning in the class.
- Ask at least three HOTS (Higher order Thinking) questions in the class, which promotes critical thinking.
- Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
- Topics will be introduced in a multiple representation.
- Showthedifferentwaystosolvethesameproblemandencouragethestudentstocomeupwiththeirowncreative ways to solve them.
- Discusshoweveryconceptcanbeappliedtotherealworld-andwhenthat'spossible,it helps improve the students' understanding.
- AdoptFlippedclasstechniquebysharingthematerials/SampleVideospriortotheclassandhavediscussionson the topic in the succeeding classes.

Module-1

Revision of Vector Calculus-**(Text1:Chapter1)**

Coulomb'sLaw,ElectricFieldIntensityandFluxdensity: Experimentallawof Coulomb, Electric field intensity, Field due to continuous volume charge distribution, Field of a line charge, Field due to Sheet of charge, Electric flux density, Numerical Problems.**(Text: Chapter2.1to 2.5, 3.1)**

Module-2
Gauss's law and Divergence: Gauss law, Application of Gauss law to point charge, line charge, Surface charge and volume charge, Point (differential) form of Gauss law, Divergence. Maxwell's First equation (Electrostatics),Vector Operator V and divergence theorem, Numerical Problems **(Text:Chapter3.2to 3.7).** **Energy, Potential and Conductors:** Energy expended or work done in moving a point charge in an electric field, The line integral, Definition of potential difference and potential, The potential field of point charge, Potential gradient, Numerical Problems **(Text: Chapter 4.1 to 4.4 and 4.6).** Current and Current density, Continuity of current. **(Text: Chapter 5.1, 5.2)**

Module-3
Poisson's and Laplace's Equations: Derivation of Poisson's and Laplace's Equations, Uniqueness theorem, Examples of the solution of Laplace's equation, Numerical problems on Laplace equation **(Text: Chapter 7.1to 7.3)** **Steady Magnetic Field:** Biot-Savart Law, Ampere's circuital law, Curl, Stokes' theorem, Magnetic flux and magnetic flux density, Basic concepts Scalar and Vector Magnetic Potentials, Numerical problems.**(Text: Chapter 8.1to8.6)**

Module-4
Magnetic Forces: Force on a moving charge, differential current elements, Force between differential current elements, Numerical problems**(Text:Chapter9.1 to9.3).** **Magnetic Materials:** Magnetization and permeability, Magnetic boundary conditions, The magnetic circuit, Potential energy and forces on magnetic materials, Inductance and mutual reactance, Numerical problems **(Text: Chapter9.6 to 9.7).** Faraday' law of Electromagnetic Induction -Integral form and Point form, Numerical problems **(Text: Chapter 10.1)**

Module-5
Maxwell's equations Continuity equation, Inconsistency of Ampere's law with continuity equation, displacement current, Conduction current, Derivation of Maxwell's equations in point form, and integral form, Maxwell's equations for different media, Numerical problems **(Text: Chapter 10.2 to 10.4)** **Uniform Plane Wave:** Plane wave, Uniform plane wave, Derivation of plane wave equations from Maxwell's equations, Solution of wave equation for perfect dielectric, Relation between E and **H,** Wave propagation in frees pace, Solution of wave equation for sinusoidal excitation, wave propagation in any conducting media (y,a, ¸ri) and good conductors, Skin effect or Depth of penetration, Poynting's theorem and wave power, Numerical problems.**(Text: Chapter 12.1 to12.4)**

Course outcome (Course Skill Set)
At the end of the course, the student will be able to : 1. Evaluate problems on electrostatic force, electric field due to point, linear, volume charges by applying conventional methods and charge in a volume. 2. Apply Gauss law to evaluate Electric fields due to different charge distributions and Volume Charge distribution by using Divergence Theorem.

3. Determine potential and energy with respect to point charge and capacitance using Laplace equation and Apply Biot-Savart's and Ampere's laws for evaluating Magnetic field for different current configurations
4. Calculate magnetic force, potential energy and Magnetization with respect to magnetic materials and voltage induced in electric circuits.
5. Apply Maxwell's equations for time varying fields, EM waves in free space and conductors and Evaluate power associated with EM waves using Poynting theorem.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). The student is declared as a pass in the course if he/she secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- There are 25 marks for the CIE's Assignment component and 25 for the Internal Assessment Test component.
- Each test shall be conducted for 25 marks. The first test will be administered after 40-50% of the coverage of the syllabus, and the second test will be administered after 85-90% of the coverage of the syllabus. The average of the two tests shall be scaled down to 25 marks
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The schedule for assignments shall be planned properly by the course teacher. The teacher should not conduct two assignments at the end of the semester if two assignments are planned. Each assignment shall be conducted for 25 marks. (If two assignments are conducted then the sum of the two assignments shall be scaled down to 25 marks)
- The final CIE marks of the course out of 50 will be the sum of the scale-down marks of tests and assignment/s marks.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

Suggested Learning Resources:

Books

1. W.H.Hayt and J.A. Buck, -Engineering Electromagnetics,8th Edition, TataMcGraw-Hill,2014,ISBN-978-93-392-0327-6.

Reference Books:

2. Elements of Electromagnetics –Matthew N.O., Sadiku, Oxford university press, 4th Edn.
3. Electromagnetic Waves and Radiating systems-E.C. Jordan and K.G. Balmain,**PHl,** 2ndEdn.
4. Electromagnetics-Joseph Edminister, Schaum Outline Series, McGraw Hill.
5. Fundamentals of Electromagnetics for Engineering-N. Narayana Rao, Pearson

Web links and Video Lectures (e-Resources):

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Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

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Basic Signal Processing		Semester	4
Course Code	**BEC402**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:2:0	SEE Marks	50
Total Hours of Pedagogy	40 hours Theory + 8-10 Lab slots	Total Marks	100
Credits	04	Exam Hours	3
Examination nature (SEE)	Theory/practical		

Course objectives:

This course will enable students to:

Preparation: To prepare students with fundamental knowledge /overview in the field of Signal Processing with Familiarization with the concept of Vector spaces and orthogonality with a qualitative insight into applications in communications.

Core Competence: To equip students with a basic foundation of Signal Processing by delivering the basics of quantitative parameters for Matrices & Linear Transformations, the mathematical description of discrete time signals and systems, analyzing the signals in time domain using convolution sum, classifying signals into different categories based on their properties, analyzing Linear Time Invariant(LTI) systems in time and transform domains

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

- Lecture method (L) does not mean only traditional lecture method, but different type of teaching methods maybe adopted to develop the outcomes.
- Show Video/animationfilmstoexplainthedifferentconceptsofLinearAlgebra&SignalProcessing.
- Encourage collaborative (Group)Learning in the class.
- Ask at least three HOTS(Higher order Thinking) questions in the class, which promotes critical thinking.
- Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
- Topics will be introduced in a multiple representation.
- Showthedifferentwaystosolvethesameproblemandencouragethestudentstocomeupwiththeirowncreative ways to solve them.
- Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.
- Adopt Flipped class technique by sharing the materials/Sample Videos prior to the class and have discussions on the that topic in the succeeding classes.
- Give Programming Assignments.

MODULE-1

Vector Spaces: Vector spaces and Null subspaces, Rank and Row reduced form, Independence, Basis anddimension,Dimensionsofthefoursubspaces,Rank-NullityTheorem,LinearTransformationsOrthogonality: Orthogonal Vectors and Subspaces, Projections and Least squares, Orthogonal Bases and Gram-Schmidt Orthogonalization procedure

(ReferChapters2and3of Text1)

MODULE-2

Eigen values and Eigen vectors: Review of Eigen values and Diagonalization of a Matrix, Special Matrices (Positive Definite, Symmetric) and their properties, Singular Value Decomposition.

(ReferChapter5,Text1)

MODULE-3

Introduction and Classification of signals: Definition of signal and systems with examples, Elementary signals/Functions: Exponential, sinusoidal, step, impulse and ramp functions **Basic Operations on signals:** Amplitude scaling, addition, multiplication, time scaling, time shift and time reversal. Expression of triangular, rectangular and other wave forms in terms of elementary signals **System Classification and properties:** Linear-nonlinear, Time variant-invariant, causal-non-causal, static-dynamic, stable-unstable, invertible. **(Text2)[Only for Discrete Signals & Systems]**
MODULE-4
Time domain representation of LTI System: Impulse response, convolution sum. Computation of convolution sum using graphical method for unit step and unit step, unit step and exponential, exponential and exponential, unit step and rectangular, and rectangular and rectangular. **LTI system Properties in terms of impulse response:** System interconnection, Memory less, Causal, Stable, Invertible and Deconvolution and step response **(Text2)[Only for Discrete Signals & Systems]**
MODULE-5
The Z-Transforms: Z-transform, properties of the region of convergence, properties of the Z-transform, Inverse Z-transform by partial fraction, Causality and stability, Transform analysis of LTI systems. **(Text2)**

PRACTICAL COMPONENT OF IPCC

Sl.NO	Experiments execute dusing programming languages Scilab / MATLAB (but not limited to)
1	a. Program to create and modify a vector (array). b. Program to create and modify a matrix.
2	Programs on basic operations on matrix.
3	Program to solve system of linear equations.
4	Program for Gram-Schmidt orthogonalization.
5	Program to find Eigen value and Eigen vector.
6	Program to find Singular value decomposition.
7	Program to generate discrete waveforms.
8	Program to perform asic operation on signals.
9	Program to perform convolution of two given sequences.
10	a. Program to perform verification of commutative property of convolution. b. Program to perform verification of distributive property of convolution. c. Program to perform verification of associative property of convolution.

Course outcomes (Course Skill Set):

At the end of the course, the student will be able to:

1. Understand the basics of Linear Algebra
2. Analyze different types of signals and systems
3. Analyze the properties of discrete-time signals & systems
4. Analyse discrete time signals & systems using Z transforms

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). The student is declared as a pass in the course if he/she secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

The IPCC means the practical portion integrated with the theory of the course. CIE marks for the theory component are **25 marks** and that for the practical component is **25 marks**.

CIE for the theory component of the IPCC

- 25 marks for the theory component are split into **15 marks** for two Internal Assessment Tests (Two Tests, each of 15 Marks with 01-hour duration, are to be conducted) and **10 marks** for other assessment methods mentioned in 22OB4.2. The first test at the end of 40-50% coverage of the syllabus and the second test after covering 85-90% of the syllabus.
- Scaled-down marks of the sum of two tests and other assessment methods will be CIE marks for the theory component of IPCC (that is for **25 marks).**

- The student has to secure 40% of 25 marks to qualify in the CIE of the theory component of IPCC.

CIE for the practical component of the IPCC

- **15 marks** for the conduction of the experiment and preparation of laboratory record, and **10 marks** for the test to be conducted after the completion of all the laboratory sessions.
- On completion of every experiment/program in the laboratory, the students shall be evaluated including viva-voce and marks shall be awarded on the same day.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to **15 marks**.
- The laboratory test **(duration 02/03 hours)** after completion of all the experiments shall be conducted for 50 marks and scaled down to **10 marks.**
- Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **25 marks**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the practical component of the IPCC.

SEE for IPCC

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored by the student shall be proportionally scaled down to 50 Marks

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper may include questions from the practical component.

- The minimum marks to be secured in CIE to appear for SEE shall be 10 (40% of maximum marks-25) in the theory component and 10 (40% of maximum marks -25) in the practical component. The laboratory component of the IPCC shall be for CIE only. However, in SEE, the questions from the laboratory component shall be included**.** The maximum of 04/05 sub-questions are to be set from the practical component of IPCC, the total marks of all questions should not be more than 20 marks.
- SEE will be conducted for 100 marks and students shall secure 35% of the maximum marks to qualify for the SEE. Marks secured will be scaled down to 50.
- The student is declared as a pass in the course if he/she secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Suggested Learning Resources:

Books

1. Gilbert Strang, "Linear Algebra and its Applications", Cengage Learning, 4thEdition, 2006, ISBN97809802327
2. Simon Haykin and Barry Van Veen, "Signals and Systems", 2nd Edition, 2008, Wiley India. ISBN9971-51-239-4.

Reference Books
3. **Michael Roberts,** "Fundamentals of Signals & Systems", 2nd edition, Tata McGraw-Hill, 2010, ISBN978-0-07-070221-9. 4. **Alan** V **Oppenheim, Alan** S **Willsky and** S **Hamid Nawab,** "Signals and Systems" Pearson Education Asia/ PHI, 2nd edition, 1997. Indian Reprint 2002. 5. **H P H su, R Ranjan,** "Signals and Systems", Schaum's outlines, TMH, 2006. 6. **BP Lathi,** "Linear Systems and Signals", Oxford University Press, 2005. 7. **Ganesh Rao and Satish Tunga,** "Signals and Systems", Pearson/Sanguine. 8. **Seymour Lipschutz,Marc Lipson,**"Schaums Easy Outline of Linear Algebra", 2020.
Web links and Video Lectures (e-Resources):
VideolecturesonSignalsandSystemsbyAlanVOppenheim Lecture1,Introduction|MITRES.6.007SignalsandSystems,Spring2011-YouTube Lecture 2, Signals and Systems: Part 1 | MIT RES.6.007 Signals and Systems, Spring 2011 - YouTubeNPTELvideolecturessignalsandsystem: https://www.youtube.com/watch?v=7Z3LE5uM-6Y&list=PLbMVogVj5nJQQZbah2uRZIRZ_9kfoqZyxVideolecturesonLinearAlgebrabyGilbertStrang https://www.youtube.com/watch?v=ZK3O402wf1c&list=PL49CF3715CB9EF31D&index=1
Activity Based Learning (Suggested Activities in Class)/ Practical Based learning
ProgrammingAssignments/MiniProjectscanbegiventoimproveprogrammingskills.

PRINCIPLES OF COMMUNICATION SYSTEMS		Semester	4
Course Code	**BEC403**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:2:0	SEE Marks	50
Total Hours of Pedagogy	40 hours Theory + 8-10 Lab slots	Total Marks	100
Credits	04	Exam Hours	3
Examination nature (SEE)	Theory/practical		

Course objectives:

This course will enable students to

- Understand and analyse concepts of Analog Modulation schemes viz; AM, FM
- Design and analyse the electronic circuits for AM and FM modulation and demodulation.
- Design and analyse the electronic circuits used at various stages of RF transmitter and receiver.
- Understand and analyse concepts of digitization of signals.
- Evolve the concept of SNR in the presence of channel induced noise

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Lecture method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.
2. Show Video/animation films to explain evolution of communication technologies.
3. Encourage collaborative (Group) Learning in the class.
4. Ask at least three HOTS (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
6. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
7. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

MODULE-1

Amplitude Modulation Fundamentals: AM Concepts, Modulation index and Percentage of Modulation, Sidebands and the frequency domain, AM Power, Single Sideband Modulation.

AM Circuits: Amplitude Modulators, Amplitude Demodulators, Balanced Modulators (Lattice type).

MODULE-2

Fundamentals of Frequency Modulation: Basic Principles of Frequency Modulation, Principles of Phase Modulation, Modulation index and sidebands, Noise Suppression effects of FM, Frequency Modulation versus Amplitude Modulation.

FM Circuits: Frequency Modulators: , Frequency Demodulators

MODULE-3

Radio Transmitters: Transmitter Fundamentals: Transmitter Configurations, Carrier Generators: Crystal Oscillators, Frequency Synthesisizers, Phase Locked Loop Synthesisizers.

Communication Receivers: Basic Principles of Signal reproduction, Superheterodyne Receivers, Frequency Conversion: Mixing principles, Mixer and Converter Circuits, Local Oscillators and Frequency Synthesizers, Intermediate Frequency and Images.

MODULE-4

Digital communication Techniques: Digital transmission of data, parallel and serial Transmission, Data Conversion: Basic Principles of Data Conversion, D/A Converters, A/D Converters, ADC Specifications, Pulse Modulation: Comparing Pulse Modulation Methods, Pulse-Code Modulation.

MODULE-5

Noise: Signal to Noise Ratio, External Noise, Internal Noise, Expressing Noise Levels, Noise in Cascade Stages.
Multiplexing and Demultiplexing: Multiplexing Principles, Frequency Division Multiplexing, Time Division Multiplexing, Pulse code Modulation: PCM Multiplexers, Demultiplexers, Benefits, Digital Carrier Systems (T carrier System) , Duplexing.

PRACTICAL COMPONENT OF IPCC *(Experiments can be conducted using a suitable circuit simulation software or hardware components)*

Sl.NO	Experiments
1	Design and Test the Amplitude Modulation and demodulation using diode and transistors.
2	Design and Test the Frequency modulation using VCO and demodulation using slope detector circuit.
3	Design and test a high power a) Class A line RF amplifier. b) Class E RF amplifier
4	Design and test a mixer used for frequency translation.
5	Design and test a VCO used for local oscillator service
6	Verification of Sampling Theorem using sampling a sinusoidal signal using a sample and hold circuit.
7	TDM PAM Multiplexer and Demultiplexer
8	A String DAC and Flash Converter (Demo Experiment)
9	Design and Test a RF Transmitter circuit (Demo Experiment)
10	Design and Test a RF Receiver circuit (Demo Experiment)

Course outcomes (Course Skill Set):
At the end of the course, the student will be able to:
1. Understand the amplitude and frequency modulation techniques and perform time and frequency domain transformations.
2. Identify the schemes for amplitude and frequency modulation and demodulation of analog signals and compare the performance.
3. Characterize the influence of channel noise on analog modulated signals.
4. Define the schemes for sampling, pulse amplitude modulation and pulse code modulation systems.
5. Design of circuits used in different stages of communication transmitters and receivers.

Assessment Details (both CIE and SEE)
The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). The student is declared as a pass in the course if he/she secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

The IPCC means the practical portion integrated with the theory of the course. CIE marks for the theory component are **25 marks** and that for the practical component is **25 marks.**

CIE for the theory component of the IPCC

- 25 marks for the theory component are split into **15 marks** for two Internal Assessment Tests (Two Tests, each of 15 Marks with 01-hour duration, are to be conducted) and **10 marks** for other assessment methods mentioned in 22OB4.2. The first test at the end of 40-50% coverage of the syllabus and the second test after covering 85-90% of the syllabus.
- Scaled-down marks of the sum of two tests and other assessment methods will be CIE marks for the theory component of IPCC (that is for **25 marks)**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the theory component of IPCC.

CIE for the practical component of the IPCC

- **15 marks** for the conduction of the experiment and preparation of laboratory record, and **10 marks** for the test to be conducted after the completion of all the laboratory sessions.
- On completion of every experiment/program in the laboratory, the students shall be evaluated including viva-voce and marks shall be awarded on the same day.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to **15 marks**.
- The laboratory test **(duration 02/03 hours)** after completion of all the experiments shall be conducted for 50 marks and scaled down to **10 marks.**
- Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **25 marks**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the practical component of the IPCC.

SEE for IPCC

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored by the student shall be proportionally scaled down to 50 Marks

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper may include questions from the practical component.

- The minimum marks to be secured in CIE to appear for SEE shall be 10 (40% of maximum marks-25) in the theory component and 10 (40% of maximum marks -25) in the practical component. The laboratory component of the IPCC shall be for CIE only. However, in SEE, the questions from the laboratory component shall be included**.** The maximum of 04/05 sub-questions are to be set from the practical component of IPCC, the total marks of all questions should not be more than 20 marks.
- SEE will be conducted for 100 marks and students shall secure 35% of the maximum marks to qualify for the SEE. Marks secured will be scaled down to 50.
- The student is declared as a pass in the course if he/she secures a minimum of 40% (40 marks out of 100)

in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.
Suggested Learning Resources: **Books** 1. Louis E Frenzel, Principles of Electronic Communication Systems, 3rd Edition, Mc Graw Hill Education (India) Private Limited, 2016. ISBN: 978-0-07-066755-6. **Reference Books** 1. Herbert Taub, Donald L Schilling, Goutam Saha, "Principles of Communication systems", 4th Edition, Mc Graw Hill Education (India) Private Limited, 2016. ISBN: 978-1-25-902985-1 2. B P Lathi, Zhi Ding, "Modern Digital and Analog Communication Systems", Oxford University Press., 4th edition, 2010, ISBN: 97801980738002. 3. Simon Haykins & Moher, Communication Systems, 5th Edition, John Wiley, India Pvt. Ltd, 2010, ISBN: 978-81-265-2151-7.
Web links and Video Lectures (e-Resources):
Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

Communication Laboratory		Semester	**4**
Course Code	**BECL404**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	0:0:2	SEE Marks	50
Credits	01	Total Marks	100
		Exam Hours	3
Examination type (SEE)	Practical		

Course objectives:

This laboratory course enables students to

- Understand the basic concepts of AM and FM modulation and demodulation.
- Design and analyse the electronic circuits used for AM and FM modulation and demodulation circuits.
- Understand the sampling theory and design circuits which enable sampling and reconstruction of ofanalog signals.
- Realize the electronic circuits to perform pulse amplitude modulation, pulse code modulation and s and multiplexing.
- Understand the working principles of RF transmitters and receivers.

	Experiments
1	Design and plot the frequency response of an active band pass and band stop filters.
2	Design and test a high-level collector Modulator circuit and Demodulation the signal using diode detector.
3	Test the Balanced Modulator / Lattice Modulator (Diode ring)
4	Frequency modulation using VCO and PLL FM demodulator.
5	Design and test i) Pulse sampling, flat top sampling and reconstruction. ii)Pulse amplitude modulation and demodulation.
6	Design and test the Time Division Multiplexing of two bandlimited signals
7	Design and test BJT/FET Mixer
8	Design and test the Pulse width Modulation and Pulse Position Modulation.
	Demonstration Experiments (For CIE)
9	PLL Frequency Synthesizer
10	PAM Multiplexer and Demultiplexer
11	PCM Multiplexer and Demultiplexer
12	Low power RF Transmitter and Receiver operations.

Course outcomes (Course Skill Set):
At the end of the course the student will be able to:
1. Understand the basic concepts of RF transmitters and Receivers.
2. Illustrate the AM and FM modulation generation and detection using suitable electronic circuits.
3. Design and test the sampling, Multiplexing and pulse modulation techniques using electronic hardware.
4. Design and Demonstrate the electronic circuits used for RF transmitters and receivers.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation (CIE):
CIE marks for the practical course are **50 Marks**.
The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment is to be evaluated for conduction with an observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments are designed by the faculty who is handling the laboratory session and are made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled down to **30 marks** (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct a test of 100 marks after the completion of all the experiments listed in the syllabus.
- In a test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability.
- The marks scored shall be scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and marks of a test is the total CIE marks scored by the student.

Semester End Evaluation (SEE):

- SEE marks for the practical course are 50 Marks.
- **SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the Head of the Institute.**
- The examination schedule and names of examiners are informed to the university before the conduction of the examination. These practical examinations are to be conducted between the schedule mentioned in the academic calendar of the University.
- All laboratory experiments are to be included for practical examination.
- (Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.
- Students can pick one question (experiment) from the questions lot prepared by the examiners jointly.
- Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.

General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall

be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)
Change of experiment is allowed only once and 15% of Marks allotted to the procedure part are to be made zero.
The minimum duration of SEE is 02 hours

Suggested Learning Resources:

1. Louis E Frenzel, Principles of Electronic Communication Systems, 3rd Edition, McGraw Hill Education (India) Private Limited, 2016. ISBN: 978-0-07-066755-6.

