CURRICULUM STRUCTURE

SECOND YEAR UG: B.E.

ELECTRONICS AND COMPUTER SCIENCE

REVISION: FRCRCE-1-24

Effective from Academic Year 2024-25

Board of Studies Approval: 09/03/2024

Academic Council Approval: 16/03/2024

Dr. DEEPAK BHOIR	Dr. SAPNA PRABHU	DR. SURENDRA RATHOD
Dean Academics	HoD (ECS)	Principal

Preamble:

Greetings and congratulations to all the education partners Fr Conceicao Rodrigues College of Engineering for getting autonomous status to the college from the year 2024-25. University Grant Commission vide letter No. F. 2-10/2023(AC-Policy) dated 23rd Nov 2023 conferred the autonomous status to Fr. Conceicao Rodrigues College of Engineering, Fr. Agnel Ashram, Bandstand, Bandra (West), Mumbai 400050 affiliated to University of Mumbai for a period of 10 years from the academic year 2024-2025 to 2033-2034 as per clause 7.5 of the UGC (Conferment of Autonomous Status Upon Colleges and Measures for Maintenance of Standards in Autonomous Colleges) Regulations,2023. We look towards autonomy as a great opportunity to design and implement curriculum sensitive to needs of Learner, Indian Society and Industries.

Government of Maharashtra has also directed Autonomous Colleges to revise their curriculum in line with National Education Policy (NEP) 2020 through Government Resolution dated 4th July 2023. We commit to ourselves to the effective implementation of UGC Regulations and NEP 2020 in its spirit.

Based on recent recommendations of the GR, we are pleased to offer our holistic curriculum for 2024-28, a "**H-Tree Model"** of Engineering Education. A unique **"H-Tree Model"** of Engineering Education Curriculum is carefully designed to systematically develop IQ (Intelligence Quotient), PQ (Physical Quotient), EQ (Emotional Quotient) and SQ (Spiritual Quotient) of a learner. This curriculum aims at the development of an **all-rounded** personality with **holistic** approach to education in which learner receives **25% teacher-led learning, 25% peer learning, 25% self-learning and 25% experiential learning**. The curriculum model is outcome based that focuses on learning by doing. Curriculum is designed to provide multiple learning opportunities for students to acquire and demonstrate competencies for rewarding careers. It ensures multiple choices to leaner acquiring skills through systematic planning. It has 7 verticals aligned to GR recommendations with strong science, and mathematics foundation and program core, sequel of electives, Multidisciplinary Minor courses, humanities & management courses and sufficient experiential learning through projects and semester-long industry / research internship along with employable skill-based courses. Learner gets an opportunity to acquire skills through NSDC aligned courses during summer vacations. Learner also gets additional option to choose the kind of degree i.e. Honors or Double Minor or Honors with Research.

Various steps are taken to transform teaching learning process to make learning a joyful experience for students. We believe that this curriculum will raise the bar of academic standards with the active involvement and cooperation from students, academic and administrative units.

Curriculum Structure for UG Programs at Fr CRCE w.e.f. A.Y. 2024-25

Credit

Nomenclature of the courses in the curriculum	
Abbreviation	**Title**
BSESC	Basic Science & Engineering Science Courses
PCPEC	Program Core and Program Elective Courses
MDC	Multidisciplinary Courses
SC	Skill Courses
HSSM	Humanities, Social Sciences and Management
EL	Experiential Learning
LLC	Liberal Learning Courses
BSC	Basic Science Courses
ESC	Engineering Science Courses
PCC	Program Core Courses
PEC	Program Elective Courses
MDM	Multidisciplinary Minor
OE	Open Elective
VSEC	Vocational and Skill Enhancement Course
VSC	Vocational Skill Courses
SEC	Skill Enhancement Courses
AEC	Ability Enhancement Course
EEMC	Entrepreneurship, Economics and Management Course
IKS	Indian Knowledge System
VEC	Value Education
RM	Research Methodologies
CEFP	Community Engagement or Field Project
ELC	Experiential Learning Courses
PRJ	Project
INT	Internship
CC	Cocurricular Courses
HMM	Honors and Multidisciplinary Minor
DM	Double Minor
BC	Bridge Course