8051 MICROCONTROLLER		Semester	4
Course Code	**BEC405A**	CIE Marks	50
Teaching Hours/Week (L: T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	3
Examination type (SEE)	Theory		

Course objectives:

This course will enable students to:

- Understand the difference between a Microprocessor and a Microcontroller and embedded microcontrollers.
- Familiarize the basic architecture of 8051 microcontroller.
- Program 8051microprocessor using Assembly Level Language and C.
- Understand the interrupt system of 8051 and the use of interrupts.
- Understand the operation and use of inbuilt Timers/Counters and Serial port of 8051.
  Interface 8051 to external memory and I/O devices using its I/O ports.

Teaching-Learning Process (General Instructions)

The sample strategies, which the teacher can use to accelerate the attainment of the various course outcomes are listed in the following:

1. Lecture method (L) does not mean only the traditional lecture method, but a different type of teaching method may be adopted to develop the outcomes.
2. Show Video/animation films to explain the functioning of various techniques.
3. Encourage collaborative (Group) Learning in the class
4. Ask at least three HOTS (Higher-order Thinking) questions in the class, which promotes critical thinking
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
6. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
7. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Give Programming Assignments.

Module-1

8051 Microcontroller:
Microprocessor Vs Microcontroller, Embedded Systems, Embedded Microcontrollers, 8051 Architecture- Registers, Pin diagram, I/O ports functions, Internal Memory organization. External Memory (ROM & RAM) interfacing.

Module-2

8051 Instruction Set: Addressing Modes, Data Transfer instructions, Arithmetic instructions, Logical instructions, Branch instructions, Bit manipulation instructions. Simple Assembly language program examples (without loops) to use these instructions

Module-3

8051 Stack, I/O Port Interfacing and Programming: 8051 Stack, Stack and Subroutine instructions. Assembly language program examples on subroutineand involving loops - Delay subroutine, Factorial of an 8 bit number (result maximum 8 bit), Block move without overlap, Addition of N 8 bit numbers, Picking smallest/largest of N 8 bit numbers.

Interfacing simple switch and LED to I/O ports to switch on/off LED withrespect to switch status.

Module-4

8051 Timers and Serial Port: 8051 Timers and Counters – Operation and Assembly language programming to generate a pulse using Mode-1 and a square wave using Mode-2 on a port pin.

8051 Serial Communication- Basics of Serial Data Communication, RS-232 standard, 9 pin RS232 signals, Simple Serial Port programming in Assembly and Cto transmit a message and to receive data serially

Module 5

8051 Interrupts and Interfacing Applications: 8051 Interrupts. 8051 Assembly language programming to generate an external interrupts using a switch, 8051 C programming to generate a square waveform on aport pin using a Timer interrupt. Interfacing 8051 to ADC-0804, LCD and Stepper motor and their 8051 Assembly language interfacing programming

Course outcome (Course Skill Set)

At the end of the course, students will be able to:

1. Explain the difference between Microprocessors & Microcontrollers, Architecture of 8051 Microcontroller, Interfacing of 8051 to external memory and Instruction set of 8051.
2. Write 8051 Assembly level programs using 8051 instruction set.
3. Explain the Interrupt system, operation of Timers/Counters and Serial port of 8051.
4. Write 8051 Assembly language program to generate timings and waveforms using 8051 timers, to send & receive serial data using 8051 serial port and to generate an external interrupt using a switch.
5. Write 8051 C programs to generate square wave on 8051 I/O port pin using interrupt and to send & receive serial data using 8051 serial port. Interface simple switches, simple LEDs, ADC 0804, LCD and Stepper Motorto 8051 using 8051 I/O ports.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). The student is declared as a pass in the course if he/she secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

There are 25 marks for the CIE's Assignment component and 25 for the Internal Assessment Test component.

Each test shall be conducted for 25 marks. The first test will be administered after 40-50% of the coverage of the syllabus, and the second test will be administered after 85-90% of the coverage of the syllabus. The average of the two tests shall be scaled down to 25 marks

Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based thenonly one assignment for the course shall be planned. The schedule for assignments shall be planned properly by the course teacher. The teacher should not conduct two assignments at theend of the semester if two assignments are planned. Each assignment shall be conducted for 25 marks. (If two assignments are conducted then the sum of the two assignments shall be scaled down to 25 marks)

The final CIE marks of the course out of 50 will be the sum of the scale-down marks of tests andassignment/s marks.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomyas per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers forthe course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximumof 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Books

1. The 8051 Microcontroller and Embedded Systems – using assembly and C ", Muhammad Ali Mazidi and Janice Gillespie Mazidi and Rollin D. McKinlay; PHI, 2006 / Pearson, 2006.
2. "The 8051 Microcontroller", Kenneth J. Ayala,3rd Edition, Thomson/ Cengage Learning

REFERENCE BOOKS:

1. "The 8051 Microcontroller Based Embedded Systems", Manish KPatel, McGraw Hill, 2014, ISBN: 978-93-329-0125-4.
2. "Microcontrollers: Architecture, Programming, Interfacing andSystem Design", Raj Kamal, Pearson Education, 2005.

Web links and Video Lectures (e-Resources):

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

Industrial Electronics		Semester	4
Course Code	**BEC405B**	CIE Marks	50
Teaching Hours/Week (L: T:P: S)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	40 hours	Total Marks	100
Credits	03	Exam Hours	03
Examination type (SEE)	Theory		

Course objectives: This course will enable student to

- Explain broad types of industrial power devices, there structure, and its characteristics.
- Design and analyse the broad categories of power electronic circuits.
- Explain various types of MEMs devices, principle of operation and construction.
- Familiarize with soft core processors and computer architecture.
- Apply protective methods for devices and circuits.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecture method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.
2. Show Video/animation films to explain evolution of communication technologies.
3. Encourage collaborative (Group) Learning in the class.
4. Ask at least three HOTS (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
6. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
7. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1

Industrial Power Devices: General purpose power diodes, fast recovery power diodes, schottky power diodes, silicon carbide power diodes **(Text book 1: 2.5, 2.6)**, Power MOSFETs, Steady state characteristics, switching characteristics, silicon carbide MOSFETs, COOLMOS, Junction field effect transistors, operation and characteristics of JFETs, Silicon Carbide JFET structures, Bipolar Junction Transistors, Steady state characteristics, switching characteristics, silicon carbide BJTs, IGBT, silicon carbide IGBTs **(Text book 1: 4.3, 4.4, 4.6, 4.7)**, Thyristor, Thyristor characteristics, two transistor model **(Text book 1: 9.2, 9.3, 9.4)**.

Module-2

Power Electronics Circuits: Controlled Rectifiers – Single phase full converter with R and RL load, Single phase dual converters, and Three phase full converter with RL load **(Text book 1: 10.2, 10.3, 10.4)**.

Switching mode regulators – Buck Regulator, Boost regulator, Buck – Boost regulator, comparison of regulators **(Text book 1: 5.9.1, 5.9.2, 5.9.3, 5.10)**

Inverters – Principle of operation, Single phase bridge inverter, Three phase inverter with 180 and 120 degree conduction, Current source inverter **(Text book 1: 6.3, 6.4, 6.5, 6.9)**.

AC voltage controllers – Single phase full wave controller with resistive load, single phase full wave controller with inductive load **(Text book 1: 11.3, 11.4)**.

Module-3

MEMS Devices: Sensing and Measuring Principles, Capacitive Sensing, Resistive Sensing, Piezoelectric Sensing, Thermal Transducers, Optical Sensors, Magnetic Sensors, MEMS Actuation Principles, Electrostatic Actuation, Thermal Actuation, Piezoelectric Actuation, Magnetic Actuation, MEMS Devices Inertial Sensors, Pressure Sensors, Radio Frequency MEMS: Capacitive Switches and Phase Shifters, Microfluidic Components, Optical Devices. **(Text book 2: 13.1, 13.3, 13.4)**

Module-4

Soft Core Processors - Processor Core Options, Processor Definition Process, Software Development Aspects, Utilization of Soft-Core Processors, Custom Instructions, Soft-Core Processor on an ASIC vs. FPGA, Design Issues, Applications for Soft-Core Processors **(Text book 2: 22.2, 22.3, 22.4, 22.5, 22.6, 22.7, 22.8, 22.9).**   **Computer Architecture -** Hardware Organization, Computer Software, Programming Languages, Operating Systems, Information Representation in Digital Computers, Computer Programming Model, CPU Registers, Immediate Operands, Memory, Organization, Memory Addressing, Computer Instruction, Types, Interrupts and Exceptions, Evaluating Instruction Set Architectures, Computer System Design, Hierarchical Memory Systems, Memory Characteristics, Semiconductor Memory Technologies, Memory System Organization, Cache Memory, Virtual Memory Management, Interfaces to Input/Output Devices, Microcontroller Architectures Multiple Processor Architectures **(Text book 2: 23.2, 23.3, 23.4, 23.5, 23.6, 23.7, 23.8, 23.9, 23.10)**
Module-5
Protections of Devices and Circuits: Cooling and Heat sinks, Thermal Modeling of Power Switching Devices, Electrical Equivalent Thermal model, Mathematical Thermal Equivalent Circuit, Coupling of Electrical and Thermal Components, Snubber circuits, Reverse Recovery Transients, Supply and Load side transients, Voltage protection by Selenium Diodes and Metaloxide Varistors, Current protection, Fusing, Fault current with AC source, Fault current with DC source, Electromagnetic Interference, sources of EMI, Minimizing EMI Generation, EMI shielding, EMI standards **(Text book 1: 17.2, 17.3, 17.4, 17.5, 17.6, 17.7, 17.8, 17.9)**.
Course outcome (Course Skill Set)   At the end of the course, the student will be able to :   1. Explain different types of industrial power devices such as MOSFET, BJT, IGBT etc, there structure, and its operating characteristics.   2. Design and analyse the power electronic circuits such as switch mode regulators, inverters, controlled rectifiers and ac voltage controllers.   3. Explain various types of MEMs devices used for sensing pressure, temperature, current, voltage, humidity, vibration etc..   4. Familiarize with soft core processors such as ASIC and FPGA.   5. Familiarize with computer hardware, software, architecture, instruction set, memory organization, multiprocessor architecture.   6. Apply protective methods for devices various industrial power devices based on thermal requirements and develop protective methods for the circuits against various electrical parameters.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). The student is declared as a pass in the course if he/she secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- There are 25 marks for the CIE's Assignment component and 25 for the Internal Assessment Test component.
- Each test shall be conducted for 25 marks. The first test will be administered after 40-50% of the coverage of the syllabus, and the second test will be administered after 85-90% of the coverage of the syllabus. The average of the two tests shall be scaled down to 25 marks
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The schedule for assignments shall be planned properly by the course teacher. The teacher should not conduct two assignments at the end of the semester if two assignments are planned. Each assignment shall be conducted for 25 marks. (If two assignments are conducted then the sum of the two assignments shall be scaled down to 25 marks)
- The final CIE marks of the course out of 50 will be the sum of the scale-down marks of tests and assignment/s marks.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Books

1. Power Electronics: Devices, Circuits, and Applications, Muhammad H. Rashid, Pearson, 4th International edition.
2. Fundamentals of Industrial Electronics , Bogdan M. Wilamowski, J. David Irwin, CRC Press, 2011,
3. Thomas E. Kissell, Industrial Electronics: Applications for Programmable Controllers, Instrumentation and Process Control, and Electrical Machines and Motor Controls, 3rd edition, 2003, Prentice Hall.
4. Ned Mohan, T.M. Undeland and W.P. Robbins, "Power Electronics: Converters, Applications and Design", Wiley India Ltd, 2008.

Web links and Video Lectures (e-Resources):

- https://archive.nptel.ac.in/courses/108/102/108102145/
- https://nptel.ac.in/courses/117105082
- https://www.youtube.com/channel/UCKg8GNii0Q-ieXE56AXosGg/featured
- https://www.ieee-ies.org/

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Quiz and Seminars

Operating system		Semester	4
Course Code	**BEC405C**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	3
Examination type (SEE)	Theory		

Course objectives:

- Understand the services provided by an operating system.
- Explain how processes are synchronized and scheduled.
- Understand the different approaches of memory management and virtual memory management,
- Describe the structure and organisation of the file system.
- Understand inter process communication and dead lock situations.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method(L) need not to be only traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1

Introduction to Operating System: OS, goals of an OS, Computational structures, resource allocation techniques, efficiency, system performance and user convenience, classes operating system, batch processing, multiprogramming, time sharing system, real time and distributed operating systems.

(Topics from sections 1.2,1.3,2.2 to 2.8 of text 1).

Module-2

Process Management: OS view of processes, PCB, Fundamental state, Transitions of a process**,** Threads, Kernel and User level Threads, Non-Preemptive Scheduling-FCFS and SRN, Preemptive Scheduling- RR and LCN, Scheduling in Unix and Scheduling Linux .

(**Topics from sections 3.3,3.3.1,3.4,3.4.1,3.4.2, Selected scheduling topics from 4.2 and 4.3,4.6,4.7 of Text 1**)

Module-3

Memory Management: Contiguous Memory Allocation, Non-contiguous Memory Allocation, Paging, Segmentation with Paging, Virtual Memory Management, Demand Paging, VM Handler, FIFO, LRU Page replacement policies, Virtual memory in Unix and Linux. (**Topics from Sections 5.5 to 5.9, 6.1 to 6.3 except optimal policy and 6.3.1, 6.7, 6.8 of Text 1**).
Module-4
File systems: File systems and IOCS, File Operation, File Organization, Directory Structure, File Protection, Interface between File system and IOCS, Allocation of disk space, Implementing file access. (**Topics from section 7.1 to 7.8 of Text**).
Module-5
Message passing and deadlocks: Overview of Message Passing, Implementing message passing, Mailboxes, Deadlocks, Deadlocks in resource allocation, Handling deadlocks, Deadlocks detection algorithm, Deadlocks Prevention. (**Topics from sections 10.1 to 10.3, 11.1 to 11.5 of Text**).
Course outcome (Course Skill Set) At the end of the course, the student will be able to : 1. Explain the goals, structure, operation and types of operating system. 2. Apply scheduling techniques to find performance factors. 3. Explain organization of file system and IOCS. 4. Apply suitable techniques for contiguous and non contiguous memory allocation. 5. Describe message passing, deadlock detection and prevention methods.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). The student is declared as a pass in the course if he/she secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- There are 25 marks for the CIE's Assignment component and 25 for the Internal Assessment Test component.
- Each test shall be conducted for 25 marks. The first test will be administered after 40-50% of the coverage of the syllabus, and the second test will be administered after 85-90% of the coverage of the syllabus. The average of the two tests shall be scaled down to 25 marks
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The schedule for assignments shall be planned properly by the course teacher. The teacher should not conduct two assignments at the end of the semester if two assignments are planned. Each assignment shall be conducted for 25 marks. (If two assignments are conducted then the sum of the two assignments shall be scaled down to 25 marks)
- The final CIE marks of the course out of 50 will be the sum of the scale-down marks of tests and assignment/s marks.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Books

1. Operating system – A concept based Approach, by Dhamdhere, TMH, 2nd edition.

Web links and Video Lectures (e-Resources):

- https://archive.nptel.ac.in/courses/106/105/106105214/
- https://onlinecourses.nptel.ac.in/noc20_cs04/preview
- https://onlinecourses.nptel.ac.in/noc21_cs72/preview
- https://nptel.ac.in/courses/106106144
- https://nptel.ac.in/courses/106102132
- https://nptel.ac.in/courses/106106168
- https://archive.nptel.ac.in/courses/106/102/106102132/.

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Real world problem solving using group discussion.
- Role play for process scheduling.
- Present animation for deadlock.
- Real world example of memory management concepts.

Control Systems		Semester	4
Course Code	BEC405D	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	3
Examination type (SEE)	Theory		

Course objectives:

This course will enable students to:

- Understand the basic features, configurations and application of control systems.
- Understand various terminologies and definitions for the control systems.
- Learn how to find a mathematical model of electrical, mechanical and electro- mechanical systems.
- Knowhowtofindtimeresponsefromthetransferfunction.
- FindthetransferfunctionviaMasons'rule.
- Analyze the stability of a system from the transfer function.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

- Lecture method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.
- Encourage collaborative (Group) Learning in the class.
- Ask at least three HOTS (Higher order Thinking) questions in the class, which promotes critical thinking.
- Adopt Problem Based Learning (PBL), which fosters students Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
- Topics will be introduced in a multiple representation.
- Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
- Discuss how every concept can be applied to the real world-and when that's possible, it helps improve the students' understanding.
- Adopt Flipped class technique by sharing the materials/ Sample Videos prior to the class and have discussions on the topic in the succeeding classes.

Module-1

Introduction to Control Systems: Types of Control Systems, Effect of Feedback Systems, Differential equation of Physical Systems -Mechanical Systems, Electrical Systems, Electro mechanical systems, Analogous Systems.

Module-2

Block diagrams and signal flow graphs: Transfer functions, Block diagram algebra and Signal Flow graphs.

Module-3

Time Response of feedback control systems: Standard test signals, Unitstep response of First and Second order Systems. Time response specifications,Time response specifications of second order systems, steady state errors and error constants. Introduction to PI, PD and PID Controllers (excluding design).
Module-4
Stability analysis: Concepts of stability, Necessary conditions for Stability, Routh stability criterion, Relative stability analysis: more on the Routh stability criterion. Introduction to Root-Locus Techniques, The root locus concepts, Construction of root loci. **Frequency domainanalysisandstability:** Correlation between timeand frequency response, Bode Plots, Experimental determination of transfer function.
Module-5
Introduction to Polar Plots, (Inverse Polar Plots excluded) Mathematical preliminaries, Nyquist Stability criterion,(Systems with transportation lag excluded) Introduction to lead, lag and lead- lag compensating networks (excluding design). **Introductionto State variable analysis:** Concepts of state, state variable and state models for electrical systems, Solution of state equations.
Course outcome (Course Skill Set) At the end of the course, the student will be able to : 1. Developthemathematicalmodelofmechanicalandelectrical systems. 2. Developtransferfunctionfora givencontrolsystemusingblock diagram reduction techniques and signal flow graph method. 3. Determine thetimedomain specificationsforfirstandsecondorder systems. 4. Determine the stability of a system in the time domain using Routh- Hurwitz criterion and Root-locus technique. 5. Determine the stability of a system in the frequency domain using Nyquist and bode plots.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). The student is declared as a pass in the course if he/she secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- There are 25 marks for the CIE's Assignment component and 25 for the Internal Assessment Test component.
- Each test shall be conducted for 25 marks. The first test will be administered after 40-50% of the coverage of the syllabus, and the second test will be administered after 85-90% of the coverage of the syllabus. The average of the two tests shall be scaled down to 25 marks
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The schedule for assignments shall be planned properly by the course teacher. The teacher should not conduct two assignments at the end of the semester if two assignments are planned. Each assignment shall be conducted for 25 marks. (If two assignments are conducted then the sum of the two assignments shall be scaled down to 25 marks)
- The final CIE marks of the course out of 50 will be the sum of the scale-down marks of tests and assignment/s marks.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with

Suggested Learning Resources:

Book

1. J. Nagarath and M. Gopal, "Control Systems Engineering", New Age International(P) Limited, Publishers, Fifth edition- 2005, ISBN:81- 224-2008-7.

ReferenceBooks:

1. "Modern Control Engineering", K.Ogata, Pearson Education Asia/PHI, 4thEdition, 2002. ISBN978-81 -203-4010- 7.
2. "Automatic Control Systems", Benjamin C. Kuo, John Wiley India Pvt. Ltd., 8thEdition, 2008.
3. "Feedback and Control System," Joseph J Distefano III et.al., Schaum's Outlines, TMH, 2ndEdition 2007.

Web links and Video Lectures (e-Resources):
• .
Activity Based Learning (Suggested Activities in Class)/ Practical Based learning   •

Embedded C Basics		Semester	4
Course Code	**BEC456A**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	0:0:2:0	SEE Marks	50
Credits	01	Total Marks	100
		Exam Hours	2
Examination type (SEE)	Theory/practical/Viva-Voce /Term-work/Others		

Course objectives: This course will enable students to:

- Understand the basic programming of Microprocessor and microcontroller.
- Develop the microcontroller-based programs for various application in simulation environment
- Program a microcontroller to control an external hardware using suitable I/O ports.

Sl.NO	Experiments
	Conduct the following experiments by writing C Program using Keil microvision simulator (any 8051 microcontroller can be chosen as the target).
1	Write a 8051C program to multiply two 16 bit binary numbers.
2	Write a 8051 C program to find the sum of first 10 integer numbers.
3	Write a 8051 C program to find factorial of a given number.
4	Write a 8051 C program to add an array of 16bit numbers and store the 32 bit result in internal RAM
5	Write a 8051C program to find the square of a number (1to10)using look-up table.
6	Write a 8051 C program to find the largest/smallest number in an array of 32 numbers
7	Writea8051 C program to arrange a series of 32bit numbers in ascending/descending order
8	Write a 8051 C program to count the number of ones and zeros in two consecutive memory locations.
9	Write a 8051C program to scan a series of 32bit numbers to find how many are negative.
10	Writea8051 C program to display "HelloWorld" message (either in simulation mode or interface an LCD display).
11	Write a 8051C program to generate the waveforms: square, triangle and ramp, using DAQ.
12	Write a 8051 C program to run a stepper motor in clock wise and counter clockwise direction with a given step angle.

Course outcomes (Course Skill Set):

At the end of the course the student will be able to:

1. Write C programs in 8051for solving simple problems that manipulate input data using different instructions.
2. Develop testing and experimental procedures on 8051Microcontroller, analyze their operation under different cases.
3. Develop programs for 8051Microcontroller to implement real world problems.
4. Develop microcontroller applications using external hardware interface.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation (CIE):

CIE marks for the practical course are **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment is to be evaluated for conduction with an observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments are designed by the faculty who is handling the laboratory session and are made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled down to **30 marks** (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct a test of 100 marks after the completion of all the experiments listed in the syllabus.
- In a test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability.
- The marks scored shall be scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and marks of a test is the total CIE marks scored by the student.

Semester End Evaluation (SEE):

- SEE marks for the practical course are 50 Marks.
- **SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the Head of the Institute**.
- The examination schedule and names of examiners are informed to the university before the conduction of the examination. These practical examinations are to be conducted between the schedule mentioned in the academic calendar of the University.
- All laboratory experiments are to be included for practical examination.
- (Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.
- Students can pick one question (experiment) from the questions lot prepared by the examiners jointly.
- Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.

General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)

Change of experiment is allowed only once and 15% of Marks allotted to the procedure part are to be made zero.

The minimum duration of SEE is 02 hours

Suggested Learning Resources:

"The8051Microcontroller:Hardware,SoftwareandApplications",VUdayashankaraandMSMallikarjunaSwamy, McGrawHillEducation,1stedition,2017.