Specification:

- Theory: 1 credit=13 to 15 hrs of teaching
- Lab: 1 Credit=26 to 30 hrs of lab work
- Studio Activities: 1 Credit= 26 to 30 hrs of creative activities
- Workshop Based Activities: 1 Credit=26 to 30 hrs of hands-on activities related to vocation/professional practice/skill based
- Seminar/Group Discussion: 1 Credit=13 to 15 hrs of participation
- Internship: 1 Credit=Per 2 weeks OR 36 to 40 hrs of engagement
- Field Based Learning/Practices: 1 Credit=26 to 30 hrs of learning activities
- Community Engagement Projects: 1 Credit=26 to 30 hrs of contact time along with 13 to 15 hrs of activities preparation, report writing, independent reading etc.

Credit requirements for different options of the Degrees:

Degree/SEM	I	II	III	IV	V	VI	VII	VIII	Total
B.E	18	20	20+6#	20+8#	20	20	20	20	158+14#=172
B.E with Honors/Minors	18	20	20+6#	20+8#	20+4*	20+4*	20+6*	20+4*	158+14#+18*=190

 # Bridge courses
**Optional Credits*

1. Learners who earn a minimum of total **172 credits** will be awarded "**Bachelor of Engineering**" degree.

2. Learners will have the following options to earn **B. E. in ……(regular) Engineering with Honours/Minor in …….. (specialization)**

Sr. No.	Honors/Minor degree programs	Programs who can offer this Honours Degree Program	Programs who can offer this as Minor Degree program
1	Internet of Things	1. Computer Engineering 2. Artificial Intelligence & Data Science 3. Electronics and Computer Science	--
2	Artificial Intelligence and Machine Learning	1. Computer Engineering 2. Electronics and Computer Science	Mechanical Engineering
3	Data Science	1. Computer Engineering 2. Electronics and Computer Science	
4	Blockchain	1. Computer Engineering 2. Artificial Intelligence & Data Science 3. Electronics and Computer Science	Mechanical Engineering
5	Cyber Security	1. Computer Engineering 2. Artificial Intelligence & Data Science 3. Electronics and Computer Science	Mechanical Engineering
6	Robotics	Mechanical Engineering	1. Computer Engineering 2. Artificial Intelligence & Data Science 3. Electronics and Computer Science
7	3D Printing	Mechanical Engineering	1. Computer Engineering 2. Artificial Intelligence & Data Science 3. Electronics and Computer Science

3. **Honours and Minor Degree Eligibility Criteria for Students:**

i. Following is the eligibility criteria for students opting the Honours/ Minor Degree program:

a. Students with no backlog in semester I, II, and III

b. The CGPI (based on semester I, II, and III) of the students must be 6.75 and above

c. For direct second year (DSE) admitted students - No backlog in semester III and CGPI must be 6.75 and above

ii) Each eligible student can opt for maximum one Honour's or one Minor Programs at any time.

iii) However, it is optional for leaners to take Honours/Minor degree program.

iv) The Honours/ Minor degree program can be opted only during regular engineering studies

v) The student shall complete the Honours/ Minor degree program in stipulated four semesters only.

4.Courses offered during internship semester shall be in online mode

5. Learner can earn additional credits by enrolling to skill courses offered in summer. College shall explore feasibility to offer NSDC aligned skill-based courses to the learners

6. Technical support team for registration of Academic Bank of Credits (ABC), registration of elective/optional courses, registration of online courses, registration for degree options etc. under supervision of Dean Academics.