<table>
<tr><td colspan="2">PCB Design</td><td>Semester</td><td>4</td></tr>
<tr><td>Course Code</td><td>BEC456B</td><td>CIE Marks</td><td>50</td></tr>
<tr><td>Teaching Hours/Week (L:T:P: S)</td><td>1:0:0:0</td><td>SEE Marks</td><td>50</td></tr>
<tr><td>Total Hours of Pedagogy</td><td></td><td>Total Marks</td><td>100</td></tr>
<tr><td>Credits</td><td>01</td><td>Exam Hours</td><td>1</td></tr>
<tr><td>Examination type (SEE)</td><td colspan="3">Theory</td></tr>
</table>

Course objectives:

- Study about layout planning, art work and design of PCB
- To understand the PCB production process
- Discuss the role of Modern trends and automatic design of PCB

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecture method (L) does not mean only the traditional lecture method, but a different type of teaching method may be adopted to develop the outcomes
2. Show Video/animation films to explain the functioning of various
3. Encourage collaborative (Group) Learning in the class to promote critical thinking
4. Topics for seminars on several MEMS related topics and their applications
5. Encourage the students to take up mini projects and main projects
6. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1

Design of Printed Circuit Boards:Layout Planning: Introduction, General Consideration, PCB Sizes, Layout Approaches, Documentation, **Layout, General Rules and Parameters**: Introduction, Resistance, Capacitance, Inductance of PCB conductors, Conductor Spacing, Component Placing and Mounting, Cooling Requirements and Package Density, Layout Check, Art work.

Module-2

Technology of PCB: Film Master Production: Introduction, Emulsion Parameters, Film Emulsions, Dimensional Stability of Film Masters, Reprographic Cameras, Darkroom, Film Processing, Film Registration, **Properties of Copper Clad Laminates:**Introduction, Manufacture of Copper Clad Laminates, Properties and Types of Laminates, Specifications and Test Methods, **Board cleaning before Pattern Transfer:** Manual and Machine Cleaning Processes.

Module-3

Photoprinting: Basic Processes for Double Sided PCBs, Photoresists, Wet Film Resists, Coating Processes, Exposure and further Processing of Wet Film Resists, Dry Film Resists. **Screen Printing:** Screen Fabrics, Screen and Frame Preparation, Pattern Transfer onto the screen, Reclamation of the Screen Fabrics, Printing, Trouble shooting

Module-4

Plating: Introduction, Immersion Plating, Electroless Plating, Electroplating, Plating Quality Control, Etching, Etching Machines, Etchant Systems, Minimising Pollution, Mechanical Machining operations. **Multilayer Boards:** Introduction, Design and Test Considerations,

Multilayer Construction, Equipment, Laminating Process and further processing.
Module-5
PCB Technology Trends: Fine line conductors with Ultra-Thin Copper Foil, Multilayer and Multiwire Boards, Flexible Printed Circuit Boards. **Automation and Computers in PCB Design:** Automated Artwork Draughting, Computer Aided Design, Design Automation.
Course outcome (Course Skill Set) At the end of the course, the student will be able to : 1. Define the detailed circuit diagram and prerequisite before the actual PCB layout. 2. Understand the process of PCB production and Material selection 3. Understand the PCB fabrication by transferring the conductor pattern on base material 4. Know about the Plating techniques, Etching process and multilayer PCB board construction 5. Understand about new streams in PCB technology and modern facilities for PCB design

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). The student is declared as a pass in the course if he/she secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- There are 25 marks for the CIE's Assignment component and 25 for the Internal Assessment Test component.
- Each test shall be conducted for 25 marks. The first test will be administered after 40-50% of the coverage of the syllabus, and the second test will be administered after 85-90% of the coverage of the syllabus. The average of the two tests shall be scaled down to 25 marks
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The schedule for assignments shall be planned properly by the course teacher. The teacher should not conduct two assignments at the end of the semester if two assignments are planned. Each assignment shall be conducted for 25 marks. (If two assignments are conducted then the sum of the two assignments shall be scaled down to 25 marks)
- The final CIE marks of the course out of 50 will be the sum of the scale-down marks of tests and assignment/s marks.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with

Suggested Learning Resources:

Books

1. Printed Circuit Boards-Design & Technology by Walter C Bosshart, Tata Mc Graw-Hill Pvt.Ltd, 2010
2. Printed Circuit Boards-Design, Fabrication, Assembly and Testing by Dr.R.S. Khandapur, Mc Graw-Hill Education, 2017

Web links and Video Lectures (e-Resources):

• PCB designing software YouTube links • NPTEL courses and videos
Activity Based Learning (Suggested Activities in Class)/ Practical Based learning • PCB making for simple electronic circuit and testing • Quizzes and seminar

DAQ using Lab VIEW		Semester	4
Course Code	BEC456C	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	0:0:2:0	SEE Marks	50
Credits	01	Total Marks	100
		Exam Hours	2
Examination type (SEE)	Theory/Practical/Viva-Voce /Term-work/Others		

Course objectives: This course will enable students to:

- Process the knowledge of loop constructs.
- Fundamentals of graphical programming and use Lab VIEW modules
- Implement 'Timing' functions.
- Input algebraic formulas via 'Formula Nodes' and 'Expression Nodes'.

Sl.NO	Experiments
1	Data acquisition using LabVIEW for temperature measurement with thermocouple.
2	Data acquisition using LabVIEW for temperature measurement with AD590.
3	Data acquisition using LabVIEW for temperature measurement with RTD.
4	Data acquisition using LabVIEW for temperature measurement with Thermistor.
5	Creation of a CRO using LabVIEW and measurement of frequency and amplitude from external source.
6	Create function generator using LabVIEW and display the amplitude and frequency on CRO (externally connected)
7	Demonstrate amplitude modulation considering modulating and carrierwave from external source.
8	Interface LEDs to DAQ output and implement counter.
9	Data acquisition using LabVIEW for load/strain measurement using suitable transducers.
10	Demonstrate binary to greycode converter (&viceversa) using DAQ card.
11	Data acquisition using LabVIEW for distance/humidity measurement using suitable transducers.
12	Reading audio input with Microphones and output using DAQ card.

Course outcomes (Course Skill Set):
At the end of the course the student will be able to:

1. Build temperature indicating instruments using LabVIEW(NIDAQ)
2. Interface peripheral devices/instruments to LabVIEW
3. Build LabVIEW modules to sense and process audio inputs
4. Apply programming structures, data types, and the analysis and signal processing algorithms in LabVIEW

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation (CIE):

CIE marks for the practical course are **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment is to be evaluated for conduction with an observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments are designed by the faculty who is handling the laboratory session and are made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled down to **30 marks** (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct a test of 100 marks after the completion of all the experiments listed in the syllabus.
- In a test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability.
- The marks scored shall be scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and marks of a test is the total CIE marks scored by the student.

Semester End Evaluation (SEE):

- SEE marks for the practical course are 50 Marks.
- **SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the Head of the Institute**.
- The examination schedule and names of examiners are informed to the university before the conduction of the examination. These practical examinations are to be conducted between the schedule mentioned in the academic calendar of the University.
- All laboratory experiments are to be included for practical examination.
- (Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.
- Students can pick one question (experiment) from the questions lot prepared by the examiners jointly.
- Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.

General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)

Change of experiment is allowed only once and 15% of Marks allotted to the procedure part are to be made zero.

The minimum duration of SEE is 02 hours

Suggested Learning Resources:

1. Virtual Instrumentation using LABVIEW, Jovitha Jerome, PHI,2011
2. Virtual Instrumentation using LABVIEW, Sanjay Gupta, Joseph John, TMH, McGrawHill,SecondEdition,2011.

Risk Management in IoT Implementation		Semester	IV
Course Code	BEC456D	CIE Marks	50
Teaching Hours/Week (L: T:P: S)	1:0:0:0	SEE Marks	50
Total Hours of Pedagogy	14	Total Marks	100
Credits	01	Exam Hours	1
Examination type (SEE)	Theory/practical		

Course objectives:

- Understand the fundamental concepts and principles of the Internet of Things (IoT) and its relevance in various industries. Identify and assess potential risks and challenges associated with implementing IoT projects.
- Develop effective risk management strategies and mitigation plans specific to IoT implementations. Implement security controls and best practices to ensure the confidentiality, integrity, and availability of IoT systems.
- Comply with relevant regulations and standards to address data privacy, security, and ethical considerations in IoT implementations.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

- Active Learning: Encourage students to actively engage in the learning process through hands-on activities, group discussions, case studies, and problem-solving exercises.
- Real-World Examples and Case Studies: Provide real-world examples and case studies related to IoT implementations and risk management.
- Collaborative Learning: Foster collaborative learning environments where students can work together in groups or teams to analyse and solve IoT-related challenges.
- Simulations and Hands-on Experiments: Incorporate simulations or hands-on experiments that replicate IoT scenarios and risk management challenges.
- Formative Assessments and Feedback: Implement regular formative assessments throughout the course to gauge students' progress and understanding of the course outcomes.

Module-1

Introduction to IoT and Risk Management

Overview of the Internet of Things (IoT) and its applications; Understanding the importance of risk management in IoT implementation; Key components of risk management in IoT; Common risks and challenges in IoT implementation; Case studies and examples of successful and failed IoT implementations.

Module-2

Identifying and Assessing Risks in IoT

Identification of potential risks in IoT implementation; Risk assessment methodologies and techniques for IoT projects; Threat modelling and risk analysis in IoT systems; Assessing the impact and likelihood of identified risks; Prioritization of risks based on their significance.

Module-3

Mitigation Strategies for IoT Risks Developing a risk mitigation plan for IoT projects; Security controls and best practices for IoT devices and networks; Data privacy and protection measures in IoT systems; Implementing secure communication protocols in IoT; Securing IoT gateways and cloud platforms.
Module-4
Monitoring and Response to IoT Risks Real-time monitoring of IoT devices and networks; Intrusion detection and prevention in IoT systems; Incident response planning for IoT security breaches; Continuous monitoring and vulnerability management in IoT; Data backup and disaster recovery strategies for IoT systems.
Module-5
Compliance and Regulatory Considerations Overview of relevant regulations and standards for IoT implementation; Compliance requirements for data privacy and security in IoT; Impact of industry-specific regulations on IoT projects; Role of audits and assessments in ensuring compliance; Ethical considerations and responsible use of IoT technologies.
Course outcome (Course Skill Set) At the end of the course the student will be able to: • Students will be able to explain the core concepts and applications of the Internet of Things and its impact on industries and society. Students will be able to identify and assess risks and challenges in IoT implementations, applying appropriate methodologies and techniques. • Students will be able to develop comprehensive risk management strategies and mitigation plans tailored to specific IoT projects. Students will be able to implement security controls and best practices to protect IoT devices, networks, and data from potential threats and vulnerabilities. • Students will be able to analyse and comply with relevant regulations, standards, and ethical considerations to ensure responsible and secure IoT implementations.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous internal Examination (CIE)

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examinations (SEE)

SEE paper shall be set for 50 questions, each of the 01 marks. The pattern of the question paper is MCQ (multiple choice questions). The time allotted for SEE is **01 hour.** The student has to secure a minimum of 35% of the maximum marks meant for SEE.

OR

MCQ (Multiple Choice Questions) are preferred for 01 credit courses, however, if course content demands the general question paper pattern that followed for 03 credit course, then

1. The question paper will have ten questions. Each question is set for 10 marks.
2. There will be 2 questions from each module. Each of the two questions under a module may or may not have the sub-questions (with maximum sub-questions of 02, with marks distributions 5+5, 4+6, 3+7).
3. The students have to answer 5 full questions, selecting one full question from each module.

Suggested Learning Resources:

1. MindMatrix.io
2. "Practical IoT Security: A Guide to Building Secure Connected Systems" by Brian Russell, Drew Van Duren, and John R. Scharlau
3. "Internet of Things: Principles and Paradigms" by Rajkumar Buyya, Amir Vahid Dastjerdi, and Sriram Venugopal
4. "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things" by David Hanes, Gonzalo Salgueiro, and Patrick Grossetete

5. "Managing Risk and Security in the Internet of Things: Frameworks and Best Practices" by Tim Lister, Brian Russell, and Tom Olzak
6. "The Internet of Risky Things: Trusting the Devices That Surround Us" by Sean Smith and Abel Sanchez

Web links and Video Lectures (e-Resources):

- makes.mindmatrix.io

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Risk Assessment and Mitigation Plan Development: Divide students into small groups and assign them different IoT implementation scenarios.
- Threat Modelling Exercise: Provide students with a sample IoT system architecture. In pairs or individually, students should conduct a threat modelling exercise, identifying potential threats and vulnerabilities in the system.
- IoT Security Audit and Compliance Assessment: Ask students to conduct a security audit and compliance assessment of a hypothetical IoT deployment. Provide them with a checklist of relevant security controls, regulatory requirements, and industry standards.
- IoT Risk Simulation Game: Develop a simulation game where students take on different roles in an IoT implementation team, such as project manager, security analyst, or compliance officer.
- Case Studies and Problem-Solving Exercises: Assign real-world case studies or problem-solving exercises related to IoT risk management. Students should analyse the given scenarios, identify risks, propose mitigation strategies, and present their solutions.

MECHANICS OF MATERIALS		Semester	03
Course Code	**BME301**	CIE Marks	50
Teaching Hours/Week (L: T:P: S)	**2:2:0:0**	SEE Marks	50
Total Hours of Pedagogy	**40**	Total Marks	100
Credits	**03**	Exam Hours	3 hrs
Examination type (SEE)	**Theory**		

Course objectives:

- To provide the basic concepts and principles of strength of materials.
- To give an ability to calculate stresses and deformations of objects under external loadings.
- To give an ability to apply the knowledge of strength of materials on engineering applications and design problems.

Teaching-Learning Process (General Instructions)

These are sample Strategies; which teachers can use to accelerate the attainment of the various course outcomes.

- Adopt different types of teaching methods to develop the outcomes through PowerPoint presentations and Videodemonstrations or Simulations.
- Chalk and Talk method for Problem Solving.
- Adopt flipped classroom teaching method.
- Adopt collaborative (Group Learning) learning in the class.
- Adopt Problem Based Learning (PBL), which fosters students' analytical skills and develops thinking skills such asevaluating, generalizing, and analyzing information.

Module-1

Simple stress and strain: Definition/derivation of normal stress, shear stress, and normal strain and shear strain – Stress strain diagram for brittle and ductile materials - Poisson's ratio & volumetric strain – Elastic constants – relationship between elastic constants and Poisson's ratio – Generalised Hook's law – Deformation of simple and compound bars, Resilience, Gradual, sudden, impact and shock loadings – thermal stresses.

Module-2

Bi-axial Stress system: Introduction, plane stress, stresses on inclined sections, principal stresses and maximum shear stresses, graphical method - Mohr's circle for plane stress.

Thick and Thin cylinders: Stresses in thin cylinders, Lame's equation for thick cylinders subjected to internal and external pressures, Changes in dimensions of cylinder (diameter, length and volume), simple numerical.

Module-3

Bending moment and Shear forces in beams: Definition of beam – Types of beams – Concept of shear force and bending moment – S.F and B.M diagrams for cantilever, simply supported and overhanging beams subjected to point loads, uniformly distributed loads, uniformly varying loads and combination of these loads – Point of contra flexure.

Module-4

Theory of simple bending – Assumptions – Derivation of bending equation - Neutral axis – Determination of bending stresses – section modulus of rectangular and circular sections (Solid and Hollow), I, T and Channel sections – Design of simple beam sections, Shear Stresses: Derivation of formula – Shear stress distribution across various beams sections like rectangular, circular, triangular, I, and T sections.

Module-5

Torsion of circular shafts: Introduction, pure torsion, assumptions, derivation of torsional equations, polar modulus, torsional rigidity / stiffness of shafts, power transmitted by solid and hollow circular shafts.

Theory of columns – Long column and short column - Euler’s formula – Rankine’s formula.

Course outcome (Course Skill Set)
At the end of the course, the student will be able to:

CO1: Understand the concepts of stress and strain in simple and compound bars.
CO2: Explain the importance of principal stresses and principal planes & Analyse cylindrical pressure vessels under various loadings
CO3: Apply the knowledge to understand the load transferring mechanism in beams and stress distribution due to shearing force and bending moment.
CO4: Evaluate stresses induced in different cross-sectional members subjected to shear loads.
CO5: Apply basic equation of simple torsion in designing of circular shafts & Columns

Assessment Details (both CIE and SEE)
The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

Internal Assessment Test question paper is designed to attain the different levels of Bloom’s taxonomy as per the outcome defined for the course.

Semester-End Examination:
Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks.

Suggested Learning Resources:
Books

1. Mechanics of Materials, S.I. Units, Ferdinand Beer & Russell Johnstan, 7th Ed, TATA McGrawHill-2014
2. Mechanics of Materials, K.V.Rao, G.C.Raju, Subhash Stores, First Edition, 2007
3. Strength of Materials by R.K. Bansal ,Laxmi Publications 2010.

Web links and Video Lectures (e-Resources):

1. Statics and Strength of Materials, Shehata, 2nd edition, 1994. (http://www.astm.org/DIGITAL_LIBRARY/JOURNALS/TESTEVAL/PAGES/JTE12637J. htm) 2. http://www.astm.org/DIGITAL_LIBRARY/JOURNALS/TESTEVAL/PAGE S/JTE12637J.htm 3. 3. http://www.freeengineeringbooks.com/Civil/Strength-of-MaterialBooks.php
Activity Based Learning (Suggested Activities in Class)/ Practical Based learning • Use Mdsolids (https://web.mst.edu/mdsolids/) or any open source software for active teaching and learning.

MANUFACTURING PROCESS		Semester	III
Course Code	BME302	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:2:0	SEE Marks	50
Total Hours of Pedagogy	40 hours Theory + 8-10 Lab slots	Total Marks	100
Credits	04	Exam Hours	03
Examination nature (SEE)	Theory /Viva-Voce /Term-work/Others		

Course objectives:

- To provide knowledge of various casting process in manufacturing.
- To provide in-depth knowledge on metallurgical aspects during solidification of metal and alloys, also to provide detailed information about the moulding processes.
- To acquaint with the basic knowledge on fundamentals of metal forming processes and also to study various metal forming processes.
- To impart knowledge of various joining process used in manufacturing.
- To impart knowledge about behaviour of materials during welding, and the effect of process
- parameters in welding

Teaching-Learning Process (General Instructions)

These are sample Strategies; that teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.
2. Arrange visits to nearby power plants, receiving station and substations to give brief information about the electrical power generation.
3. Show Video/animation films to explain functioning of various machines
4. Encourage collaborative (Group Learning) Learning in the class
5. Ask at least three HOTS (Higher order Thinking) questions in the class, which promotes critical thinking
6. Adopt Problem Based Learning (PBL), which fosters students Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
7. Topics will be introduced in a multiple representation.
8. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
9. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.
10. Individual teacher can device the innovative pedagogy to improve the teaching-learning.

MODULE-1

Introduction & basic materials used in foundry: *Introduction: Definition, Classification of manufacturing processes. Metals cast in the foundry-classification, factors that determine the selection of a casting alloy. Introduction to casting process & steps involved – (Brief Introduction)- Not for SEE*

Patterns: Definition, classification, materials used for pattern, various pattern allowances and their importance.

Sand moulding: Types of base sand, requirement of base sand. Binder, Additive's definition, need and types; preparation of sand moulds. Molding machines- Jolt type, squeeze type and Sand slinger.

Study of important moulding process: Green sand, core sand, dry sand, sweep mould, CO2mould, shell mould, investment mould, plaster mould, cement bonded mould.

Cores: Definition, need, types. Method of making cores,

Concept of gating (top, bottom, parting line, horn gate) and risers (open, blind) Functions and types.
MODULE-2
Melting furnaces: Classification of furnaces, Gas fired pit furnace, Resistance furnace, Coreless induction furnace, electric arc furnace, constructional features & working principle of cupola furnace. **Casting using metal moulds**: Gravity die casting, pressure die casting, centrifugal casting, squeeze casting, slush casting, thixocasting, and continuous casting processes. Casting defects, their causes and remedies.
MODULE-3
METAL FORMING PROCESSES ***Introduction of metal forming process**:* Mechanical behaviour of metals in elastic and plastic deformation, stress-strain relationships, Yield criteria, Application to tensile testing, train rate and temperature in metal working; Hot deformation, Cold working and annealing. ***Metal Working Processes**:* Fundamentals of metal working, Analysis of bulk forming processes like forging, rolling, extrusion, wire drawing by slab method, ***Other sheet metal processes**:* Sheet metal forming processes (Die and punch assembly, Blanking, piercing, bending etc., Compound and Progressive die), High Energy rate forming processes.
MODULE-4
JOINING PROCESSES ***Operating principle, basic equipment, merits and applications of***: Fusion welding processes: Gas welding - Types – Flame characteristics; Manual metal arc welding – Gas Tungsten arc welding - Gas metal arc welding – Submerged arc welding
MODULE-5
Weldability and thermal aspects: Concept of weldability of materials; Thermal Effects in Welding (Distortion, shrinkage and residual stresses in welded structures); Welding defects and remedies. ***Allied processes***: Soldering, Brazing and adhesive bonding **Advance welding processes:** Resistance welding processes, friction stir welding (FSW).

PRACTICAL COMPONENT OF IPCC

Course objectives:

- Impart fundamental understanding of various casting, welding and forming processes
- To provide in-depth knowledge on metallurgical aspects during solidification of metal and alloys
- Discuss design methodology and process parameters involve in obtaining defect free component

PRACTICAL COMPONENT OF IPCC *(May cover all / major modules)*

Sl.NO	Experiments
1	Preparation of sand specimens and conduction of the following tests: Compression, Shear and Tensile tests on Universal Sand Testing Machine.
2	To determine permeability number of green sand, core sand and raw sand.
3	To determine AFS fineness no. and distribution coefficient of given sand sample.
4	Studying the effect of the clay and moisture content on sand mould properties
5	Use of Arc welding tools and welding equipment Preparation of welded joints using Arc Welding equipment L-Joint, T-Joint, Butt joint, V-Joint, Lap joints on M.S. flats
6	Foundry Practice: Use of foundry tools and other equipment for Preparation of molding sand mixture. Preparation of green sand molds kept ready for pouring in the following cases: 1. Using two molding boxes (hand cut molds). 2. Using patterns (Single piece pattern and Split pattern).
7	Preparation of green sand molds kept ready for pouring in the following cases: 1. Incorporating core in the mold.(Core boxes).
8	Forging Operations: Use of forging tools and other forging equipment. Preparing minimum three forged models involving upsetting, drawing and bending operations.
	Demo experiments for CIE
9	Demonstration of forging model using Power Hammer.
10	To study the defects of Cast and Welded components using Non-destructive tests like: a) Ultrasonic flaw detection b) Magnetic crack detection c) Dye penetration testing
11	Mould preparation of varieties of patterns, including demonstration
12	Demonstration of material flow and solidification simulation using Auto-Cast software

Course outcomes (Course Skill Set):

At the end of the course, the student will be able to:

CO1: Describe the casting process and prepare different types of cast products. Acquire knowledge on Pattern, Core, Gating, Riser system and to use Jolt, Squeeze, and Sand Slinger Moulding machines.

CO2: Compare the Gas fired pit, Resistance, Coreless, Electrical and Cupola Metal Furnaces. Compare the Gravity, Pressure die, Centrifugal, Squeeze, slush and Continuous Metal mold castings.

CO3: Understand the Solidification process and Casting of Non-Ferrous Metals.

CO4: Describe the Metal Arc, TIG, MIG, Submerged and Atomic Hydrogen Welding processes etc. used in manufacturing.

CO5: Describe the methods of different joining processes and thermal effects in joining process

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

CIE for the theory component of the IPCC (maximum marks 50)

- IPCC means practical portion integrated with the theory of the course.
- CIE marks for the theory component are **25 marks** and that for the practical component is **25 marks**.
- 25 marks for the theory component are split into **15 marks** for two Internal Assessment Tests (Two Tests, each of 15 Marks with 01-hour duration, are to be conducted) and **10 marks** for other assessment methods mentioned in 22OB4.2. The first test at the end of 40-50% coverage of the syllabus and the second test after covering 85-90% of the syllabus.
- Scaled-down marks of the sum of two tests and other assessment methods will be CIE marks for the theory component of IPCC (that is for **25 marks)**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the theory component of IPCC.

CIE for the practical component of the IPCC

- **15 marks** for the conduction of the experiment and preparation of laboratory record, and **10 marks** for the test to be conducted after the completion of all the laboratory sessions.
- On completion of every experiment/program in the laboratory, the students shall be evaluated including viva-voce and marks shall be awarded on the same day.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to **15 marks**.
- The laboratory test **(duration 02/03 hours)** after completion of all the experiments shall be conducted for 50 marks and scaled down to **10 marks.**
- Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **25 marks**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the practical component of the IPCC.

SEE for IPCC

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored by the student shall be proportionally scaled down to 50 Marks

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper may include questions from the practical component.

Suggested Learning Resources:

Books

1. Ghosh, A. and Mallik, A. K., (2017), Manufacturing Science, East-West Press.
2. Parmar R. S., (2007), Welding Processes and Technology, Khanna Publishers.
3. Little R. L. – 'Welding and Welding Technology' – Tata McGraw Hill Publishing Company Limited, New Delhi – 1989
4. Grong O. – 'Metallurgical Modelling of Welding' – The Institute of Materials – 1997 – 2nd Edition
5. Kou S. – 'Welding Metallurgy' – John Wiley Publications, New York – 2003 – 2nd Edition.

6. Serope Kalpakjian and Steven R. Schmid – 'Manufacturing Engineering and Technology' – Prentice Hall – 2013 – 7th Edition
7. Principles of foundry technology, 4th edition, P L Jain, Tata McGraw Hill, 2006.
8. Advanced Welding Processes technology and process control, John Norrish, Wood Head Publishing, 2006.

Web links and Video Lectures (e-Resources):

- (Link:http://www.springer.com/us/book/9781447151784http://nptel.ac.in/courses/112
- 105127/)
- http://www.astm.org/DIGITAL_LIBRARY/MNL/SOURCE_PAGES/MNL11.htm
- http://www.astm.org/DIGITAL_LIBRARY/JOURNALS/COMPTECH/PAGES/CTR10654J.htm
- MOOCs: http://nptel.ac.in/courses/112105126/

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

Metal Casting: Design pattern/core for a given component drawing and develop a sand mould with optimum gating and riser system for ferrous and non-ferrous materials. Melting and casting, inspection for macroscopic casting defects.

- Welding: TIG and MIG welding processes – design weld joints – welding practice –weld quality inspection.
- Metal Forming: Press working operation – hydraulic and mechanical press -load calculation: blanking, bending and drawing operations – sheet metal layout design.

MATERIAL SCIENCE AND ENGINEERING		Semester	III
Course Code	BME303	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:2:0	SEE Marks	50
Total Hours of Pedagogy	40 hours Theory + 8-10 Lab slots	Total Marks	100
Credits	04	Exam Hours	3
Examination nature (SEE)	Theory		

Course objectives:

- Explain the basic concepts of geometrical crystallography, crystal structure and imperfections in Solids.
- Construct the phase diagrams to know the phase transformations and concept of diffusion in solids.
- Identify the heat treatment, cooling method for controlling the microstructure and plastic deformation to modify their properties.
- Explain the powder metallurgy process, types and surface modifications.
- Apply the method of materials selection, material data, properties and knowledge sources for computer-aided selection of materials.

Teaching-Learning Process (General Instructions)

These are sample Strategies; that teachers can use to accelerate the attainment of the various course outcomes.

- Adopt different types of teaching methods to develop the outcomes through PowerPoint presentations and Videodemonstrations or Simulations.
- Chalk and Talk method for Problem Solving.
- Adopt flipped classroom teaching method.
- Adopt collaborative (Group Learning) learning in the class.
- Adopt Problem Based Learning (PBL), which fosters students' analytical skills and develops thinking skills such asevaluating, generalizing, and analysing information.

MODULE-1

Structure of Materials

Introduction: Classification of materials, crystalline and non-crystalline solids, atomic bonding: Ionic Bonding and Metallic bonding.

Crystal Structure: Crystal Lattice, Unit Cell, Planes and directions in a lattice, Planar Atomic Density, Coordination number, atomic Packing Factor of all the Cubic structures and Hexa Close Packed structure. Classification and Coordination of voids, Bragg's Law.

Imperfections in Solids: Types of imperfections, Point defects: vacancies, interstitials, line defects, 2-D and 3D-defects, Concept of free volume in amorphous solids. Slip, Twinning.

MODULE-2

Physical Metallurgy

Alloy Systems: Classification of Solid solutions, Hume- Rothery Rules

Diffusion: Diffusion Mechanisms: Vacancy Diffusion and Interstitial Diffusion, Fick's laws of diffusion, Factors affecting diffusion.

Phase Diagrams: Gibbs Phase Rule, Solubility limit, phase equilibrium and Phase Diagrams: Isomorphous systems, Invariant Binary Reactions: Eutectic reaction, Eutectoid reaction and Peritectic reaction, Lever Rule, Iron-Carbon Diagram. Effect of common alloying elements in steel. Numerical on Lever rule.

MODULE-3

Nucleation and growth: Introduction to homogeneous and heterogeneous nucleation, critical radius for nucleation.

Heat treatment: Annealing, Normalizing, hardening, Tempering, Nitriding, Cyaniding, Induction Hardening and Flame Hardening, Recent advances in heat treat technology. TTT diagram, Recovery-Recrystallization-Grain Growth. Strengthening mechanisms: Strain hardening, Precipitation hardening (Solid-Solution Strengthening), Grain refinement.

MODULE-4
Surface coating technologies: Introduction, coating materials, coating technologies, types of coating: Electro-plating, Chemical Vapor Deposition(CVD), Physical Vapor Deposition(PVD), High Velocity Oxy-Fuel Coating, advantages and disadvantages of surface coating. **Powder metallurgy:** Introduction, Powder Production Techniques: Different Mechanical methods: Chopping or Cutting, Abrasion methods, Machining methods, Ball Milling and Chemical method: Chemical reduction method. **Characterization of powders (Particle Size & Shape Distribution), Powder Shaping:** Particle Packing Modifications, Lubricants & Binders, Powder Compaction & Process, Sintering and Application of Powder Metallurgy.
MODULE-5
Engineering Materials and Their Properties: Classification, **Ferrous materials:** Properties, Compositions and uses of Grey cast iron and steel. **Non-Ferrous materials:** Properties, Compositions and uses of Copper, Brass, Bronze. **Composite materials** - Definition, classification, types of matrix materials & reinforcements, Metal Matrix Composites (MMCs), Ceramic Matrix Composites (CMCs) and Polymer Matrix Composites (PMCs), Particulate-reinforced and fiber- reinforced composites, Applications of composite materials. Mechanical and functional properties of Engineering Materials **The Design Process and Materials Data:** Types of design, design tools and materials data, processes of obtainingmaterials data, materials databases. **Material Selection Charts:** Selection criteria for materials, material property Charts, deriving property limits and material indices.

PRACTICAL COMPONENT OF IPCC*(May cover all / major modules)*

Sl.NO	Experiments
1	Specimen preparation for macro and micro structural examinations and study the macrostructure and microstructure of a sample metal/ alloys.
2	Study the heat treatment processes (Hardening and tempering) of steel/Aluminium specimens.
3	To determine the hardness values of Mild Steel/ Aluminium by Rockwell hardness/Vickers Hardness.
4	To determine the hardness values of Copper/ Brass by Brinell's Hardness testing machine.
5	To determine the tensile strength, modulus of elasticity, yield stress, % of elongation and % of reduction in area of Cast Iron, Mild Steel/Brass/ Aluminium and to observe the necking.
6	To conduct a wear test on Mild steel/ Cast Iron/Aluminium/ Copper to find the volumetric wear rate and coefficient of friction.
7	To determine the Impact strength of the mild steel using Izod test and Charpy test.
8	Study the chemical corrosion and its protection. ***Demonstration***
9	Study the properties of various types of plastics. ***Demonstration***
10	Computer Aided Selection of Materials: Application of GRANTA Edupack for material selection: Case studies based on material properties. ***Demonstration***

Course outcomes (Course Skill Set):

At the end of the course the student will be able to:

1. Understand the atomic arrangement in crystalline materials and describe the periodic arrangement of atoms in terms of unit cell parameters.
2. Understand the importance of phase diagrams and the phase transformations.
3. Explain various heat treatment methods for controlling the microstructure..

4. Correlate between material properties with component design and identify various kinds of defects.
5. Apply the method of materials selection, material data and knowledge sources for computer-aided selection of materials.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

CIE for the theory component of the IPCC (maximum marks 50)

- IPCC means practical portion integrated with the theory of the course.
- CIE marks for the theory component are **25 marks** and that for the practical component is **25 marks**.
- 25 marks for the theory component are split into **15 marks** for two Internal Assessment Tests (Two Tests, each of 15 Marks with 01-hour duration, are to be conducted) and **10 marks** for other assessment methods mentioned in 22OB4.2. The first test at the end of 40-50% coverage of the syllabus and the second test after covering 85-90% of the syllabus.
- Scaled-down marks of the sum of two tests and other assessment methods will be CIE marks for the theory component of IPCC (that is for **25 marks)**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the theory component of IPCC.

CIE for the practical component of the IPCC

- **15 marks** for the conduction of the experiment and preparation of laboratory record, and **10 marks** for the test to be conducted after the completion of all the laboratory sessions.
- On completion of every experiment/program in the laboratory, the students shall be evaluated including viva-voce and marks shall be awarded on the same day.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to **15 marks**.
- The laboratory test **(duration 02/03 hours)** after completion of all the experiments shall be conducted for 50 marks and scaled down to **10 marks.**
- Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **25 marks**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the practical component of the IPCC.

SEE for IPCC

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scoredby the student shall be proportionally scaled down to 50 Marks

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper may include questions from the practical component.

Suggested Learning Resources:

Text Books:

1. Callister Jr, W.D., Rethwisch, D.G., (2018), Materials Science and Engineering: An Introduction, 10th Edition, Hoboken, NJ: Wiley.
2. Ashby, M.F. (2010), Materials Selection in Mechanical Design, 4th Edition, Butterworth- Heinemann.
3. Azaroff, L.V., (2001) Introduction to solids, 1st Edition, McGraw Hill Book Company.
4. Avner, S.H., (2017), Introduction to Physical Metallurgy, 2nd Edition, McGraw Hill Education.

Reference Books

1. Jones, D.R.H., and Ashby,M.F., (2011), Engineering Materials 1: An Introduction to Properties, Application and Design, 4th Edition, Butterworth-Heinemann.
2. Jones, D.R.H., and Ashby,M.F., (2012), Engineering Materials 2: An Introduction to Microstructure and Processing, 4th Edition, Butterworth-Heinemann.
3. Abbaschian, R., Abbaschian, L., Reed-Hill, R. E., (2009), Physical Metallurgy Principles, 4th Edition, Cengate Learning.
4. P. C. Angelo and R. Subramanian: Powder Metallurgy- Science, Technology and Applications, PHI, New Delhi,2008.

Web links and Video Lectures (e-Resources):

Web links and Video Lectures (e-Resources):

1. Bhattacharya,B., Materials Selection and Design, NPTEL Course Material, Department of Mechanical Engineering, Indian Institute of Technology Kanpur, http://nptel.ac.in/courses/112104122/
2. Prasad, R., Introduction to Materials Science and Engineering, NPTEL Course Material, Department of Materials

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

Course seminar

Industrial tour/Visit to Advanced Research Centres

BASIC THERMODYNAMICS		Semester	**3rd**
Course Code	**BME304**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	**2:2:0:0**	SEE Marks	50
Total Hours of Pedagogy	**40**	Total Marks	100
Credits	**03**	Exam Hours	03
Examination type (SEE)	**Theory**		

Course Objectives:

- Learn about thermodynamic system and its equilibrium, basic law of zeroth law of thermodynamics.
- Understand various forms of energy - heat transfer and work, Study the first law of thermodynamics.
- Study the second law of thermodynamics.
- Interpret the behaviour of pure substances and its application in practical problems.
- Study of Ideal and real gases and evaluation of thermodynamic properties.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Adopt different types of teaching methods to develop the outcomes through PowerPoint presentations and Video demonstrations or Simulations.
2. Chalk and Talk method for Problem Solving.
3. Adopt flipped classroom teaching method.
4. Adopt collaborative (Group Learning) learning in the class
5. Adopt Problem Based Learning (PBL), which fosters students' analytical skills and develops thinking skills such as evaluating, generalizing, and analysing information.

Module-1

Introduction and Review of fundamental concepts: Thermodynamic definition and scope, Microscopic and Macroscopic approaches. Characteristics of system boundary and control surface, examples. Thermodynamic properties; definition and units, intensive, extensive properties, specific properties, pressure, specific volume, Thermodynamic state, state point, state diagram, path and process, quasi-static process, cyclic and non-cyclic; processes; Thermodynamic equilibrium; definition, mechanical equilibrium; diathermic wall, thermal equilibrium, chemical equilibrium ***(The topics are Only for Self-study and not to be asked in SEE. However, may be asked for CIE)***

Zeroth law of thermodynamics, Temperature; concepts, scales, international fixed points and measurement of temperature. Constant volume gas thermometer, constant pressure gas thermometer, mercury in glass thermometer, thermocouples, electrical resistance thermometer. Numerical.

Work and Heat: Mechanics, definition of work and its limitations. Thermodynamic definition of work; examples, sign convention. Displacement work; as a part of a system boundary, as a whole of a system boundary, expressions for displacement work in various processes through p-v diagrams. Shaft work; Electrical work. Other types of work. Heat; definition, units and sign convention. Problems.

Module-2

First Law of Thermodynamics: Joules experiments, equivalence of heat and work. Statement of the First law of thermodynamics, extension of the First law to non - cyclic processes, energy, energy as a property, modes of energy, Problems.

Extension of the First law to control volume; steady flow energy equation (SFEE), Problems.

Module-3
Second Law of Thermodynamics: Limitations of first law of thermodynamics, Thermal reservoir, heat engine and heat pump: Schematic representation, efficiency and COP. Reversed heat engine. Kelvin - Planck statement of the Second law of Thermodynamics; PMM I and PMM II, Clausius statement of Second law of Thermodynamics, Equivalence of the two statements; Carnot cycle, Carnot principles. Problems **Entropy**: Clausius inequality, Statement- proof, Entropy- definition, a property, change of entropy, entropy as a quantitative test for irreversibility, principle of increase in entropy, entropy as a coordinate. Problems
Module-4
Availability, Irreversibility and General Thermodynamic relations. Introduction, Availability (Exergy), Unavailable energy, Relation between increase in unavailable energy and increase in entropy. Maximum work, maximum useful work for a system and control volume, irreversibility. Problems **Pure Substances**: P-T and P-V diagrams, triple point and critical points. Sub-cooled liquid, saturated liquid, mixture of saturated liquid and vapor, saturated vapor and superheated vapor states of pure substance with water as example. Enthalpy of change of phase (Latent heat). Dryness fraction (quality), T-S and H-S diagrams, representation of various processes on these diagrams. Steam tables and its use. Throttling calorimeter, separating and throttling calorimeter. Problems.
Module-5
Ideal gases: Ideal gas mixtures, Daltons law of partial pressures, Amagat's law of additive volumes, evaluation of properties of perfect and ideal gases, Air- Water mixtures and related properties (*Processes are not to be asked for SEE*). **Real gases** – Introduction, Van-der Waal's Equation of state, Van-der Waal's constants in terms of critical properties, Beattie-Bridgeman equation, Law of corresponding states, compressibility factor; compressibility chart. Difference between Ideal and real gases. **Thermodynamic relations:** Maxwell's equations, TdS equation. Ratio of Heat capacities and Energy equation, Joule-Kelvin effect, Clausius-Clapeyron equation.
Course outcome (Course Skill Set) At the end of the course, the student will be able to : CO1: Explain fundamentals of thermodynamics and evaluate energy interactions across the boundary of thermodynamic systems. CO2: Apply 1st law of thermodynamics to closed and open systems and determine quantity of energy transfers. CO3: Evaluate the feasibility of cyclic and non-cyclic processes using 2nd law of thermodynamics CO4: Apply the knowledge of entropy, reversibility and irreversibility to solve numerical problems and Interpret the behaviour of pure substances and its application in practical problems. CO5: Recognize differences between ideal and real gases and evaluate thermodynamic properties of ideal and real gas mixtures using various relations.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation (CIE):

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Books

1. Basic and Applied Thermodynamics P.K.Nag, Tata McGraw Hill 2nd Ed., 2002.
2. Basic Engineering Thermodynamics A.Venkatesh Universities Press, 2008.
3. Basic Thermodynamics, B.K Venkanna, Swati B. Wadavadagi PHI, New Delhi 2010.
4. Thermodynamics- An Engineering Approach YunusA.Cenegal and Michael A.Boles Tata McGraw Hill publications 2002

Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=9GMBpZZtjXM&list=PLD8E646BAB3366BC8
- https://www.youtube.com/watch?v=jkdMtmXo664&list=PL3zvA_WajfGAwLuULH-L0AG9fKDgplYne
- https://www.youtube.com/watch?v=1lk7XLOxtzs&list=PLkn3QISf55zy2Nlqr5F09oO2qcIwNNfrZ&index=3
- https://www.youtube.com/watch?v=Dy2UeVCSRYs&list=PL2_EyjPqHc10CTN7cHiM5xB2qD7BHUry7

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Organise Industrial visits to Thermal power plants and submission of report
- Case study report and power point presentation on steam power plant
- .List of thermal energy devices at homes, hostels and college premises and applicable laws

TEMPLATE for AEC (if the course is a theory)

Introduction to Modelling and Design for Manufacturing		Semester	3
Course Code	**BMEL305**	CIE Marks	50
Teaching Hours/Week (L: T:P: S)	**0:0:2*:0**	SEE Marks	50
Total Hours of Pedagogy	**14 Sessions**	Total Marks	100
Credits	**01**	Exam Hours	3
Examination nature (SEE)	**Practical**		
***One hour per week can be taken additionally**			

Course objectives:

1. To improve the visualisation skills and understand the conventions used in engineering drawing.
2. To inculcate understanding of the theory of projection and make drawings using orthographic projections and sectional views.
3. To impart fundamental knowledge of drawing of different machine parts.
4. To enable the students with concepts of dimensioning and standards related to drawings.
5. To enable the students to draw the assembly of various machine components.
6. To enable the students on limits, tolerance and fits and indicate them on machine drawings.

Teaching-Learning Process (General Instructions)

These are sample Strategies; which teachers can use to accelerate the attainment of the various course outcomes.

- Adopt different types of teaching methods to develop the outcomes through PowerPoint presentations and Video demonstrations or Simulations.
- Chalk and Talk method for Problem Solving.
- Adopt online sharable playlist for students
- Adopt collaborative (Group Learning) learning in the class.
- Adopt Problem Based Learning (PBL), which fosters students' analytical skills and develops thinking skills such as evaluating, generalizing, and analysing information.

Module-1

Introduction to Computer Aided Sketching Review of graphic interface of the software. Review of 2D Sketching, Parametric Solid Modeling, Assembly creation and product rendering.

Limits, Fits and Tolerances: Introduction, Fundamental tolerances, Deviations, Methods of placing limit dimensions, Types of fits with symbols and applications, Geometrical tolerances on drawings, Standards followed in industry. ***(Above topics to be studied as a review)***

01 Session

Geometrical Dimensioning and Tolerances (GD&T): Introduction, Fundamental tolerances, Deviations, Methods of placing limit dimensions, machining symbols, types of fits with symbols and applications, geometrical tolerances on drawings. Standards followed in industry. The basics of sketching and modelling:

Create a basic sketch - Profile Tools, Curve Tools, Editing Tools, Operation Tools, Constraints, construction geometries and adding dimensions. Part- Solid from sketches, Solid from surfaces, modify Tools, Operation Tools.

02 Sessions

Module-2 **02 Sessions**

Exploring design tools for production:

Create draft during a feature - Create draft as a feature - Add ribs and plastic supports - Analyze draft on a design - Create holes and threads - Use a coil feature - Mirrors and patterns - Surface creation for complex geometry - Use surfaces to replace faces - Use surfaces to split bodies and faces - Practice exercise.

Module-3 **03 Sessions**

The Basics of Assemblies The different ways to create components - Use scripts to create gears - Component color swatch and color cycling - Use McMaster-Carr parts in a design - Copy, paste, and paste new. - Distributed designs - Create as-built joints - Create joints - Joint origins and midplane joints - Drive joints and motion studies - Interference detection and contact sets - Isolation and opacity control - Create groups and organize a timeline - Practice exercise.	
Module-4	**06 Sessions**
Assembly Drawings: (Part drawings shall be given) Drawing Basics-Detailing Drawings. Explode a 3D model for a drawing, Create a drawing sheet and views, Add geometry and dimensions to a drawing, Add GD & T text, BOM, tables and symbols, Place an exploded view, Edit a title block, Export to different file formats. 1. **Reciprocating saw mechanical assembly,** 2. **Innovated bottle design for sustainability** 3. **Engine Piston** 4. **Cylinder Flange** 5. **Engine Case** 6. **Design for Injection Molding** 1. Plummer block (Pedestal Bearing) 2. Rams Bottom Safety Valve 3. I.C. Engine connecting rod 4. Screw jack (Bottle type) 5. Tailstock of lathe 6. Machine vice 7. Lathe square tool post	
Course outcome (Course Skill Set) At the end of the course the student will be able to: 1. Demonstrate their visualization skills. 2. Apply limits and tolerances to assemblies and choose appropriate fits for given assemblies. Make component drawings. 3. Produce the assembly drawings using part drawings. 4. Engage in lifelong learning using sketching and drawing as communication tool.	

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation (CIE):

- CIE marks for the practical course is 50 Marks.
- CIE shall be evaluated for max marks 100. Marks obtained shall be accounted for CIE final marks, reducing it by 50%.
- CIE component should comprise of
  - Continuous evaluation of Drawing work of students as and when the Modules are covered.
  - At least one closed book Test covering all the modules on the basis of below detailed weightage.
  - *Weightage for Test and Continuous evaluation shall be suitably decided by respective course coordinators.*

Module	**Max. Marks weightage**	**Evaluation Weightage in marks**	
		Computer display & printout	**Preparatory sketching**
Module-1	15	10	05
Module-2	15	10	05
Module-3	20	15	05
Module-4	50	40	10
Total	**100**	**80**	**20**

Semester End Evaluation (SEE):

SEE marks for the practical course is 50 Marks.