Salient Features of Curriculum:

- ✓ Framed as per Government Resolution dated 4th July 2023 in line with National Education Policy (NEP) 2020.
- ✓ Minimum 172 choice-based credit structure with options of Degrees earning additional credits
- ✓ Unique 'H-Tree' Model of Curriculum: Hybrid model for holistic development with happy learning environment having bridge connecting verticals providing unique path for each learner for 3-dimensional growth, Life Long Learning, bridge courses, inclusive model indicating equal distribution of central resources
- ✓ More emphasis on laboratory based and experiential learning
- ✓ More weightage to continuous assessment to reduce examination stress
- ✓ Mandatory Semester-long internship, courses with emotional & spiritual learning and skill-based learning aligned with NSDC framework
- ✓ Well balanced curriculum to attain Program Outcomes and skills of 21st century learner
- ✓ Curriculum is designed to create excitement among learners for education through stories, activities, collaboration, hackathon, contest, case studies, creative art etc.
- ✓ Curriculum is designed to make graduates responsible citizens of country with future ready skills to handle challenges of 21st Century

Society of St. Francis Xavier, Pilar's
Fr. Conceicao Rodrigues College of Engineering
Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
(Autonomous College affiliated to University of Mumbai)

SEMESTERWISE CURRICULUM STRUCTURE

SECOND YEAR Electronics and Computer Science Program:

SEM-III

Course Code	Course Vertical	Sub-Vertical	Course Name		Contact Hours	Examination Marks (1 Credit=50 Marks)					Credits	
						ISE 1	MSE	ISE 2	ESE	Total	Points	Total
BSC12EC05	BSESC	BSC	Signals and Systems	TH	2	20	30	20	30	100	2	3
				TU	1	20	-	30	-	50	1	
PCC12EC05	PCPEC	PCC	Electronic Devices	TH	2	20	30	20	30	100	2	2
PCC12EC06	PCPEC	PCC	Computer Organisation and Architecture	TH	2	20	30	20	30	100	2	3
				PR	2	20	-	30	-	50	1	
PCC12EC07	PCPEC	PCC	Object Oriented Programming with JAVA Lab	PR	2	20	-	30	-	50	1	1
MDM01	MDC	MDM	Law for Engineers	TH	2	50	-	50	-	100	2	2
OEEC11	MDC	OE	Database Management Systems	TH	1	10	15	10	15	50	1	2
				PR	2	20	-	30	-	50	1	
OEEC21	MDC	OE	Software Engineering for Web Applications	TH	1	10	15	10	15	50	1	2
				PR	2	20	-	30	-	50	1	
EEM12EC01	HSSM	EEMC	Financial Planning, Taxation and Investment	TH	2	50	--	50	--	100	2	2
VEC12EC01	HSSM	VEC	Human Values and Professional Ethics	TH	1	50	-	50	-	100	1	2
				PR	2						1	
CEP12EC01	EL	CEFP	Community Engagement Project	PRJ	4	50	-	50	-	100	2	2
LLCXX	LLC	CC	One Course from CC	PR	2	-	-	50	-	50	2	1
PCC11EC03	BC	BC	Digital Electronics	TH	2	20	30	20	30	100	2	3*
				PR	2	20	-	30	-	50	1	
PCC11EC01	BC	BC	Innovation and Design Thinking	PR	2	20	-	30	-	50	1	1*
				Total	**TH:TU:PR 15:2:20=37**			-	-	**1000+300 ***	-	**22+4 ***

* Introduced as Bridge Courses to fulfil Credit Requirements of University of Mumbai

SEM-IV

Course Code	Course Vertical	Sub-Vertical	Course Name		Contact Hours	Examination Marks (1 Credit=50 Marks)					Credits	
						ISE 1	MSE	ISE 2	ESE	Total	Points	Total
BSC12EC06	BC	BC	Mathematics and Numerical Methods	TH	2	20	30	20	30	100	2	3
				TU	1	20	-	30	-	50	1	
PCC12EC08	PCPEC	PCC	Analog Electronics	TH	2	20	30	20	30	100	2	3
				PR	2	20	-	30	-	50	1	
PCC12EC09	PCPEC	PCC	Discrete Structures and Automata Theory	TH	2	20	30	20	30	100	2	3
				TU	1	20	-	30	-	50	1	
PCC12EC10	PCPEC	PCC	Embedded Systems	PR	2	20	-	30	-	50	1	1
MDM02	MDC	MDM	Emerging Technology and Law	TH	2	50	-	50	-	100	2	2
OEEC31	MDC	OE	Operating Systems	TH	1	10	15	10	15	50	1	2
				PR	2	20	-	30	-	50	1	
VSE12EC03	SC	VSEC	Data Structures	PR	4	50	-	50	-	100	2	2
AEC12EC02	HSSM	AEC	Modern Indian Language	TH	2	50	-	50	-	100	2	2
EEM12EC02	HSSM	EEMC	Technology Entrepreneurship	TH	2	20	30	20	30	100	2	2
VEC12EC02	HSSM	VEC	Technology Innovation for Sustainable Development	TH	1	40	-	60	-	100	1	2
				PR	2						1	
LLCXX	LLC	CC	One Course from CC	PR	2	-	-	50	-	50	2	1
BC12EC01	BC	BC	Electromagnetic Theory	TH	2	20	30	20	30	100	2	3*
				TU	1	20	-	30	-	50	1	
VSE11EC02	BC	BC	Creative Coding in Python	PR	4	50	-	50	-	100	2	2*
				Total	**TH:TU:PR 17:2:18=37**			-	-	**1150+250 ***	-	**23+5***