- The duration of SEE is 03 hours. Questions shall be set worth of 3 hours
- SEE shall be conducted jointly by the two examiners (one internal and one external) appointed by the University.
- SEE shall be conducted and evaluated for maximum of 100 marks. Marks obtained shall be accounted for SEE final marks, reducing it to 50 marks.
- Question paper shall be set jointly by both examiners and made available for each batch as per schedule.
- Questions are to be set preferably from Text Books.
- Evaluation shall be carried jointly by both the examiners.
- Scheme of Evaluation: To be defined by the examiners jointly and the same shall be submitted to the university along with question paper.
- One full question shall be set from each Modules as per the below tabled weightage details. ***However, the student may be awarded full marks, if he/she completes solution on computer display without sketch.***

Module	Max. Marks Weightage	Evaluation Weightage in marks	
		Computer display & printout	Preparatory sketching
Module-1 OR Module-2	20	15	05
Module-3	20	15	05
Module-4	60	50	10
Total	**100**	**80**	**20**

Suggested Learning Resources:

Books

Text Books:

1. 'A Primer on Computer Aided Machine Drawing-2007', Published by VTU, Belgaum.
2. 'Machine Drawing', N.D.Bhat & V.M.Panchal, Published by Charotar Publishing House, 1999.
3. 'Machine Drawing', K.R. Gopala Krishna, Subhash publication.

Reference Book:

1. "A Text Book of Computer Aided Machine Drawing", S. Trymbakaa Murthy, CBS Publishers, New Delhi, 2007.
2. 'Machine Drawing', N.Siddeshwar, P.Kannaih, V.V.S. Sastri, published by Tata Mc.Grawhill, 2006.
3. K L Narayana, P Kannaiah, K Venkata Reddy, "Machine Drawing", New Age International, 3rd Edition. ISBN-13: 978-81-224-2518-5, 2006
4. Ajeet Singh, "MACHINE DRAWING", Tata McGraw-Hill Education,, ISBN: 9781259084607, 2012

Web links and Video Lectures (e-Resources):

- . https://www.autodesk.com/certification/learn/course/learn-fusion-360-in-90-minutes
- Introduction to Modelling and Design for Manufacturing
- https://www.autodesk.com/certification/learn/course/fusion360-intro-modeling-design-professional

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

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Electric and Hybrid Vehicle Technology		Semester	3
Course Code	**BME306A**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	**3:0:0:0**	SEE Marks	50
Total Hours of Pedagogy	**40**	Total Marks	100
Credits	**03**	Exam Hours	3
Examination type (SEE)	**Theory**		

Course objectives:

- To understand the models, describe hybrid vehicles and their performance.
- To understand the different possible ways of energy storage.
- To understand the different strategies related to hybrid vehicle operation & energy management.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

- Adopt different types of teaching methods to develop the outcomes through PowerPoint presentations and Videodemonstrations or Simulations.
- Chalk and Talk method for Problem Solving.
- Adopt flipped classroom teaching method.
- Adopt collaborative (Group Learning) learning in the class.
- Adopt Problem Based Learning (PBL), which fosters students' analytical skills and develops thinking skills such asevaluating, generalizing, and analyzing information.

Module-1

Introduction to Electric Vehicle (EV) & Hybrid Vehicle(HV):

A brief history of Electric and Hybrid vehicles, basic architecture of hybrid drive train, vehicle motion and the dynamic equations for the vehicle, types of HV and EV, advantages over conventional vehicles, limitations of EV and HV, impact on environment of EV and HV technology, disposal of battery, cell and hazardous material and their impact on environment.

Module-2

Power Management and Energy Sources of EV and HV:

Power and Energy management strategies and its general architecture of EV and HV, various battery sources, energy storage, battery based energy storage, Battery Management Systems (BMS), fuel cells, their characteristics, Super capacitor based energy storage, flywheel, hybridization of various energy storage devices, Selection of the energy storage technology.

Module-3

DC and AC Machines & Drives in EV & HV:

Various types of motors, selection and size of motors, **Induction** motor drives and control characteristics, **Permanent** magnet motor drives and characteristics, **Brushed & Brushless** DC motor drive and characteristics, **switched reluctance motors** and characteristics, **IPM motor drives** and characteristics, mechanical and electrical connections of motors.

Module-4

Components & Design Considerations of EV & HV:

Design parameters of batteries, ultra-capacitors and fuel cells, aerodynamic considerations, calculation of the rolling resistance and the grade resistance, calculation of the acceleration force, total tractive effort, torque required on the drive wheel, transmission efficiency, consideration of vehicle mass.

Module-5

Electric and Hybrid Vehicles charging architecture:

Introduction to smart charging: Grid to vehicle and vehicle to grid, smart metering and ancillary services, preliminary discussion on vehicle to vehicle and vehicle to personal communication systems, introduction to battery charging stations and its installation and commissioning, preliminary discussion on estimation on station capacity and associated technical issues, different connectors.

Course outcome (Course Skill Set)

At the end of this course, students will demonstrate the ability to

1. Understand the architecture and vehicle dynamics of electric and hybrid vehicles
2. Analyze the power management systems for electric and hybrid vehicles
3. Understand different motor control strategies for electric and hybrid vehicles
4. Analyze various components of electric and hybrid vehicles with environment concern.
5. Understand the domain related grid interconnections of electric and hybrid vehicle.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (duration 03 hours).

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), should have a mix of topics under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks.

Suggested Learning Resources:

Text Books

1. Iqbal Hussain, "Electric and Hybrid Vehicles Design Fundamentals", 1st Edition, CRC Press, 2003.
2. James Larminie, John Lowry "Electric Vehicle Technology Explained", 1st Edition, John Wiley and Sons, 2003.

3. Chris Mi, M. Abul Masrur, David Wenzhong Gao, "Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives", Wiley publication ,2011. 4. Allen Fuhs, "Hybrid Vehicles and the future of personal transportation", CRC Press, 2009.
Web links and Video Lectures (e-Resources):
1. Web course on "Introduction to Hybrid and Electric Vehicles" by Dr. Praveenkumar and Prof. S Majhi, IIT Guwahati available on NPTEL at https://nptel.ac.in/courses/108/103/108103009/ 2. Video Course on "Electric Vehicles" by Prof. Amitkumar Jain, IIT Delhi available on NPTEL at https://nptel.ac.in/courses/108/102/108102121/
Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

	Smart Materials & Systems		Semester	III
	Course Code	**BME306B**	CIE Marks	50
	Teaching Hours/Week (L: T:P: S)	**3:0:0:0**	SEE Marks	50
	Total Hours of Pedagogy	**40**	Total Marks	100
	Credits	**03**	Exam Hours	03
	Examination type (SEE)	**Theory**		

Course objectives:

- To make the students understand about smart materials
- To make students to know about making of material smart
- To enable the students to appreciate the material properties

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Class room teaching through chalk & talk, PPT, Appropriate Videos, etc
2. Industry visit
3. Activity based learning
4. Display the sample materials in class room / laboratory

Module-1

Smart materials and structures: System intelligence- components and classification of smart structures, common smart materials and associated stimulus-response, Application areas of smart systems

Module-2

Electrically Activated Materials: Piezoelectricity, Piezoresistivity, Ferroelectricity, Piezoelectric materials- piezoelectric effect, Piezoceramics, Piezopolymers, Piezoelectric materials as sensors, Actuators and bimorphs, nanocarbon tubes

Module-3

Thermally activated materials: Shape memory materials; Shape memory alloys (SMAs), Classification - Transformation - Ni-Ti Alloys, Shape memory effect, Martensitic transformation, One way and two-way SME, binary and ternary alloy systems, Functional properties of SMAs, Shape memory ceramics - Shape memory polymers – Applications

Module-4

Smart polymers: Thermally responsive polymers, Electroactive polymers microgels, Synthesis, Properties and Applications, Protein-based smart polymers, pH-responsive and photo-responsive polymers, Self-assembly, Drug delivery using smart polymers

Module-5

Chemically Activated Materials - Chemical Gels - Self healing materials Optically Activated Materials - Optically activated polymers - Azobenzene - Liquid Crystal, Smart materials for space applications: Elastic memory composites, Smart corrosion protection coatings, Sensors, Actuators, Transducers,

Course outcome (Course Skill Set)

At the end of the course, the student will be able to :
1. Apply the knowledge for materials characterisation
2. Evaluate the materials based on actuation
3. Select and justify appropriate materials for specific application

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

- The question paper will have ten questions. Each question is set for 20 marks.
- There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
- The students have to answer 5 full questions, selecting one full question from each module.
- Marks scored shall be proportionally reduced to 50 marks

Suggested Learning Resources: **Books** 1. D.J. Leo, Engineering Analysis of Smart Material Systems, Wiley 2007. 2. M. Addington, D.L. Schodek, Smart Materials and New Technologies in Architecture, Elsevier 2005. 3. Donald R. Askeland and Pradeep P. Fulay, Essentials of Materials Science and Engineering, 2009, Cengage Laerning. **References** 1. Gandi, M.V. and Thompson, B.S., “Smart Materials and Structures,” Chapman & Hall, UK, 1992, 2. Culshaw, B., “Smart Structures and Materials,” Artech House, Inc., Norwood, USA, 1996. 3. Dimitris C. Lagoudas, Shape Memory Alloys: Modelling and Engineering Applications, Springer, 2008. 4. T. Yoneyama & S. Mayazaki, Shape memory alloys for biomedical applications, CRCPress, 200
Web links and Video Lectures (e-Resources):
• Smart materials intelligent system design NPTEL course
Activity Based Learning (Suggested Activities in Class)/ Practical Based learning • Prepare a smart material sample • Visit to industry

INTERNET OF THINGS		Semester	3
Course Code	**BME306C**	CIE Marks	50
Teaching Hours/Week (L: T:P: S)	**3:0:0:0**	SEE Marks	50
Total Hours of Pedagogy	**40**	Total Marks	100
Credits	**03**	Exam Hours	
Examination type (SEE)	**Theory**		

Course objectives:

The Internet is evolving to connect people to physical things and also physical things to other physical things all in real time. It's becoming the Internet of Things (IoT). The course enables student to

- Understand the basics of Internet of things and protocols.
- Understand some of the application areas where Internet of Things can be applied.
- Learn about the middleware for Internet of Things.
- Understand the concepts of Web of Things

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes and make Teaching –Learning more effective

1. At the start of course, the course delivery pattern, prerequisite of the subject will be discussed
2. Lecture may be conducted with the aid of multi-media projector, chalk & Talk
3. Attendance is compulsory in lectures and laboratory, which may carries five marks in overall evaluation.
4. Promoting project based learning may be conducted having a share of 20 marks in the overall internal evaluation.
5. Assignment based on course content will be given to the student for each unit/topic and will be evaluated at regular interval. It may carry an importance of ten marks in the overall internal evaluation.
6. Surprise tests/Quizzes/Seminar/Tutorial may be conducted and having share of 10 marks in the overall internal evaluation.

Module-1

IOT - What is the IoT and why is it important? Elements of an IoT ecosystem, Technology drivers, Business drivers, Trends and implications, Overview of Governance, Privacy and Security Issues.

Module-2

IOT PROTOCOLS - Protocol Standardization for IoT – Efforts – M2M and WSN Protocols – SCADA and RFID Protocols – Issues with IoT Standardization – Unified Data Standards – Protocols – IEEE802.15.4–BACNet Protocol– Modbus – KNX – Zigbee– Network layer – APS layer – Security

Module-3

IOT ARCHITECTURE - IoT Open source architecture (OIC)- OIC Architecture & Design principles- IoT Devices and deployment models- IoTivity: An Open source IoT stack - Overview- IoTivity stack architecture- Resource model and Abstraction.

Module-4

WEB OF THINGS - Web of Things versus Internet of Things – Two Pillars of the Web – Architecture Standardization for WoT– Platform Middleware for WoT – Unified Multitier WoT Architecture – WoT Portals and Business Intelligence.

Module-5

IOT APPLICATIONS - IoT applications for industry: Future Factory Concepts, Brownfield IoT, Smart Objects, Smart Applications. Study of existing IoT platforms /middleware, IoT- A, Hydra etc.

Course outcome (Course Skill Set)

At the end of the course, the student will be able to :

1. Explain the definition and usage of the term "Internet of Things" in different contexts
2. Understand the key components that make up an IoT system
3. Differentiate between the levels of the IoT stack and be familiar with the key technologies and protocols employed at each layer of the stack
4. Apply the knowledge and skills acquired during the course to build and test a complete, working IoT system involving prototyping, programming and data analysis
5. Understand where the IoT concept fits within the broader ICT industry and possible future trends and Appreciate the role of big data, cloud computing and data analytics in a typical IoT system

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Text Books

1. Honbo Zhou, "The Internet of Things in the Cloud: A Middleware Perspective", CRC Press,2012.
2. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), "Architecting the Internet of Things", Springer, 2011.
3. David Easley and Jon Kleinberg, "Networks, Crowds, and Markets: Reasoning About a Highly Connected World", Cambridge University Press, 2010.
4. Olivier Hersent, David Boswarthick, Omar Elloumi, "The Internet of Things – Key applications and Protocols", Wiley, 2012.

References Books:

1. Vijay Madisetti and ArshdeepBahga, "Internet of Things (A Hands-on-Approach)",1st Edition, VPT, 2014
2. Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", 1st Edition, Apress Publications, 2013
3. CunoPfister, Getting Started with the Internet of Things, O"Reilly Media, 2011, ISBN: 978-1-4493-9357-1

Web links and Video Lectures (e-Resources):

- Introduction to IoT - https://www.youtube.com/watch?v=WUYAjxnwjU4&list=PLE7VH8RC_N3bpVn-e8QzOAHziEgmjQ2qE
- https://www.coursera.org/learn/beginning-custom-projects-with-raspberry-pi
- https://www.edx.org/course/introduction-to-the-internet-of-things-3

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

1. Familiarization with Arduino/Raspberry Pi and perform necessary software installation.
2. To interface LED/Buzzer with Arduino/Raspberry Pi and write a program to turn ON LED for 1 sec after every 2 seconds.
3. To interface Push button/Digital sensor (IR/LDR) with Arduino/Raspberry Pi and write a program to turn ON LED when push button is pressed or at sensor detection.
4. To interface DHT11 sensor with Arduino/Raspberry Pi and write a program to print temperature and humidity readings.
5. To interface motor using relay with Arduino/Raspberry Pi and write a program to turn ON motor when push button is pressed.
6. To interface OLED with Arduino/Raspberry Pi and write a program to print temperature and humidity readings on it.
7. To interface Bluetooth with Arduino/Raspberry Pi and write a program to send sensor data to smartphone using Bluetooth.
8. To interface Bluetooth with Arduino/Raspberry Pi and write a program to turn LED ON/OFF when '1'/'0' is received from smartphone using Bluetooth.
9. Write a program on Arduino/Raspberry Pi to upload temperature and humidity data to thing speak cloud.
10. Write a program on Arduino/Raspberry Pi to retrieve temperature and humidity data from thing speak cloud.
11. To install MySQL database on Raspberry Pi and perform basic SQL queries.
12. Write a program on Arduino/Raspberry Pi to publish temperature data to MQTT broker.

WASTE HANDLING & MANAGEMENT			Semester	**III**
Course Code	**BME306D**		CIE Marks	50
Teaching Hours/Week (L: T:P: S)	**3:0:0:0**		SEE Marks	50
Total Hours of Pedagogy	**40**		Total Marks	100
Credits	**03**		Exam Hours	03
Examination type (SEE)	**Theory**			

Course objectives: To make students to understand about;

1. Waste generation & effects
2. Solid waste management & challenges
3. Hazordous waste management & challenges
4. Innovative methods in practice to handle waste & its effects
5. Laws governing the waste management

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Class room teaching through chalk & talk, PPT, Appropriate Videos, etc
2. Visit to nearby waste handling sites
3. Segregation of waste & Preparation of compost practical execution
4. Student speeches on their observations
5. Conduction / participation in Waste management idea formulation competition events
6. Case study discussions at least 4 in each topic mentioned

Module-1: Introduction to waste management

Importance, methods of logistics, human components, technological components- waste handling equipment and technology, steps in waste management logistics.

Waste collection system and organization: Environmental aspects of waste collection, role of public authority and private sector in waste collection, organizing collection of residential waste, fee schemes, public awareness programs.

Module-2 : Engineering Systems for Solid Waste Management

Characteristics of solid waste, types of solid waste, Processing and Treatment of Solid Waste; Mechanical Treatment Material Recovery Facility, Recycling and Recovery, Types of Material Recovery Facilities, Biological Treatment & Biological methods for waste processing; Composting & methods. Biomethanation, Biodeisel, Biohydrogen, Mechanical Biological Stabilization, Thermal Treatment Incineration, Residues and its utilisation, co-combustion, Pyrolysis, Gasification, Refuse Derived Fuel, solid recovered fuel.

Engineering Disposal of SW: Dumping of solid waste; sanitary land fills – site selection,.

Module-3 Hazardous Waste Management

Introduction, Hazardous waste definition, sources, identification and classification, Characteristics, Industrial waste & Plastic Waste; sources, environmental effects, challenges in handling Biomedical waste; Introduction to biomedical wastes, sources, classification, collection, segregation, treatment and disposal,

E- waste; characteristics, generation, collection, transport, recycling and disposal, Effects on the society and environment, Transportation and Disposal, recycling and reuse,

Nuclear waste; Characteristics, Types, Power reactors, Refinery and fuel fabrication wastes, Health and environmental effects, Decommissioning of Nuclear power reactors

Hazardous waste landfills, Site selections.

	Module-4 Innovations in waste management
	Global and Indian Context, recycling, reuse, energy production, land filling, remediation of hazardous waste contaminated sites. Revenue models, Developing Networks, Entrepreneurship activities, Best practices in India and Abroad- Case studies, Waste management and waste handling entrepreneurs in India and other countries, Case studies of different municipalities waste handling techniques, domestic composting, medium & large scale composting, Centralised composting
	Module-5 Waste Management Laws in India
	The Environmental Protection Act, The Hazardous Wastes (Management, Handling and Transboundary Movement) Rules, 2008, The Plastic Waste (Management and Handling) Rules, 2011, Bio-Medical Waste (Management and Handling) Rules, 1998, The E- Waste (Management and Handling) Rules, 2011, The Batteries (Management and Handling) Rules, 2001. Duties of constitutional bodies and Ministries

Course outcome (Course Skill Set)

At the end of the course, the student will be able to:

1. Identify & segregate the waste
2. Formulate the appropriate waste segregation, collection & disposal system
3. Generate a report on waste management challenges
4. Select a remedial measure for environmental & living being protection
5. Exercise the constitution laws as a citizen

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

- The question paper will have ten questions. Each question is set for 20 marks.
- There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
- The students have to answer 5 full questions, selecting one full question from each module.
- Marks scored shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Books

1. Handbook of Solid Waste Management, Tchobanoglous G and Kreith F, McGraw-Hill Education, 2002, 2nd Edition
2. Hazardous Wastes - Sources, Pathways, Receptors, Richard J. Watts, John Wiley and Sons, 1998, 1st Edition.
3. Strategic Management,Hitt, M.A.,Hoskisson, R.E., Ireland, R.D., (2016)., Cengage Learning, India.
4. Waste Management Practices: Municipal, Hazardous and Industrial, John Pichtel, CRC Press, 2014, 2nd Edition
5. Handbook of Solid Waste Management, Tchobanoglous G and Kreith F, McGraw-Hill Education, 2002, 2nd Edition

Reference books:

1. Waste Management Practices: Municipal, Hazardous and Industrial, John Pichtel (2014)., 2nd Ed., CRC Press, USA.
2. Waste: A Handbook for Management, Letcher, T.M., Vallero, D.A. (2011)., 1st Ed, Academic Press, USA.
3. Waste Management Strategy and Action Plan,IGES, UNEP, CCET. (2018), Phnom Penh 2018-2035. Phnom Penh, Cambodia.
4. National Environment Policy, 2006, Ministry of Environment and Forests, Government of India, Approved by the Union Cabinet on 18 May, 2006 2
5. Innovation and Entrepreneurship, Peter Drucker, (2012)., Routledge Publishers, England UK

Web links and Video Lectures (e-Resources):

- https://nptel.ac.in/content/storage2/courses/105106056/Introduction.pdf
- https://nptel.ac.in/courses/105/103/105103205/
- http://cpheeo.gov.in/cms/manual-on-municipal-solid-waste-management-2016.php
- https://nptel.ac.in/courses/105/103/105103205/
- https://nptel.ac.in/courses/120/108/120108005/
- https://nptel.ac.in/courses/105/106/105106056/
- https://nptel.ac.in/courses/105/105/105105160/
- https://nptel.ac.in/courses/103/107/103107125/
- https://nptel.ac.in/courses/110/108/110108047/
- https://nptel.ac.in/courses/105/106/105106056/
- https://nptel.ac.in/courses/105/105/105105184/
- https://nptel.ac.in/content/storage2/courses/105106056/Introduction.pdf
- https://wedocs.unep.org/bitstream/handle/20.500.11822/31379/IWM_Guidelines.pdf?se quence=1&isAllowed=y

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning
• Preparation of a model for waste management for a hostel, apartment, institution, • Speeches by students about best practices followed for domestic waste handling • Prepare compost using machines • Visit nearby waste dump yard and prepare a report covering challenges & remedies • Visit industries and observe large-scale industry waste disposal practices and challenges • Visit near by hospitals and observe large-scale bio-medical waste disposal practices and challenges • Display everyday one/ two constitution rules on class notice board • Poster preparation by students

ADVANCED PYTHON PROGRAMMING		Semester	3
Course Code	**BME358A**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	**0:0:2:0**	SEE Marks	50
Total Hours of Pedagogy	**15**	Total Marks	100
Credits	**01**	Exam Hours	03
Examination type (SEE)	**Practical**		

Course objectives:

- To understand the problem solving approaches.
- To learn the basic programming constructs in Python.
- To practice various computing strategies for Python-based solutions to real world problems.
- To use Python data structures – lists, tuples, dictionaries.
- To do input/output with files in Python.

Sl.NO	Experiments
1	Demonstrate following functions/methods which operates on strings in Python with suitable examples: i) len( ) ii) strip( ) iii) rstrip( ) iv) lstrip( ) v) find( ) vi) rfind( ) vii) index( ) viii) rindex(),ix) count( ) x) replace( ) xi) split( ) xii) join( ) xiii) upper( ) xiv) lower( ) xv) swapcase( ) xvi) title( ) xvii) capitalize( ) xviii) startswith() xix) endswith()
2	Implementing programs using Functions. (Factorial, largest number in a list, area of shape).
3	NESTED LISTS: Write a program to read a 3 X 3 matrix and find the transpose, addition, subtraction, multiplication of two 3 X 3 matrices, check whether two given 3 X 3 matrices are identical or not.
4	Implementing programs using Strings. (Reverse, palindrome, character count, replacing characters). Real time applications using sets and Dictionaries
5	Scientific problems using Conditionals and Iterative loops. (Number series and different Patterns).
6	Numpy Library: Linear Algebra a) Write a python program to find rank, determinant, and trace of an array. b) Write a python program to find eigen values of matrices d) Write a python program to solve a linear matrix equation, or system of linear scalar equations.
7	Graphics: • Consider turtle object. Write functions to draw triangle, rectangle, polygon, circle and sphere. Use object oriented approach. • Design a Python program using the Turtle graphics library to construct a turtle bar chart representing the grades obtained by N students read from a file categorizing them into distinction, first class, second class, third class and failed.
8	Create a colour images using NumPy in Python.
	Demonstration Experiments (For CIE)
9	Write a python program to implement Pandas Series with labels.
10	Implementing real-time/technical applications using File handling. (copy from one file to another, word count, longest word).
11	Implementing real-time/technical applications using Exception handling. (divide by zero error, voter's age validity, student mark range validation).
12	Developing a game activity using Pygame like bouncing ball, car race etc.