* Introduced as Bridge Courses to fulfil Credit Requirements of University of Mumbai

SEM-V													
Course Code	Course Vertical	Sub-Vertical	Course Name		Contact Hours	Examination Marks (1 Credit=50 Marks)					Credits	
						ISE1	MSE	ISE 2	ESE	Total	Points	Total
PCC13EC11	PCPEC	PCC	Control System	TH	2	20	30	20	30	100	2	3
				PR	2	20	-	30	-	50	1	
PCC13EC12	PCPEC	PCC	Computer Network	TH	2	20	30	20	30	100	2	3
				PR	2	20	-	30	-	50	1	
PCC13EC13	PCPEC	PCC	Artificial Intelligence	TH	2	20	30	20	30	100	2	3
				PR	2	20	-	30	-	50	1	
PCC13EC14	PCPEC	PCC	Analysis of Algorithms	PR	2	20	-	30	-	50	1	1
PEC13ECXX	PCPEC	PEC	Program Elective Course	TH	2	20	30	20	30	100	2	3
				PR	2	20	-	30	-	50	1	
PEC13ECXX	PCPEC	PEC	Program Elective Lab	PR	2	20	-	30	-	50	1	1
MDM03	MDC	MDM	Health, Wellness and Psychology	TH	2	50	-	50	-	100	2	2
MDM04	MDC	MDM	Public Relations and Corporate Communication	TH	2	50	-	50	-	100	2	2
OEEC41	MDC	OE	Cloud Computing	TH	1	10	15	10	15	50	1	2
				PR	2	20	-	30	-	50	1	
HXXXC501	HMM/DM	HMM/DM	Honors/Minor Degree Course	TH	4	20	30	20	30	100	4	4*
				Total	**TH:TU:PR 13:0:14=27 17:0:14=31***			-	-	**1000+100***	-	**20+4***

* Introduced as Optional Honors/Minor Degree Courses

SEM-VI												
Course Code	Course Vertical	Sub-Vertical	Course Name		Contact Hours	Examination Marks (1 Credit=50 Marks)					Credits	
						ISE 1	MSE	ISE2	ESE	Total	Points	Total
PCC13EC15	PCPEC	PCC	VLSI Design	TH	2	20	30	20	30	100	2	3
				PR	2	20	-	30	-	50	1	
PCC13EC16	PCPEC	PCC	Analog and Digital Communication	TH	2	20	30	20	30	100	2	3
				PR	2	20	-	30	-	50	1	
PCC13EC17	PCPEC	PCC	Machine Learning	PR	2	20	-	30	-	50	1	1
PCC13EC18	PCPEC	PCC	CAD for VLSI	PR	2	20	-	30	-	50	1	1
PEC13ECXX	PCPEC	PEC	Program Elective Course	TH	2	20	30	20	30	100	2	3
				PR	2	20	-	30	-	50	1	
PEC13ECXX	PCPEC	PEC	Program Elective Course	TH	2	20	30	20	30	100	2	3
				PR	2	20	-	30	-	50	1	
PEC13ECXX	PCPEC	PEC	Program Elective Lab	PR	2	20	-	30	-	50	1	1
PEC13ECXX	PCPEC	PEC	Program Elective Lab	PR	2	20	-	30	-	50	1	1
MDM05	MDC	MDM	Emotional and Spiritual Intelligence	TH	2	50	-	50	-	100	2	2
VSE13EC04	SC	VSEC	Data Acquisition and Processing	PR	4	50	-	50	-	100	2	2
HXXXC601	HMM/DM	HMM/DM	Honors/Minor Degree Course	TH	4	20	30	20	30	100	4	4*
				Total	**TH:TU:PR 10:0:18=28 14:0:18=32***			-	-	**1000+100***	-	**20+4***

* Introduced as Optional Honors/Minor Degree Courses

SEM-VII												
Course Code	Course Vertical	Sub-Vertical	Course Name		Contact Hours	Examination Marks (1 Credit=50 Marks)					Credits	
						ISE 1	MSE	ISE2	ESE	Total	Points	Total
PCC14EC19	PCPEC	PCC	Data Warehousing and Mining	TH	2	20	30	20	30	100	2	3
				PR	2	20	-	30	-	50	1	
PCC14EC20	PCPEC	PCC	System Security	PR	2	20	-	30	-	50	1	1
PEC14ECXX	PCPEC	PEC	Program Elective Course	TH	2	20	30	20	30	100	2	3
				PR	2	20	-	30	-	50	1	
PEC14ECXX	PCPEC	PEC	Program Elective Course	TH	2	20	30	20	30	100	2	3
				PR	2	20	-	30	-	50	1	
MDM06	MDC	MDM	Principles of Management	TH	2	50	-	50	-	100	2	2
RMC14EC01	EL	RM	Essentials of Research Methodology	TH	1	40	-	60	-	100	1	2
				TU	1						1	
RMC14EC02	EL	RM	Intellectual Property Rights	TH	1	40	-	60	-	100	1	2
				TU	1						1	
PRJ14EC01	EL	PR	Project	PR	8	100	-	100	-	200	4	4
HXXXC701	HMM/DM	HMM/DM	Honors/Minor Degree Course	TH	4	20	30	20	30	100	4	4*
HXXXSBL701	HMM/DM	HMM/DM	Honors/Minor Degree Course Lab	PR	4	50	-	50	-	100	2	2*
				Total	**TH:TU:PR 10:2:16=28 14:2:20=36***			-	-	**1000+120***	-	**20+6 ***

* Introduced as Optional Honors/Minor Degree Courses

SEM-VIII													
Course Code	Course Vertical	Sub-Vertical	Course Name		Contact Hours	Examination Marks					Credits	
						ISE1	MSE	ISE2	ESE	Total	Points	Total
PCC14EC21	PCPEC	PCC	Program Core Course	T H	SWAYAM	As Per SWAYAM					2	2
PCC14EC22	PCPEC	PCC	Program Core Course	T H	SWAYAM	As Per SWAYAM					2	2
PEC14ECXX	PCPEC	PEC	Program Elective Course	T H	SWAYAM	As Per SWAYAM					2	2
MDM07	MDC	MDM	One MDM Course	T H	SWAYAM	As Per SWAYAM					2	2
INT14EC01	EL	INT	Semester long Internship	PR	36-40 hrs	As Per Internship Manual					12	12
HXXXC701	HMM/DM	HMM/DM	Honors/Minor Degree Course	T H	SWAYAM	As Per SWAYAM					30	4*
				Total							-	20+4*

* Introduced as Optional Honors/Minor Degree Courses

Online course 1 Credit=4 Week course from SWAYAM can be taken in SEM 7 or SEM VIII
Online min 8 week course from SWAYAM can be taken in SEM 7 or SEM VIII to complete 2 credit course (Combination of two 4-week credit courses shall be allowed with prior approval)
* Online min 12 week course from SWAYAM can be taken in SEM 7 or SEM VIII to complete 3 credit course

List of Program Elective Courses:

Choice for Third Year:

Track-A:

SEM-V: Automation, Biomedical Instrumentation Lab

SEM-VI :