Course outcomes (Course Skill Set):

At the end of the course the student will be able to:

- CO1: Develop algorithmic solutions to simple computational problems.
- CO2: Develop and execute simple Python programs.
- CO3: Use functions to decompose a Python program.
- CO4: Process compound data using Python data structures.
- CO5: Utilize Python packages in developing software applications.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation (CIE):

CIE marks for the practical course are **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment is to be evaluated for conduction with an observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments are designed by the faculty who is handling the laboratory session and are made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled down to **30 marks** (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct a test of 100 marks after the completion of all the experiments listed in the syllabus.
- In a test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability.
- The marks scored shall be scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and marks of a test is the total CIE marks scored by the student.

Semester End Evaluation (SEE):

- SEE marks for the practical course are 50 Marks.
- SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the Head of the Institute.
- The examination schedule and names of examiners are informed to the university before

the conduction of the examination. These practical examinations are to be conducted between the schedule mentioned in the academic calendar of the University.

- All laboratory experiments are to be included for practical examination.
- (Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.
- Students can pick one question (experiment) from the questions lot prepared by the examiners jointly.
- Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.

- General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)
- Change of experiment is allowed only once and 15% of Marks allotted to the procedure part are to be made zero.

The minimum duration of SEE is 02 hours

Suggested Learning Resources:

- G Venkatesh and Madhavan Mukund, "Computational Thinking: A Primer for Programmers and Data Scientists", 1st Edition, Notion Press, 2021.
- John V Guttag, "Introduction to Computation and Programming Using Python: With Applications to Computational Modeling and Understanding Data", Third Edition, MIT Press, 2021
- Paul Deitel and Harvey Deitel, "Python for Programmers", Pearson Education, 1st Edition, 2021.
- Eric Matthes, "Python Crash Course, A Hands – on Project Based Introduction to Programming", 2nd Edition, No Starch Press, 2019.
- Martin C. Brown, "Python: The Complete Reference", 4th Edition, Mc-Graw Hill, 2018.

TEMPLATE for AEC (if the course is a theory)

INTRODUCTION TO VIRTUAL REALITY		Semester	3rd
Course Code	**BME358B**	CIE Marks	50
Teaching Hours/Week (L: T:P: S)	**0-2-0-0**	SEE Marks	50
Total Hours of Pedagogy	**30**	Total Marks	100
Credits	**01**	Exam Hours	01
Examination nature (SEE)	**Theory**/practical/Viva-Voce /Term-work/Others		

Course objectives:

- Describe how VR systems work and list the applications of VR.
- Understand the design and implementation of the hardware that enables VR systems to be built.
- Understand the system of human vision and its implication on perception and rendering.
- Explain the concepts of motion and tracking in VR systems.
- Describe the importance of interaction and audio in VR systems.

Teaching-Learning Process (General Instructions)

These are sample Strategies; which teachers can use to accelerate the attainment of the various course outcomes.

1. Adopt different types of teaching methods to develop the outcomes through PowerPoint presentations and Video demonstrations or Simulations.
2. Chalk and Talk method for Problem Solving.
3. Adopt flipped classroom teaching method.
4. Adopt collaborative (Group Learning) learning in the class.
5. Adopt Problem Based Learning (PBL), which fosters students' analytical skills and develops thinking skills such as evaluating, generalizing, and analyzing information.

Module-1

Introduction to Virtual Reality : Defining Virtual Reality, History of VR, Human Physiology and Perception, Key Elements of Virtual Reality Experience, Virtual Reality System, Interface to the Virtual World-Input & output- Visual, Aural & Haptic Displays, Applications of Virtual Reality.

Teaching- Learning Process	1. Power-point Presentation, 2. Video demonstration or Simulations, 3. Chalk and Talk are used for Problem Solving./White board

Module-2

Representing the Virtual World : Representation of the Virtual World, Visual Representation in VR, Aural Representation in VR and Haptic Representation in VR

Teaching- Learning Process	1. Power-point Presentation, 2. Video demonstration or Simulations, 3. Chalk and Talk are used for Problem Solving./White board

Module-3

The Geometry of Virtual Worlds &The Physiology of Human Vision: Geometric Models, Changing Position and Orientation, Axis-Angle Representations of Rotation, Viewing Transformations, Chaining the Transformations, Human Eye, eye movements & implications for VR.

Teaching- Learning Process	1. Power-point Presentation, 2. Video demonstration or Simulations, 3. Chalk and Talk are used for Problem Solving./White board

Module-4

Visual Perception & Rendering: Visual Perception - Perception of Depth, Perception of Motion, Perception of Color, Combining Sources of Information Visual Rendering -Ray Tracing and Shading Models, Rasterization, Correcting Optical Distortions, Improving Latency and Frame Rates	
Teaching- Learning Process	1. Power-point Presentation, 2. Video demonstration or Simulations, 3. Chalk and Talk are used for Problem Solving./White board
Module-5	
Motion & Tracking: Motion in Real and Virtual Worlds- Velocities and Accelerations, The Vestibular System, Physics in the Virtual World, Mismatched Motion and Vection Tracking- Tracking 2D & 3D Orientation, Tracking Position and Orientation, Tracking Attached Bodies	
Teaching- Learning Process	1. Power-point Presentation, 2. Video demonstration or Simulations, 3. Chalk and Talk are used for Problem Solving./White board
Course outcome (Course Skill Set) At the end of the course the student will be able to: CO1: Describe how VR systems work and list the applications of VR. CO2: Demonstrate the design and implementation of the hardware that enables VR systems to be built. CO3: Understand the system of human vision and its implication on perception and rendering. CO4: Explain the concepts of motion and tracking in VR systems. CO5: Describe the importance of interaction and audio in VR systems.	

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Examination (CIE)

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examinations (SEE)

SEE paper shall be set for 50 questions, each of 01 mark. The pattern of the question paper is MCQ (multiple choice questions). The time allotted for SEE is **01 hour.** The student has to secure a minimum of 35% of the maximum marks meant for SEE.

Suggested Learning Resources:

Text Books

1. Virtual Reality, Steven M. LaValle, Cambridge University Press, 2016
2. Understanding Virtual Reality: Interface, Application and Design, William R Sherman and Alan B Craig, (The Morgan Kaufmann Series in Computer Graphics)". Morgan Kaufmann Publishers, San Francisco, CA, 2002.
3. Developing Virtual Reality Applications: Foundations of Effective Design, Alan B Craig, William R Sherman and Jeffrey D Will, Morgan Kaufmann, 2009.

Reference Books:

1. Gerard Jounghyun Kim, "Designing Virtual Systems: The Structured Approach", 2005.
2. Doug A Bowman, Ernest Kuijff, Joseph J LaViola, Jr and Ivan Poupyrev, "3D User Interfaces, Theory and Practice", Addison Wesley, USA, 2005.
3. Oliver Bimber and Ramesh Raskar, "Spatial Augmented Reality: Meging Real and Virtual Worlds", 2005.
4. Burdea, Grigore C and Philippe Coiffet, "Virtual Reality Technology", Wiley Interscience, India, 2003.

Web links and Video Lectures (e-Resources):

- http://lavalle.pl/vr/book.html
- https://nptel.ac.in/courses/106/106/106106138/
- https://www.coursera.org/learn/introduction-virtual-reality.

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning
• Course seminars

<table>
<tr><td colspan="2">SPREADSHEET FOR ENGINEERS</td><td>Semester</td><td>3</td></tr>
<tr><td>Course Code</td><td>BME358C</td><td>CIE Marks</td><td>50</td></tr>
<tr><td>Teaching Hours/Week (L:T:P: S)</td><td>0:0:2:0</td><td>SEE Marks</td><td>50</td></tr>
<tr><td>Total Hours of Pedagogy</td><td>15 sessions</td><td>Total Marks</td><td>100</td></tr>
<tr><td>Credits</td><td>1</td><td>Exam Hours</td><td>03</td></tr>
<tr><td>Examination type (SEE)</td><td colspan="3">Practical</td></tr>
</table>

Course objectives:

- To create different plots and charts
- To compute different functions, conditional functions and make regression analysis
- To carryout iterative solutions for roots, multiple roots, optimization and non-linear regression analysis
- To carryout matrix operations
- To Understand VBA and UDF
- To understand VBA subroutines and Macros
- To carryout numerical integration and solving differential equations using different methods

Sl.NO	Experiments
1	Charting: Create an XY scatter graph, XY chart with two Y-Axes, add error bars to your plot, create a combination chart
2	Functions: Computing Sum, Average, Count, Max and Min, Computing Weighted Average, Trigonometric Functions, Exponential Functions, Using The CONVERT Function to Convert Units
3	Conditional Functions: Logical Expressions, Boolean Functions, IF Function, Creating a Quadratic Equation Solver, Table VLOOKUP Function, AND, OR and XOR functions.
4	Regression Analysis: Trendline, Slope and Intercept, Interpolation and Forecast, The LINEST Function, Multilinear Regression, Polynomial Fit Functions, Residuals Plot, Slope and Tangent, Analysis ToolPack.
5	Iterative Solutions Using Excel: Using Goal Seek in Excel, Using The Solver To Find Roots, Finding Multiple Roots, Optimization Using The Solver, Minimization Analysis, NonLinear Regression Analysis.
6	Matrix Operations Using Excel: Adding Two Matrices, Multiplying a Matrix by a Scalar, Multiplying Two Matrices, Transposing a Matrix, Inverting a Matrix and Solving System of Linear Equations.
7	VBA User-Defined Functions (UDF): The Visual Basic Editor (VBE), The IF Structure, The Select Case Structure, The For Next Structure, The Do Loop Structure, Declaring Variables and Data Types, An Array Function The Excel Object Model, For Each Next Structure.
8	VBA Subroutines or Macros: Recording a Macro, Coding a Macro Finding Roots by Bisection, Using Arrays, Adding a Control and Creating User Forms.
	Demonstration Experiments (For CIE)
9	Numerical Integration Using Excel: The Rectangle Rule, The Trapezoid Rule, The Simpson's Rule, Creating a User-Defined Function Using the Simpson's Rule.
10	Differential Equations: Euler's Method, Modified Euler's Method, The Runge Kutta Method, Solving a Second Order Differential Equation

Course outcomes (Course Skill Set):

At the end of the course the student will be able to:

- Create different plots and charts
- Compute different functions, conditional functions and make regression analysis
- Carryout iterative solutions for roots, multiple roots, optimization and non-linear regression analysis
- Carryout matrix operations

- Understand VBA and UDF, VBA subroutines and Macros
- Carryout numerical integration and solving differential equations using different methods

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation (CIE):

CIE marks for the practical course are **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment is to be evaluated for conduction with an observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments are designed by the faculty who is handling the laboratory session and are made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled down to **30 marks** (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct a test of 100 marks after the completion of all the experiments listed in the syllabus.
- In a test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability.
- The marks scored shall be scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and marks of a test is the total CIE marks scored by the student.

Semester End Evaluation (SEE):

- SEE marks for the practical course are 50 Marks.
- SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the Head of the Institute.
- The examination schedule and names of examiners are informed to the university before the conduction of the examination. These practical examinations are to be conducted between the schedule mentioned in the academic calendar of the University.
- All laboratory experiments are to be included for practical examination.
- (Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement

evaluation rubrics shall be decided jointly by examiners.

- Students can pick one question (experiment) from the questions lot prepared by the examiners jointly.
- Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.

General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)

Change of experiment is allowed only once and 15% of Marks allotted to the procedure part are to be made zero.

The minimum duration of SEE is 03 hours

Suggested Learning Resources:

- Excel Resources - 600+ Self Study Guides, Articles & Tools (wallstreetmojo.com)
- https://www.ictlounge.com/html/year_7/esafety_part7.htm
- McFedries PaulMicrosoft Excel 2019 Formulas And Functions Microsoft Press, U.S, 2019 Edition

Tools in Scientific Computing		Semester	**3**
Course Code	**BME358D**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	**0:0:2:0**	SEE Marks	50
Total Hours of Pedagogy	**15 sessions**	Total Marks	100
Credits	**01**	Exam Hours	03
Examination type (SEE)	Theory/**Practical**/Viva-Voce /Term-work/Others		

Course objectives:

1. To learn the fundamentals of problem-solving using MATLAB/MATHCAD and go plot graphs using Origin software
2. To introduce programming for curve fitting and solving both linear and nonlinear equations.
3. To understand the concept of approximate methods and recognize their significance in computing.

Sl.NO	Experiments
1	Develop a program to find the eigenvalues and eigenvectors of a square matrix
2	Develop a user-friendly program for the Newton-Raphson method for solving simultaneous nonlinear equations
3	Develop a user-friendly program to find solution of simultaneous linear equations using matrix methods
4	Develop a program to find the equation that best fits for the given set of points using any of the curve fitting techniques
5	Develop a program to compute the area under the given curve described by the function using numerical techniques
6	Develop a user-friendly program for the thick or thin cylinders subjected to internal and external loads, determine the stresses developed within the cylinder and plot the variation of stresses
7	Develop a program to find the principal stresses and their associated directions for a given state of stress described by the components of stress in three dimensions (σxx, σyy, σzz, σxy, σxz, σyz),
8	Develop a user-friendly program for plotting the Mohr's circle for the given 2D stress state and determine the principal stresses and directions of principle stress
	Demonstration Experiments (For CIE)
9	Develop a program to find the multiplication and inverse of a square matrix
10	Develop a program to find and plot the response of spring-mass-dashpot system subjected to hormonic excitation.
11	Develop a program to find the roots of a quadratic equation using numerical methods
12	Develop a program to find the solution of differential equation using approximate methods

Course outcomes (Course Skill Set):

At the end of the course the student will be able to:

1. Understand the fundamentals of programming in scientific computations.
2. Develop programming for curve fitting and solving both linear and nonlinear equations.
3. Apply the concept of approximate methods and recognize their significance in computing.
4. Apply MATLAB/MATHCAD/FORTRAN/PYTHON tools, etc., for solving engineering problems

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation (CIE):

CIE marks for the practical course are **50 Marks.**

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment is to be evaluated for conduction with an observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments are designed by the faculty who is handling the laboratory session and are made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled down to **30 marks** (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct a test of 100 marks after the completion of all the experiments listed in the syllabus.
- In a test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability.
- The marks scored shall be scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and marks of a test is the total CIE marks scored by the student.

Semester End Evaluation (SEE):

- SEE marks for the practical course are 50 Marks.
- SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the Head of the Institute.

- The examination schedule and names of examiners are informed to the university before the conduction of the examination. These practical examinations are to be conducted between the schedule mentioned in the academic calendar of the University.
- All laboratory experiments are to be included for practical examination.
- (Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.
- Students can pick one question (experiment) from the questions lot prepared by the examiners jointly.
- Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.

General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)

Change of experiment is allowed only once and 15% of Marks allotted to the procedure part are to be made zero.

The minimum duration of SEE is 03 hours

Suggested Learning Resources:

1. Applied Numerical Methods with MATLAB for Engineers and Scientists, Steven C. Chapra, Edition 3, McGraw-Hill, 2012
2. Numerical methods for engineers, Steven C. Chapra, Raymond P. Canale, 5th fifth edition, 2006, McGraw-Hill Higher Education, Boston, 2006
3. MATLAB and Its Applications in Engineering, Raj Kumar Bansal, et.al 2009, Pearson Education,

APPLIED THERMODYNAMICS		Semester	4
Course Code	**BME401**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	**2:2:0:0**	SEE Marks	50
Total Hours of Pedagogy	**30**	Total Marks	100
Credits	**03**	Exam Hours	03
Examination type (SEE)	**Theory**		

Course objectives:

- Explain the air standard cycle and combustion in I. C. Engines.
- Describe the gas power cycle and vapour power cycles.
- Explain the performance of compressor.
- Explain the concepts of Refrigeration and Air conditioning.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Adopt different types of teaching methods to develop the outcomes through PowerPoint presentations and Video demonstrations or Simulations.
2. Chalk and Talk method for Problem Solving.
3. Adopt flipped classroom teaching method.
4. Adopt collaborative (Group Learning) learning in the class.
5. Adopt Problem Based Learning (PBL), which fosters students' analytical skills and develops thinking skills such as evaluating, generalizing, and analysing information.

Module-1

Air standard cycles: Carnot cycle. Otto, Diesel, Dual and cycles, p-v and T -s diagrams, description, efficiencies and mean effective pressures. Comparison of Otto and Diesel cycles.

I.C.Engines: Classification of IC engines, Combustion of SI engine and CI engine, Detonation and factors affecting detonation, Performance analysis of I.C Engines, Heat balance, Morse test

Module-2

Gas power Cycles: Gas turbine (Brayton) cycle; description and analysis. Regenerative, Intercooling and reheating in gas turbine cycles.

Jet Propulsion cycles: Turbojet, Turboprop, Turbofan, Ram Jet, Rocket, Pulse Jet, Ram Rocket.

Module-3

Vapour Power Cycles: Carnot vapour power cycle, drawbacks as a reference cycle. Simple Rankine cycle; description, T-S diagram, analysis for performance. Comparison of Carnot and Rankine cycles. Effects of pressure and temperature on Rankine cycle performance.

Actual vapour power cycles: Actual vapour power cycles, regenerative vapour power cycle with open and closed feed water heaters. Reheat Rankine cycle.

Module-4

Refrigeration Cycles: Vapour compression refrigeration system; description, analysis, refrigerating effect. Capacity, power required, units of refrigeration, COP, Refrigerants and their desirable properties, alternate Refrigerants. Vapour absorption refrigeration system.

Pscychrometrics and Air-conditioning Systems: Psychometric properties of Air (***only for review***), Psychometric Chart, Analyzing Air-conditioning Processes; Heating, Cooling, Dehumidification and Humidification, Evaporative Cooling. Adiabatic mixing of two moist air streams.

Module-5

Reciprocating Compressors: Operation of a single stage reciprocating compressors. Work input through p-v diagram and steady state steady flow analysis. Effect of Clearance and Volumetric efficiency. Adiabatic, Isothermal and Mechanical efficiencies. Multi-stage compressor, saving in work, Optimum intermediate pressure, Inter-cooling, Minimum work for compression.

Steam nozzles: Flow of steam through nozzles, Shape of nozzles, effect of friction, Critical pressure ratio, Super saturated flow.

Course outcome (Course Skill Set)

At the end of the course, the student will be able to :

1. Analyse air standard cycle to evaluate the performance of I C engines.
2. Analyze the gas power cycles to evaluate the overall efficiency of gas turbine plant.
3. Apply thermodynamic concepts to analyze the performance of vapour power cycles.
4. Analyze the vapour compression and vapour absorption systems to improve refrigeration.
5. Determination of various parameters of air compressors and steam nozzles.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

- The question paper will have ten questions. Each question is set for 20 marks.
- There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
- The students have to answer 5 full questions, selecting one full question from each module.
- Marks scored shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Books (Title of the Book/Name of the author/Name of the publisher/Edition and Year)

Text Books:

1. Engineering Thermodynamics, P.K. Nag, Tata McGraw Hill, 6th Edition 2018
2. Thermodynamics, Yunus A, Cengel, Michael A Boles, Tata McGraw Hill 7th Edition

Reference Books:

1. Thermodynamics for engineers Kenneth A. Kroosand Merle C. Potter, Cengage Learning 2016
2. Principles of Engineering Thermodynamics, Michael J, Moran,Howard N. Shapiro, Wiley 8th Edition
3. I.C.Engines, M.L.Mathur&Sharma. Dhanpat Rai& sons-India

Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=AwbhbN20xl8&list=PLwdnzlV3ogoVJnW1S9GgOKYj5heOzl1dn
- https://ciechanow.ski/internal-combustion-engine/
- https://www.youtube.com/watch?v=1Vn1PDuPHsY&list=PL4K9r9dYCOoozyQU9kmQFJkTz

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Organise Industrial visits to Thermal power plants and submission of report.
- Visit to a building under construction to explore the design consideration of duct to understand the concept of centralized Air Conditioning.

MACHINING SCIENCE & METROLOGY		Semester	IV
Course Code	**BME402**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:2:0	SEE Marks	50
Total Hours of Pedagogy	40 hours Theory + 8-10 Lab slots	Total Marks	100
Credits	04	Exam Hours	03
Examination nature (SEE)	Theory /Viva-Voce /Term-work/Others		

Course objectives:

- To enrich the knowledge pertaining to relative motion and mechanics required for various machine tools.
- To introduce students to different machine tools to produce components having different shapes and sizes.
- To develop the knowledge on mechanics of machining process and effect of various parameters on machining.
- To understand the basic principles of measurements
- To enrich the knowledge pertaining to gauge , comparator and angular measurement.

Teaching-Learning Process (General Instructions)

These are sample Strategies; that teachers can use to accelerate the attainment of the various course outcomes.

1. Adopt different teaching methods to develop the outcomes through presentations/ video demonstrations/ simulations.
2. Chalk and talk method for problem-solving.
3. Arrange industrial visits to show the live working models other than laboratory topics.
4. Adopt collaborative learning in the class.
5. Adopt Problem Based Learning (PBL), which fosters students' analytical skills and develops thinking skills such as evaluating, generalizing, and analyzing information.
6. Conduct laboratory demonstrations and practical experiments to enhance experiential skills.

MODULE-1

Introduction to Metal cutting: Orthogonal and oblique cutting. Classification of cutting tools: single, and multipoint; tool signature for single point cutting tool. Mechanics of orthogonal cutting; chip formation, shear angle and its significance, Merchant circle diagram. Numerical problems. Cutting tool materials and applications.

Introduction to basic metal cutting machine tools: Lathe- Parts of lathe machine, accessories of lathe Machine and various operations carried out on lathe. Kinematics of lathe. Turret and Capstan lathe.

MODULE-2

Milling Machines: up milling & down milling, classification of milling machines, constructional features (Column and Knee and vertical milling machine), milling cutter nomenclature, various milling operations, calculation of machining time.

Indexing: Need of indexing Simple, compound and differential indexing calculations. Simple numerical on indexing.

Shaping, Slotting and Planning Machines Tools: Driving mechanisms of Shaper, Slotter and Planer. Operations done on Shaper, Planer & Slotter Difference between shaping and planning operations.

Drilling Machines: Constructional features (Radial & Bench drilling Machines), operations, types of drill & drill bit nomenclature. Calculation of machining time.

Grinding: Grinding operation, classification of grinding processes: cylindrical, surface &centerless grinding

MODULE-3
Thermal aspects, Tool wear, and Machinability **Temperature in Metal Cutting**: Heat generation in metal cutting; temperature distribution in metal cutting, effect of cutting speed on temperatures, measurement of cutting temperatures Tool life and tool Wear: progressive tool wear; **forms of wear in metal cutting:** crater wear, flank wear, tool-life criteria, cutting tool materials: basic requirements of tool materials, major classes of tool materials: high-speed steel, cemented carbide, ceramics, CBN and diamond, tool coatings; the work material and its machinability **Cutting fluids:** Action of coolants and application of cutting fluids.
MODULE-4
Introduction: Introduction to metrology & measurements, definition, objectives and classification of metrology, standards of length- wave length standard, sub division of standards, numerical problems on length calibration. **Line & End Standards:** Line and end standard, slip gauges, wringing phenomena, numerical problems on slip gauges. **Systems of Limits, Fits & Tolerance:** Definition of tolerance, tolerance specification in assembly, principle of interchangeability and selective assembly, limits of size, Indian standards, concepts of limits of size and tolerances, cost v/s tolerances, compound tolerances, accumulation of tolerances, definition of fits, types of fits and their designation.
MODULE-5
Gauges: Classification of gauges, Taylor's principle, design of GO, NO GO gauges, wear allowance on gauges, types of gauges- plain plug gauges, ring gauges, snap gauge, limit gauge, simple problems. **Comparators:** Introduction to comparators, classification, characteristics, systems of displacement amplification in mechanical comparators, Reed type, Sigma comparator, Zeiss ultra-optimeter, Solex air gauge, ultrasonic gauges, LVDT. **Angular Measurements:** Bevel protractor, sine bar, angular gauges, numerical on building of angles.

PRACTICAL COMPONENT OF IPCC *(May cover all / major modules)*

Sl.NO	Experiments
1	Preparation of one model on lathe involving - Plain turning, Facing, Knurling, Drilling, Boring, Internal Thread cuts and Eccentric turning.
2	Preparation of One model on lathe involving - Plain turning, Facing , Taper turning, Step turning, Thread cutting, Facing, Knurling, Drilling, Boring, Internal Thread cutting and Eccentric turning.
3	One Job, Cutting of V Groove/ dovetail / Rectangular groove using a shaper.
4	Cutting of Gear Teeth using Milling Machine.
5	Simple operations and One Job on the drilling and grinding machine.
6	Cutting force measurement with dynamometers (Demonstration) for turning, drilling, grinding operations.
7	Analysis of chip formation and chip reduction coefficient in turning of mild steel by HSS tool with different depth of cut, speed, and feed rate.
8	Experiment on anyone advanced machining process
9	Study & Demonstration of power tools like power drill, power hacksaw, portable hand grinding, cordless screw drivers, production air tools, wood cutter, etc., used in Mechanical Engineering.
10	Demonstration/Experimentation of simple programming of CNC machine operations.
11	Demonstration / Experiment on tool wears and tool life on anyone conventional machining process.
12	To study the tool geometry of a single point turning tool (SPTT) in the American Standards Association (ASA) system.

Course outcomes (Course Skill Set):

At the end of the course, the student will be able to:

CO1: Analyze various cutting parameters in metal cutting.

CO2: Understand the construction of machines & machine tools and compute the machining time of various operations.

CO3: Understand the concept of Temperature in Metal Cutting, forms of wear in metal cutting and Cutting fluids

CO4: Understand the objectives of metrology, methods of measurement, standards of measurement & various measurement parameters. Explain tolerance, limits of size, fits, geometric and position tolerances, gauges and their design

CO5: Understand the working principle of different types of comparators, gauges, angular Measurements

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

CIE for the theory component of the IPCC (maximum marks 50)

- IPCC means practical portion integrated with the theory of the course.
- CIE marks for the theory component are **25 marks** and that for the practical component is **25 marks**.

- 25 marks for the theory component are split into **15 marks** for two Internal Assessment Tests (Two Tests, each of 15 Marks with 01-hour duration, are to be conducted) and **10 marks** for other assessment methods mentioned in 22OB4.2. The first test at the end of 40-50% coverage of the syllabus and the second test after covering 85-90% of the syllabus.
- Scaled-down marks of the sum of two tests and other assessment methods will be CIE marks for the theory component of IPCC (that is for **25 marks)**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the theory component of IPCC.

CIE for the practical component of the IPCC

- **15 marks** for the conduction of the experiment and preparation of laboratory record, and **10 marks** for the test to be conducted after the completion of all the laboratory sessions.
- On completion of every experiment/program in the laboratory, the students shall be evaluated including viva-voce and marks shall be awarded on the same day.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to **15 marks**.
- The laboratory test **(duration 02/03 hours)** after completion of all the experiments shall be conducted for 50 marks and scaled down to **10 marks.**
- Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **25 marks**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the practical component of the IPCC.

SEE for IPCC

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours**)

- The question paper will have ten questions. Each question is set for 20 marks.
- There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
- The students have to answer 5 full questions, selecting one full question from each module.
- Marks scored by the student shall be proportionally scaled down to 50 Marks

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper may include questions from the practical component.

Suggested Learning Resources:

Books

1. Shaw, M C, (2014), Metal Cutting Principles, Oxford University Press.
2. McGeough, J A, (1988), Advanced Methods of Machining, Springer.
3. Boothroyd, G., and Knight, W. A., Fundamentals of Machining and Machine Tools, CRC Press.
4. Chattopadhyay, A B, (2013), Machining and Machine Tools, Wiley India.
5. Mikell P. Groover, (2019), Fundamentals of Modern Manufacturing: Materials, Processes, and Systems, Wiley Publications.
6. Rao P. N., Manufacturing Technology II, Tata McGraw Hill.
7. Mechanical Measurements Beckwith Marangoni and Lienhard Pearson Education 6th Ed.,
8. Instrumentation, Measurement and Analysis B C Nakra, K K Chaudhry McGraw–Hill 4th Edition
9. Engineering Metrology R.K. Jain Khanna Publishers 2009

Web links and Video Lectures (e-Resources):

1. V. K. Jain, Advanced Machining Processes, NPTEL Course Department of Mechanical Engineering, IIT Kanpur, Link: http://nptel.ac.in/courses/112104028/.
2. U. S. Dixit, Mechanics of Machining, NPTEL Course Department of Mechanical Engineering Guwahati, Link: http://nptel.ac.in/courses/112103248/.
3. A. B. Chattopadhyay, Manufacturing Processes II, NPTEL Course of Department of Mechanical Engineering, IIT Kharagpur, https://nptel.ac.in/courses/112/105/112105126/

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

Visit any one machining center or machining industry and/or
Case study on process parameter influence on anyone advanced machining process and hybrid machining process.

FLUID MECHANICS		Semester	04
Course Code	BME403	CIE Marks	50
Teaching Hours/Week (L: T:P: S)	3:0:2:0	SEE Marks	50
Total Hours of Pedagogy	40 hours Theory + 8-10 Lab slots	Total Marks	100
Credits	04	Exam Hours	03
Examination nature (SEE)	Theory		

Course objectives:

- To have a working knowledge of the basic properties of fluids and understand the continuum approximation.
- To Calculate the forces exerted by a fluid at rest on submerged surfaces and understand the force of buoyancy.
- To understand the flow characteristic and dynamics of flow field for various Engineering applications.
- To know how velocity changes and energy transfers in fluid flows are related to forces and torques and to understand why designing for minimum loss of energy in fluid flows is so important.
- To discuss the main properties of laminar and turbulent pipe flow and appreciate their differences and the concept of boundary layer theory.
- Understand the concept of dynamic similarity and how to apply it to experimental modelling.
- To appreciate the consequences of compressibility in gas flow and understand the effects of friction and heat transfer on compressible flows.

Teaching-Learning Process (General Instructions)

These are sample Strategies; that teachers can use to accelerate the attainment of the various course outcomes.

1. Power-point Presentation,
2. Video demonstration or Simulations
3. Chalk and Talk are used for Problem Solving
4. Laboratory Demonstrations and Practical Experiments

MODULE-1

Basics: Introduction, Properties of fluids-mass density, weight density, specific volume, specific gravity, viscosity, surface tension, capillarity, vapour pressure, compressibility and bulk modulus. Concept of continuum, types of fluids etc,pressure at a point in the static mass of fluid, variation of pressure, Pascal's law,Absolute, gauge, atmospheric and vacuum pressures pressure measurement by simple, differential manometers and mechanical gauges.

Fluid Statics: Total pressure and center of pressure for horizontal plane, vertical plane surface and inclined plane surface submerged in static fluid.

MODULE-2

Fluid Kinematics: Types of Flow-steady, unsteady, uniform, non-uniform, laminar, turbulent, one, two and three dimensional, compressible, incompressible, rotational, irrotational, stream lines, path lines, streak lines, velocity components, convective and local acceleration, velocity potential, stream function, continuity equation in Cartesian co-ordinates. Rotation, vorticity and circulation, Laplace equation in velocity potential and Poisson equation in stream function, flow net, Problems.

Laminar and Turbulent flow: Flow through circular pipe, between parallel plates, Power absorbed in viscous flow in bearings, Poiseuille equation.

MODULE-3

Fluid Dynamics: Momentum equation, Impacts of jets- force on fixed and moving vanes, flat and curved. Numericals.Euler's equation, Integration of Euler's equation to obtain Bernoulli's equation,

Bernoulli's theorem, Application of Bernoulli's theorem such as venture meter, orifice meter, rectangular and triangular notch, pitot tube, orifices etc., related numericals. **Loss of head due to friction in pipes,** Major and minor losses, pipes in series and parallel.
MODULE-4
Flow over bodies: Development of boundary layer, Lift and Drag, Flow around circular cylinders, spheres, aerofoils and flat plates, Streamlined and bluff bodies, boundary layer separation and its control. **Dimensional Analysis:** Derived quantities, dimensions of physical quantities, dimensional homogeneity, Rayleigh method, Buckingham Pi-theorem, dimensionless numbers, similitude, types of similitude.
MODULE-5
Compressible flows: Speed of sound, adiabatic and isentropic steady flow, Isentropic flow with area change stagnation and sonic properties, normal and oblique shocks, flow through nozzles. **Introduction to CFD:** Necessity, limitations, philosophy behind CFD, applications

PRACTICAL COMPONENT OF IPCC*(May cover all / major modules)*

Sl.NO	Experiments
1	Determine the viscosity of oil using Red wood viscometer and Say-bolt viscometer. **Can be Demo experiments for CIE**
2	Measurement of pressure using different Manometers for high and low pressure measurements (manometers using different manometric fluids).
3	Working principle of different flow meters and their calibration (orifice plate, venture meter, turbine, Rota meter, electromagnetic flow meter) **Can be Demo experiments for CIE**
4	Determination of head loss in pipes and pipe fittings having different diameters, different materials and different roughness
5	Reynolds apparatus to measure critical Reynolds number for pipe flows
6	Effect of change in cross section and application of the Bernoulli equation
7	Impact of jet on flat and curved plates
8	Measurement of coefficient of pressure distribution on a cylinder at different Reynolds Numbers
9	Effect of change in cross section and application of the Bernoulli equation
10	Working principle of different flow meters for open channel and their calibration
11	Determination of drag and lift co-efficients of standard objects using wind tunnel. **Can be Demo experiments for CIE**
12	Use any CFD package to study the flow over aerofoil/cylinder **Can be Demo experiments for CIE**

Course outcomes (Course Skill Set):
At the end of the course, the student will be able to:
CO1: Identify and calculate the key fluid properties used in the analysis of fluid behavior.
CO2: Understand and apply the principles of pressure, buoyancy and floatation
CO3: Apply the knowledge of fluid dynamics while addressing problems of mechanical and chemical engineering.
CO4: Understand the concept of boundary layer in fluid flow and apply dimensional analysis to form dimensionless numbers in terms of input output variables.
CO5: Understand the basic concept of compressible flow and CFD
CO 6: Conduct basic experiments of fluid mechanics and understand the experimental uncertainties.

Assessment Details (both CIE and SEE)
The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

CIE for the theory component of the IPCC (maximum marks 50)

- IPCC means practical portion integrated with the theory of the course.
- CIE marks for the theory component are **25 marks** and that for the practical component is **25 marks**.
- 25 marks for the theory component are split into **15 marks** for two Internal Assessment Tests (Two Tests, each of 15 Marks with 01-hour duration, are to be conducted) and **10 marks** for other assessment methods mentioned in 22OB4.2. The first test at the end of 40-50% coverage of the syllabus and the second test after covering 85-90% of the syllabus.
- Scaled-down marks of the sum of two tests and other assessment methods will be CIE marks for the theory component of IPCC (that is for **25 marks)**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the theory component of IPCC.

CIE for the practical component of the IPCC

- **15 marks** for the conduction of the experiment and preparation of laboratory record, and **10 marks** for the test to be conducted after the completion of all the laboratory sessions.
- On completion of every experiment/program in the laboratory, the students shall be evaluated including viva-voce and marks shall be awarded on the same day.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to **15 marks**.
- The laboratory test **(duration 02/03 hours)** after completion of all the experiments shall be conducted for 50 marks and scaled down to **10 marks.**
- Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **25 marks**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the practical component of the IPCC.

SEE for IPCC
Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours**)

- The question paper will have ten questions. Each question is set for 20 marks.
- There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
- The students have to answer 5 full questions, selecting one full question from each module.
- Marks scored by the student shall be proportionally scaled down to 50 Marks

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper may include questions from the practical component.

Suggested Learning Resources:

Books

- Fox, R. W., Pitchard,P.J.,and McDonald, A. T., (2010), Introduction to Fluid Mechanics, 7thEdition, John Wiley & Sons Inc.
- Cimbala, J.M., Cengel, Y. A. (2010),Fluid Mechanics: Fundamentals and Applications, McGraw-Hill
- Frank M White., (2016), Fluid Mechanics, 8thEdition , McGraw-Hill

Additional References:

- A text book of Fluid Mechanics and Hydraulic Machines, Dr. R K Bansal, Laxmi publishers
- Fundamentals of Fluid Mechanics, Munson, Young, Okiishi&Hebsch, John Wiley Publicationss, 7th Edition

Web links and Video Lectures (e-Resources):

- Nptel.ac.in
- VTU, E- learning
- MOOCS
- Open courseware

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Industrial visits
- Course seminar
- Term project

Template for Practical Course and if AEC is a practical Course

MECHANICAL MEASUREMENTS AND METROLOGY LAB		Semester	4
Course Code	**BME404**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	**0:0:2:0**	SEE Marks	50
Total Hours of Pedagogy	**15 sessions**	Total Marks	100
Credits	**01**	Exam Hours	03
Examination nature (SEE)	**Practical**		

Course objectives:

1. To illustrate the theoretical concepts taught in Mechanical Measurements & Metrology through experiments.
2. To illustrate the use of various measuring tools measuring techniques.
3. To understand calibration techniques of various measuring devices.

Sl.NO	Experiments
	MECHANICAL MEASUREMENTS:
1	Calibration of Pressure Gauge
2	Calibration of Thermocouple
3	Calibration of LVDT
4	Calibration of Load cell
5	Determination of modulus of elasticity of a mild steel specimen using strain gauges.
	METROLOGY:
6	Measurements using Optical Projector / Toolmaker Microscope.
7	Measurement of angle using Sine Center / Sine bar / bevel protractor
8	Measurement of alignment using Autocollimator / Roller set
	Demonstration Experiments (For CIE)
9	Measurement of cutting tool forces using a) Lathe tool Dynamometer OR b) Drill tool Dynamometer.
10	. Measurements of Screw thread Parameters using two wire or Three-wire methods.
11	Measurements of Surface roughness, Using Tally Surf/Mechanical Comparator
12	Measurement of gear tooth profile using gear tooth Vernier /Gear tooth micrometer

Course outcomes (Course Skill Set):

At the end of the course the student will be able to:

1. To calibrate pressure gauge, thermocouple, LVDT, load cell, micrometer.
2. To measure angle using Sine Center/ Sine Bar/ Bevel Protractor, alignment using Autocollimator/ Roller set.
3. To demonstrate measurements using Optical Projector/Tool maker microscope, Optical flats.
4. To measure cutting tool forces using Lathe/Drill tool dynamometer.
5. To measure Screw thread parameters using 2-Wire or 3-Wire method, gear tooth profile using gear tooth vernier/Gear tooth micrometer.
6. To measure surface roughness using Tally Surf/ Mechanical Comparator.

Template for Practical Course and if AEC is a practical Course

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation (CIE):

CIE marks for the practical course are **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment is to be evaluated for conduction with an observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments are designed by the faculty who is handling the laboratory session and are made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled down to **30 marks** (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct a test of 100 marks after the completion of all the experiments listed in the syllabus.
- In a test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability.
- The marks scored shall be scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and marks of a test is the total CIE marks scored by the student.

Semester End Evaluation (SEE):

- SEE marks for the practical course are 50 Marks.
- SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the Head of the Institute.
- The examination schedule and names of examiners are informed to the university before the conduction of the examination. These practical examinations are to be conducted between the schedule mentioned in the academic calendar of the University.
- All laboratory experiments are to be included for practical examination.
- (Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.
- Students can pick one question (experiment) from the questions lot prepared by the examiners jointly.
- Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.

General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and

scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners) Change of experiment is allowed only once and 15% of Marks allotted to the procedure part are to be made zero. The minimum duration of SEE is 02 hours
Suggested Learning Resources: •

NON TRADITIONAL MACHINING		Semester	IV
Course Code	BME405A	CIE Marks	50
Teaching Hours/Week (L: T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03
Examination nature (SEE)	**Theory**/practical/Viva-Voce /Term-work/Others		

Course Objectives:

- To learn various concepts related to modern machining processes & their applications.
- To appreciate the differences between conventional and non-conventional machining processes.
- To acquire a functional understanding of non-traditional manufacturing equipment.
- To know about various process parameters and their influence on performance and their applications.
- To impart knowledge on various types of energy involved in non-traditional machining processes.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

- Adopt different types of teaching methods to develop the outcomes through PowerPoint presentations and Videodemonstrations or Simulations.
- Chalk and Talk method for Problem Solving.
- Adopt flipped classroom teaching method.
- Adopt collaborative (Group Learning) learning in the class.
- Adopt Problem Based Learning (PBL), which fosters students' analytical skills and develops thinking skills such asevaluating, generalizing, and analyzing information.

Module-1

Introduction to Non-traditional machining

Introduction to Non-traditional machining, Need for Non-traditional machining process, Comparison between traditional and non-traditional machining, general classification Non-traditional machining processes, classification based on nature of energy employed in machining, selection of non-traditional machining processes, Specific advantages, limitations and applications of non-traditional machining processes.

Module-2

Ultrasonic Machining (USM):

Introduction, Equipment and material process, Effect of process parameters: Effect of amplitude and frequency, Effect of abrasive grain diameter, effect of slurry, tool & work material. Process characteristics: Material removal rate, tool wear, accuracy, surface finish, applications, advantages & limitations of USM.

Abrasive Jet Machining (AJM):

Introduction, Equipment and process of material removal, process variables: carrier gas, type of abrasive, work material, stand-off distance (SOD). Process characteristics-Material removal rate, Nozzle wear, accuracy & surface finish. Applications, advantages & limitations of AJM.

Module-3

Electrochemical machining (ECM):

Introduction, Principle of electro chemical machining, ECM equipment, elements of ECM operation, Chemistry of ECM. ECM Process characteristics: Material removal rate, accuracy, surface finish. Process parameters: Current density, Tool feed rate, Gap between tool & work piece, velocity of electrolyte flow, type of electrolyte, its concentration temperature, and choice of electrolytes. ECM Tooling: ECM tooling technique & example, Tool & insulation materials. Applications ECM: Electrochemical grinding and electrochemical honing process. Advantages, disadvantages and application of ECG, ECH.

Chemical Machining (CHM):

Elements of the process, Resists (maskants), Etchants. Types of chemical machining process-chemical

blanking process, chemical milling process. Process characteristics of CHM: material removal rate, accuracy, surface finish, advantages, limitations and applications of chemical machining process.
Module-4
Electrical Discharge Machining (EDM): Introduction, mechanism of metal removal, EDM equipment: spark erosion generator (relaxation type), dielectric medium-its functions & desirable properties, electrode feed control system. Flushing types; pressure flushing, suction flushing, side flushing, pulsed flushing. EDM process parameters: Spark frequency, current & spark gap, surface finish, Heat Affected Zone. Advantages, limitations & applications of EDM, Electrical discharge grinding, Traveling wire EDM. **Plasma Arc Machining (PAM):** Introduction, non-thermal generation of plasma, equipment mechanism of metal removal, Plasma torch, process parameters, process characteristics. Safety precautions. Safety precautions, applications, advantages and limitations.
Module-5
Laser Beam Machining (LBM): Introduction, generation of LASER, Equipment and mechanism of metal removal, LBM parameters and characteristics, Applications, Advantages & limitations. **Electron Beam Machining (EBM):** Introduction, Principle, equipment and mechanism of metal removal, applications, advantages and limitations.
Course outcome (Course Skill Set) At the end of the course, the student will be able to : **CO1: Describe** non-traditional machining process and **compare** with Traditional machining process. R**ecognize** the need for Non-traditional machining process. **CO2: Describe** the constructional features, performance parameters, process characteristics, applications, advantages, and limitations of USM, AJM and WJM. **CO3: Characterize** the need of Chemical and electro-chemical machining process along with the constructional features, process parameters, process characteristics, applications, advantages, and limitations. **CO4: Illustrate** the constructional feature of the equipment, process parameters, process characteristics, applications, advantages and limitations EDM & PAM

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Books

TEXT BOOKS:

1. Modern Machining Process by P.C Pandey and H S Shah, McGraw Hill Education India Pvt. Ltd. 2000
2. Wellar, E.J. "Non-Traditional Machining Processes", Society of Manufacturing Engineers Publications, 2nd Edition, Michigan, 1984.
3. Non Traditional Manufacturing Processes, by Gary F Benedict, Taylor & Francis

REFERENCE BOOKS:

1. Production technology, HMT, McGraw Hill Education India Pvt. Ltd. 2001
2. New Technology, Dr. Amitabha Bhattacharyya, The Institute of Engineers (India), 2000
3. Modern Machining process, Aditya, 2002.
4. Non-Conventional Machining, P.K.Mishra, The Institution of Engineers (India) Test book series, Narosa Publishing House – 2005.
5. Metals Handbook: Machining Volume 16, Joseph R. Davis (Editor), American Society of Metals (ASM)
6. Gary F. Benedict, ―Nontraditional manufacturing processes‖, Marcel Dekker, Inc. 1987.

Web links and Video Lectures (e-Resources):
• https://nptel.ac.in/courses/112105127
Activity Based Learning (Suggested Activities in Class)/ Practical Based learning •

ENVIRONMENTAL STUDIES		Semester	IV
Course Code	**BME405B**	CIE Marks	50
Teaching Hours/Week (L: T:P: S)	**3:0:0:0**	SEE Marks	50
Total Hours of Pedagogy	**40 hr**	Total Marks	100
Credits	**03**	Exam Hours	3
Examination type (SEE)	**Theory**		

Course objectives:

To impart the knowledge and awareness for the environmental protection for real-time contribution during an execution of engineering practices in the society.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

- Visit to a local area to document environmental assets/ecosystems-River/forest/grassland/mountain
- Construction of Food chain/food web of the visited area
- To identify the sources of air/water/soil/noise pollution of any area.