Any two Theory: Mobile Communication, Digital Signal Processing, Analog VLSI Design

Lab: IoT Lab, Image Processing Lab

Track-B:

SEM-V: Cryptography, Blockchain Lab

SEM-VI:

Any two Theory: Natural Language Processing, Big Data Analytics, Advanced Algorithms

Lab: Deep Learning Lab, Software Testing & Quality Assurance Lab

SEM- VII: Any two theory courses from the other track

Open Electives offered to ECS students:

SEM-III: Database Management System

SEM-III: Software Engineering for Web Applications

SEM-IV: Operating Systems

SEM-V: Cloud Computing

List of Multi-Disciplinary Minor Courses (MDM):

1. **SEM-III:** Law for Engineers
2. **SEM-IV:** Emerging Technology and Law
3. **SEM-V:** Public Relations and Corporate Communication
4. **SEM-V:** Health, Wellness and Psychology
5. **SEM-VI:** Emotional and Spiritual Intelligence
6. **SEM-VII:** Principles of Management
7. **SEM-VIII:** From SWAYAM (To be approved by Dean Academics)

List of Modern Indian Language (2 credit) (AEC):

1. Sanskrit for Beginners

2. Telugu for Beginners
3. Kannada for Beginners
4. Tamil for Beginners

Indicative List of Cocurricular Courses (CC): (Min 15 to Max 20 students in each course: Except Social Activities). Will be offered based on student choice and availability of resources to conduct a course.

LLC01. Culinary Arts: Foundations of Cooking
LLC02. Indian Aesthetics
LLC03. Sketching
LLC04. Personality Development and People Management
LLC05. Work Life Balance
LLC06. Art of Living
LLC07. Yoga Vidya
LLC08. First Aid and Self Defence
LLC09. Fire Safety and Electronic Security
LLC010. Sports Technology
LLC011. Athletics
LLC012. Aerobics and Fitness
LLC013. Study of Dance Forms
LLC014. Introduction to Dramatics: Exploring Theatre Arts
LLC015. Fundamentals of Photography
LLC016. Cinematography
LLC017. Music Appreciation and Composition
LLC018. Script writing
LLC019. Vehicle maintenance and traffic rules
LLC020. Garden Design and Maintenance
LLC021. Managing Social Media
LLC022. Server and Network Maintenance
LLC023. Electrical Safety
LLC024. Mentoring of School Children
LLC025. Social Club Activities
LLC026. Cultural Club Activities
LLC027. Any other course approved by Dean Academics

Honors Degree Offered to ECS Students from SEM-V to SEM-VIII:

A. Name: **Internet of Things**

1. SEM-V: HIoTC501: IoT Sensor Technologies
2. SEM VI: HIoTC601: IoT System Design
3. SEM VII: HIoTC701: Dynamic Paradigm in IoT
4. SEM VIII: HIoTSBL701: Interfacing & Programming with IoT Lab (SBL)
5. SEM VIII: HIoTC801: Industrial IoT

B. Name Artificial Intelligence and Machine Learning

1. SEM-V: HAIMLC501: Mathematics for AI & ML
2. SEM VI: HAIMLC601: Game Theory using AI & ML
3. SEM VII: HAIMLC701: AI & ML in Healthcare

4. SEM VIII: HAIMLSBL701: AI & ML in Healthcare: Lab
5. SEM VIII: HAIMLC801: Text, Web and Social Media Analytics

C. Name: Data Science

1. SEM-V: HDSC501: Mathematics for Data Science
2. SEM VI: HDSC601: Statistical Learning for Data Science
3. SEM VII: HDSC701: Data Science for Health and Social Care
4. SEM VIII: HDSSBL701: Data Science for Health and Social Care Lab
5. SEM VIII: HDSC801: Text, Web and Social Media Analytics

D. Name: Blockchain

1. SEM-V: HBCC501: Bit coin and Crypto currency
2. SEM VI: HBCC601: Blockchain Platform
3. SEM VII: HBCC701: Blockchain Development
4. SEM VIII: HBCSBL701: Private Blockchain Setup Lab (SBL)
5. SEM VIII: HBCC801: DeFi (Decentralized Finance)