Module-1

Introduction to Environmental Studies:

Multidisciplinary nature of environmental studies.

Scope and importance; Concept of sustainability and sustainable development.

Ecosystems: Structure and function of ecosystem; Energy flow in an ecosystem: food chains, food webs and ecological succession. Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Module-2

Natural Resources: Renewable and Non-Renewable Resources:

Land resources and land-use change; Land degradation, soil erosion and desertification.

Deforestation: Causes and impacts due to mining, dam building on environment, forests, biodiversity and tribal populations.

Water: Use and over-exploitation of surface and ground water, floods, droughts, conflicts over water (International & Inter-state).

Energy resources: Renewable and non-renewable energy sources, use of alternate energy sources, growing energy needs, case studies.

Module-3

Biodiversity and Conservation:

Levels of biological diversity: Genetic, species and ecosystem diversity; Biogeographic zones of India; Biodiversity patterns and global biodiversity hotspots.

India as a mega-biodiversity nation; Endangered and endemic species of India.

Threats to biodiversity: Habitat loss, poaching of wildlife, man-wildlife conflicts, biological invasions; Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

Ecosystem and biodiversity services: Ecological, economic, social, ethical, aesthetic and Informational value.

Environmental Pollution

Environmental Pollution: Types, causes, effects and controls; Air, water, soil and noise pollution.

Nuclear hazards and human health risks.

Solid waste management, Control measures of urban and industrial waste.

Module-4

Environmental Policies and Practices

Climate change, global warming, ozone layer depletion, acid rain and impacts on human communities and agriculture.

Environment Laws: Environment Protection Act; Air (Prevention & Control of Pollution) Act; Water (Prevention and Control of Pollution) Act; Wildlife (Protection) Act; Forest Conservation Act.

International agreements: Montreal and Kyoto protocols and Convention on Biological Diversity (CBD).
Nature reserves, tribal populations and rights, and human wildlife conflicts in Indian context.

Module-5

Human Communities and the Environment
Human population growth: Impacts on environment, human health and welfare.
Resettlement and rehabilitation of project affected persons; case studies.
Disaster management: Floods, Earthquake, Cyclones and Landslides.
Environmental movements: Chipko, Silent valley, Bishnois of Rajasthan.
Environmental ethics: Role of Indian and other religions and cultures in environmental conservation.
Environmental communication and public awareness, case studies (e.g., CNG vehicles in cities).

Course outcome (Course Skill Set)

At the end of the course, the student will be able to :
CO1: Understand the basic concepts of environmental studies and natural resources.
CO2: Explain about the various eco-systems of nature.
CO3: Discuss different types of environmental pollutions and their control measures.
CO4: Explain the acquired knowledge about the various social aspects related to the environment.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

- The question paper will have ten questions. Each question is set for 20 marks.
- There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
- The students have to answer 5 full questions, selecting one full question from each module.
- Marks scored shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Text Books:

1. Benny Joseph (2005)., *Environmental Studies*, New Delhi, Tata McGraw Hill Publishing co.Ltd
2. Erach Bharucha (2005)., *Textbook of Environmental Studies for Undergraduate Courses*,Hyderabad, Universities Press.

Reference Books:

1. Anji Reddy .M (2007), *Textbook of Environmental Sciences and Technology*, Hyderabad, BS Publications.
2. Y Anjaneyulu.(2004), Introduction to *Environmental Sciences*, BS Publications.
3. Climate Change: Science and Politics. (2021). Centre Science and Environment, New Delhi.
4. Gadgil, M., & Guha, R. (1993). This Fissured Land: An Ecological History of India. Univ. of California Press.
5. Gleeson, B. and Low, N. (eds.) (1999). Global Ethics and Environment, London, Routledge.
6. Groom, Martha J., Gary K. Meffe, and Carl Ronald Carroll. (2006). Principles of Conservation Biology. Sunderland: Sinauer Associates.
7. Nandini, N., Sunitha N., & Sucharita Tandon. (2019). A text book on Environmental Studies (AECC). Sapna Book House, Bengaluru.
8. Rosencranz, A., Divan, S., & Noble, M. L. (2001). Environmental law and policy in India.

Web links and Video Lectures (e-Resources):

- .www.eco-prayer.org
- www.teriin.org
- www.cpcb.nic.in
- www.indiaenvironmentportal.org.in
- www.sustainabledevelopment.un.org
- www.conserve-energy-future.com

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Study of common plants, insects, birds, and basic principles of identification.
- Study of simple ecosystems – pond, river, etc.

MEMS-Micro Electro Mechanical Systems		Semester	IV
Course Code	BME 405C	CIE Marks	50
Teaching Hours/Week (L: T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03
Examination type (SEE)	**Theory**/practical/Viva-Voce /Term-work/Others		

Course objectives:

1. Students are exposed to the MEMS technology & Miniaturization.
2. Students will understand the Process of Micro fabrication Techniques.
3. Students are made to understand the principles of system modelling.
4. Students are made to understand the working principles of Mechanical sensors and actuators.
5. Students are made to understand the working principles of Micro-Opto-Electro Mechanical Systems.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Power Point Presentation,
2. Chalk and Talk are used for Derivations and Correlations (In-general).
3. Video demonstration or Simulations.

Module-1

MEMS: Introduction, Production Engineering, Precision Engineering and Ultra- Precision Engineering, Integrated circuits, Micro Electro Mechanical Systems.

Module-2

Micromachining: Introduction, Photo Lithography, Structural and Sacrificial Materials, Etching, Surface Micromachining, Bulk versus Surface Micromachining, Wafer Bonding, LIGA.

Module-3

System Modelling: Introduction, Need for Modelling, System types, Basic Modelling Elements In Mechanical System, Basic Modelling Elements In Electrical Systems, Basic Modelling Elements In Fluid Systems and Thermal Systems.

Module-4

Mechanical sensors and actuators: Introduction, Principles of Sensing and Actuation, Beam and Cantilever, Micro Plates, Capacitive Effects, Piezo Electric Material as Sensing and Actuating Elements.

Module-5

Micro-Opto-Electro Mechanical Systems: Introduction, Fundamental Principles of MOEMS Technology, Review on Properties of Light, Light Modulators, Micro mirrors, Digital Micro mirror Device.

Course outcome (Course Skill Set):

At the end of the course, the student will be able to :

1. Understand the working of MEMS technology & Miniaturization.
2. Explain the Process of Micro fabrication Techniques.
3. Explain the principles of system modelling.
4. Understand the working principles of Mechanical sensors and actuators.
5. Describe the working principles of Micro-Opto-Electro Mechanical Systems

Assessment Details (both CIE and SEE) :

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

- The question paper will have ten questions. Each question is set for 20 marks.
- There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
- The students have to answer 5 full questions, selecting one full question from each module.
- Marks scored shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Books

1. MEMS- Nitaigour Premchand Mahalik, TMH 2007.
2. Micro and Smart Systems: G.K.Ananthasuresh, K.J.Vinoy, S.Gopalakrishnan, K.N.Bhat,V.K.Aatre,Wiley India 2010.
3. Design and Development Methodogies, Smart Material Systems and MEMS: V. Varadan, K. J. Vinoy, S. Goplakrishnan, Wiley.
4. MEMS & Microsystems: Design and Manufacture, Tai-Ran Hsu, Tata Mc-Graw-Hill.

Web links and Video Lectures (e-Resources):

- VTU e-Shikshana Program
- VTU EDUSAT Program.

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Gaining hands on Knowledge to work on ANSYS Tool
- Simulation of Cantilever Beam For Different Loads On ANSYS Tool.

ROBOTICS AND AUTOMATION		Semester	IV
Course Code	**BME405D**	CIE Marks	50
Teaching Hours/Week (L: T:P: S)	**3:0:0**	SEE Marks	50
Total Hours of Pedagogy	**40**	Total Marks	100
Credits	**03**	Exam Hours	3
Examination type (SEE)	**Theory**		

Course objectives:

- Gain knowledge of Robotics and automation.
- Understand the working methodology of robotics and automation.
- Write the program for robot for various applications

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Through Power Point Presentations and Video demonstrations or Simulations.
2. Chalk and Talk method for Problem Solving.
3. Encourage collaborative (Group) Learning in the class.
4. Ask at least three higher order Thinking questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.

Module-1

Industrial Automation: Definition, Types of automation, List basic Devices in Automated Systems, Distinguish Different Controllers Employed In Automated Systems. Identify Safety in Industrial Automation

Basic Concepts: Definition and origin of robotics – different types of robotics – various generations of robots – degrees of freedom – Asimov's laws of robotics

Module-2

Fundamentals of Robotics: robot anatomy, work volume, robot drive systems, control systems, precision of movement, end effectors, Introduction to Manipulator kinematics, Robot Dynamics.

Basic control systems and components: Basic control systems concepts and models, Controllers, control system analysis,

Module-3

Robot End Effector: Types of End effectors, Mechanical Grippers, Other types of Grippers, Tools and End effector, The Robot/End effector interface Consideration in Gripper selecting and Design.

Sensors in Robotics: Transducers and sensors, sensors in robotics, tactile sensors, proximity and range sensors, uses of sensors in robotics.

Module-4

Robot Programming: Methods of robot programming, lead -through programming methods, a robot program as a path in space, motion interpolation, wait, signal and delay commands, branching, capabilities and limitations of lead-through methods.

Module-5

Material handling and Identification Technologies: Overview of Material Handling Systems, Principles and Design Consideration, Material Transport Systems, Storage Systems, Overview of Automatic Identification Methods.

Course outcome (Course Skill Set)

At the end of the course, the student will be able to :

CO 1: Explain various types of Robotics, automation, robotics motion, sensors and control, machine vision, robotic programming and roles of robots in industry.

CO 2: Understand the working methodology of robotics and automation, motion and control, machine vision and programming, application of robots in industry.

CO 3: Write the program for robot for various applications.

CO 4: Describe the different material handling and Identification technologies used in automation

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

- The question paper will have ten questions. Each question is set for 20 marks.
- There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
- The students have to answer 5 full questions, selecting one full question from each module.
- Marks scored shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Books

1. Mikell P. Groover, Mitchel Weiss, Roger N. Nagel, Nicholas G. Odrey and Ashish Dutta, "Industrial Robotics: Technology, Programming and Applications", 2 nd Edition, Tata McGraw Hill, 2012.
2. Roland Siegwart, Illah R. Nourbakhsh, an d Davide Scaramuzza, "Introduction to Autonomous Mobile Robots", 2 nd Edition, PHI, 2011

Web links and Video Lectures (e-Resources):

- NPTEL course on Industrial Robotics
- Videos on Industrial Automation

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Visit any automated production Industry understand the importance and applications of Robots in Automated Industry

INTRODUCTION TO AI & ML		Semester	IV
Course Code	BME456A	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	0:0:2:0	SEE Marks	50
Total Hours of Pedagogy	15 sessions	Total Marks	100
Credits	01	Exam Hours	03
Examination type (SEE)	PRACTICAL		

Course objectives:

- Make use of Data sets in implementing the machine learning algorithms
- Implement the machine learning concepts and algorithms in any suitable language of choice.
- Analyse the working of various documents like PDF, Word file

Sl.NO	Experiments
1	Implement A* Search algorithm.
2	Implement AO* Search algorithm.
3	Write a program to implement Water jug program using AI.
4	The probability that it is Friday and that a student is absent is 3 %. Since there are 5 school days in a week, the probability that it is Friday is 20 %. What is the probability that a student is absent given that today is Friday? Apply Baye's rule in python to get the result.
5	Implement and demonstrate the FIND-S algorithm for finding the most specific hypothesis based on a given set of training data samples. Read the training data from a .CSV file.
6	For a given set of training data examples stored in a .CSV file, implement and demonstrate the Candidate-Elimination algorithm to output a description of the set of all hypotheses consistent with the training examples.
7	Build an Artificial Neural Network by implementing the Backpropagation algorithm and test the same using appropriate data sets.
8	Write a program to construct a Bayesian network considering medical data. Use this model to demonstrate the diagnosis of heart patients using standard Heart Disease Data Set. You can use Java/Python ML library classes/API
	Demonstration Experiments (For CIE)
9	Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.

Course outcomes (Course Skill Set):

- Understand the implementation procedures for the machine learning algorithms
- Design Java/Python programs for various Learning algorithms.
- Apply appropriate data sets to the Machine Learning algorithms
- Identify and apply Machine Learning algorithms to solve real world problems
- Examine working of PDF and word file formats

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation (CIE):

CIE marks for the practical course are**50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment is to be evaluated for conduction with an observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments are designed by the faculty who is handling the laboratory session and are made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled down to **30 marks** (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct a test of 100 marks after the completion of all the experiments listed in the syllabus.
- In a test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability.
- The marks scored shall be scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and marks of a test is the total CIE marks scored by the student.

Semester End Evaluation (SEE):

- SEE marks for the practical course are 50 Marks.
- SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the Head of the Institute.
- The examination schedule and names of examiners are informed to the university before the conduction of the examination. These practical examinations are to be conducted between the schedule mentioned in the academic calendar of the University.
- All laboratory experiments are to be included for practical examination.
- (Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.
- Students can pick one question (experiment) from the questions lot prepared by the examiners jointly.
- Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.

General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)

Change of experiment is allowed only once and 15% of Marks allotted to the procedure part are to be made zero.

The minimum duration of SEE is 03 hours

Suggested Learning Resources:

1. Tom M Mitchell,“Machine Lerning”,1 st Edition, McGraw Hill Education, 2017.
2. 2. Elaine Rich, Kevin K and S B Nair, “Artificial Inteligence”, 3rd Edition, McGraw Hill Education, 2017.

Digital Marketing		Semester	IV
Course Code	**BME456B**	CIE Marks	50
Teaching Hours/Week (L: T:P: S)	**1:0:0:0**	SEE Marks	50
Total Hours of Pedagogy	**15**	Total Marks	100
Credits	**01**	Exam Hours	01
Examination type (SEE)	**Theory**		

Course objectives:

- To focuses on the importance of digital marketing and its applications and to introduce current and core practices of Digital and Social Media Marketing that will allow learners to analyse, plan, execute and evaluate a digital marketing strategy.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

- Adopt different types of teaching methods to develop the outcomes through PowerPoint presentations and Video demonstrations.
- Adopt flipped classroom teaching method.
- Adopt collaborative (Group Learning) learning in the class.

Module-1

Introduction to Digital Marketing (DM)-Meaning, Definition, Need of DM, Scope of DM, History of DM, Concept and approaches to DM, Examples of good practices in DM. Email Marketing-Need for Emails, Types of Emails, options in Email advertising, Mobile Marketing.

Module-2

Social Media Marketing -Introduction to Blogging. Introduction to Face book, Twitter, Google +, LinkedIn, YouTube, Instagram and Pinterest; their channel advertising and campaigns.

Module-3

Acquiring & Engaging Users through Digital Channels: Understanding the relationship between content and branding and its impact on sales, search engine marketing, mobile marketing, video marketing, and social-media marketing.

Module-4

Designing Organization for Digital Success: Digital transformation, digital leadership principles, online P.R. and reputation management. ROI of digital strategies, how digital marketing is adding value to business, and evaluating cost effectiveness of digital strategies

Module-5

Digital Innovation and Trends: The contemporary digital revolution, digital transformation framework; security and privatization issues with digital marketing, Understanding trends in digital marketing – Indian and global context, online communities and co-creation.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous internal Examination (CIE)

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examinations (SEE)

SEE paper shall be set for 50 questions, each of the 01 marks. The pattern of the question paper is MCQ (multiple choice questions). The time allotted for SEE is **01 hour.** The student has to secure a minimum of 35% of the maximum marks meant for SEE.

OR

MCQ (Multiple Choice Questions) are preferred for 01 credit courses, however, if course content demands the general question paper pattern that followed for 03 credit course, then

- The question paper will have ten questions. Each question is set for 10 marks.
- There will be 2 questions from each module. Each of the two questions under a module may or may not have the sub-questions (with maximum sub-questions of 02, with marks distributions 5+5, 4+6, 3+7).
- The students have to answer 5 full questions, selecting one full question from each module.

Suggested Learning Resources:

Books

1. Fundamentals of Digital Marketing by Puneet Singh Bhatia, Pearson
2. Moutsy Maiti: Internet Marketing, Oxford University Press India
3. Vandana, Ahuja; Digital Marketing, Oxford University Press India (November, 2015).
4. Eric Greenberg, and Kates, Alexander; Strategic Digital Marketing: Top Digital Experts
5. Share the Formula for Tangible Returns on Your Marketing Investment; McGraw-Hill
6. Professional (October, 2013).
7. Ryan, Damian; Understanding Digital Marketing: marketing strategies for engaging the
8. digital generation; Kogan Page (3rd Edition, 2014).
9. Tracy L. Tuten & Michael R. Solomon: Social Media Marketing (Sage Publication)

Web links and Video Lectures (e-Resources):

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Activity Based Learning (Suggested Activities in Class)/ Practical Based learning
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INTRODUCTION TO DATA ANALYTICS		Semester	IV
Course Code	BME456C	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	0:0:2:0	SEE Marks	50
Total Hours of Pedagogy	15 sessions	Total Marks	100
Credits	01	Exam Hours	03
Examination type (SEE)	Practical		

Course objectives:

- To understand Numpy, Pandas and Matplot library
- To understand basics of statistics
- To learn the basic of decision tree algorithm.
- To understand random forest algorithm and Anova
- To use Python data structures.
- To use excel in data analytics

Sl.NO	Experiments
1	Use Numpy to create single and multi-dimensional array and perform various operations using Python.
2	Use Pandas to access dataset, cleaning, manipulate data and analyze using Python
3	Use matplot library to plot graph for data visualization using Python
4	Determine probability, sampling and sampling distribution using Python
5	Determine frequency distributions, variability, average, and standard deviation using Python
6	Draw normal curves, correlation, correlation coefficient and scatter plots using Python
7	Implement and analyze Linear regression in Python (Single variable & Multivariable)
8	Implement and analyze Logistic regression in Python
9	Implement and analyze Decision tree algorithm in Python
10	Implement and analyze Random Forest algorithm in Python
	Only for CIE
11	Implementation of two samples T-test and paired two-sample T-test in excel.
12	Implementation of one-way and two-way ANOVA in excel.

Course outcomes (Course Skill Set):

At the end of the course the student will be able to:

- CO1: Analyze data using tools and represent for visualization
- CO2: Implement various statistical methods.
- CO3: Understand and use decision tree and random forest algorithm
- CO4: Understand and Implement T test and Anova

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation (CIE):

CIE marks for the practical course are **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment is to be evaluated for conduction with an observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments are designed by the faculty who is handling the laboratory session and are made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled down to **30 marks** (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct a test of 100 marks after the completion of all the experiments listed in the syllabus.
- In a test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability.
- The marks scored shall be scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and marks of a test is the total CIE marks scored by the student.

Semester End Evaluation (SEE):

- SEE marks for the practical course are 50 Marks.
- SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the Head of the Institute.
- The examination schedule and names of examiners are informed to the university before the conduction of the examination. These practical examinations are to be conducted between the schedule mentioned in the academic calendar of the University.
- All laboratory experiments are to be included for practical examination.
- (Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.

- Students can pick one question (experiment) from the questions lot prepared by the examiners jointly.
- Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.

- General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)
- Change of experiment is allowed only once and 15% of Marks allotted to the procedure part are to be made zero.

The minimum duration of SEE is 02 hours

Suggested Learning Resources:

- McKinney, W. (2012). Python for data analysis: Data wrangling with Pandas, NumPy, and IPython. " O'Reilly Media, Inc.".
- Swaroop, C. H. (2003). A Byte of Python. Python Tutorial.
- Ken Black, sixth Editing. Business Statistics for Contemporary Decision Making. “John Wiley & Sons, Inc”
- https://www.simplilearn.com/tutorials/data-analytics-tutorial/data-analytics-with-python
- https://www.youtube.com/watch?v=GPVsHOlRBBI&ab_channel=freeCodeCamp.org

Introduction to programming in C++		Semester	IV
Course Code	**BME456D**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	0:0:2:0	SEE Marks	50
Total Hours of Pedagogy	**15 sessions**	Total Marks	100
Credits	01	Exam Hours	03
Examination type (SEE)	Practical		

Course objectives:

- To learn object-oriented programming concepts using the C++ language.
- To apply the principles of data abstraction, inheritance and polymorphism;
- To use the principles of virtual functions and polymorphism
- To learn how to handle formatted I/O and unformatted I/O

Sl.NO	Experiments
1	Write a C++ Program to display Names, Roll No., and grades of 3 students who have appeared in the examination. Declare the class of name, Roll No. and grade. Create an array of class objects. Read and display the contents of the array.
2	Write a C++ program to declare Struct. Initialize and display contents of member variables.
3	Write a C++ program to declare a class. Declare pointer to class. Initialize and display the contents of the class member.
4	Given that an EMPLOYEE class contains following members: data members: Employee number, Employee name, Basic, DA, IT, Net Salary and print data members.
5	Write a C++ program to read the data of N employee and compute Net salary of each employee (DA=52% of Basic and Income Tax (IT) =30% of the gross salary).
6	Write a C++ to illustrate the concepts of console I/O operations.
7	Write a C++ program to use scope resolution operator. Display the various values of the same
8	Write a C++ program to create an array of pointers. Invoke functions using array objects.
	Demonstration Experiments (For CIE)
9	Write a C++ program for Vehicle reservation system
10	Write a C++ program to Create a Modern Periodic Table
11	Write a C++ program to Develop a Bookshop inventory
12	Write a C++ program for Credit Card Validation System

Course outcomes (Course Skill Set):

At the end of the course the student will be able to:

CO1: Apply Object Oriented Programming concepts in C++

CO2: Write a C++ program by applying knowledge of mathematics, science, and engineering.

CO4: Function on multi-disciplinary teams.

CO5: Identify, formulate, and solve engineering problems.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation (CIE):

CIE marks for the practical course are **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment is to be evaluated for conduction with an observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments are designed by the faculty who is handling the laboratory session and are made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled down to **30 marks** (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct a test of 100 marks after the completion of all the experiments listed in the syllabus.
- In a test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability.
- The marks scored shall be scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and marks of a test is the total CIE marks scored by the student.

Semester End Evaluation (SEE):

- SEE marks for the practical course are 50 Marks.
- SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the Head of the Institute.
- The examination schedule and names of examiners are informed to the university before the conduction of the examination. These practical examinations are to be conducted between the schedule mentioned in the academic calendar of the University.
- All laboratory experiments are to be included for practical examination.
- (Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.
- Students can pick one question (experiment) from the questions lot prepared by the examiners jointly.
- Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.
- General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100

marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)

- Change of experiment is allowed only once and 15% of Marks allotted to the procedure part are to be made zero.
- The minimum duration of SEE is 02 hours

Suggested Learning Resources:

1. The C++ Programming Language, 3rd Edition, B. Stroutstrup, Pearson Education.
2. OOP in C++, 3rd Edition, T. Gaddis, J. Walters and G. Muganda, Wiley Dream Tech Press.
3. Object Oriented Programming in C++, 3rd Edition, R. Lafore, Galigotia Publications Pvt Ltd.