E. Name: Cyber Security

1. SEM-V: HCSC501: Ethical Hacking
2. SEM VI: HCSC601: Digital Forensic
3. SEM VII: HCSC701: Security Information Management
4. SEM VIII: HCSSBL601: Vulnerability Assessment Penetration Testing (VAPT) Lab
5. SEM VIII: HCSC801: Application Security

Minors Degree Offered to ECS Students from SEM-V to SEM-VIII:

A. Name: Robotics

1. SEM-V: HRC501: Industrial Robotics
2. SEM VI: HRC601: Mechatronics & IoT
3. SEM VII: HRC701: Artificial Intelligence & Data Analysis
4. SEM VIII: HRSBL701: Robotics and Automation Lab
5. SEM VIII: HRC801: Autonomous Vehicle Systems

B. Name: 3D Printing

1. SEM-V: HC3DP501: Introduction to CAD
2. SEM VI: HC3DP601: 3D Printing: Introduction & Processes
3. SEM VII: HC3DP701: Applications of 3D Printing
4. SEM VIII: H3DPSBL801: Skill Based Lab– Digital Fabrication
5. SEM VIII: HC3DP801: 3D Printing in Medical Technology

Comparison of Credit Distribution for Four Year UG Program for Fr CRCE and GR:

UG: Electronics and Computer Science

	Course Verticals																Total Credits
	BSESC		PCPEC		MDC		SC	HSSM				EL				LLC	BC	
SEM	BSC	ESC	PCC	PEC	MDM	OE	VSEC	AEC	EEMC	IKS	VEC	RM	CEFP	PRJ	INT	CC	BC	
I	9	9															--	18
II	9	8						3									--	20
III	3		6		2	4			2		2		2			1	6	22+4
IV	3		7		2	2	2	2	2		2					1	8	23+5
V			10	4	4	2											--	20
VI			8	8	2		2										--	20
VII			4	6	2							4		4			--	20
VIII			4	2	2										12		--	20
Total Credits as per Fr CRCE	**21**	**17**	**37**	**20**	**14**	**8**	**4**	**5**	**4**	**-**	**4**	**4**	**2**	**4**	**12**	**2**	**14**	**163+9 =172**
Total Credits as per GR	**14**	**12**	**44**	**20**	**14**	**8**	**8**	**4**	**4**	**2**	**4**	**4**	**2**	**4**	**12**	**4**	**--**	**160**

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
BSC12EC05	Signals and Systems	L	T	P	L	T	P	Total
		2	1	0	2	1	0	3
		Examination Scheme						
			ISE1	MSE	ISE2	ESE	Total	
		Theory	20	30	20	100 (30% weightage)	100	
		Tutorial	20	--	30	--	50	

Pre-requisite Course Codes		Differential and Integral calculus
Course Outcomes	CO1	Operate Laplace Transform on a piecewise continuous function.
	CO2	Operate inverse Laplace Transform on a bounded function.
	CO3	Interpret periodic function as a Fourier series and integrable function as Fourier transform.
	CO4	Apply Z transform to convert a sequence of real numbers into a complex function.

Theory:

Module No.	Unit No.	Topics	Ref.	Hrs.
1		**Laplace Transform**	1,2,3,4	**7**
	1.1	Definition of Laplace transform, Condition of Existence of Laplace transform. Laplace Transform (L) of Standard Functions like e^{at}, sin(at), cos(at), sinh (at), cosh (at), t^n, $n \geq 0$.		
	1.2	Properties of Laplace Transform: Linearity, First Shifting theorem, Second Shifting Theorem, change of scale Property, multiplication by *t*, Division by *t*, Laplace Transform of derivatives and integrals (Properties without proof).		
	1.3	Evaluation of integrals by using Laplace Transformation.		
	1.4	Application of Laplace transform to design filters		
2		**Inverse Laplace Transform**	1,2,3,4	**6**
	2.1	Inverse Laplace Transform, Linearity property, use of standard formulae to find inverse Laplace Transform, finding Inverse Laplace transform using derivatives.		
	2.2	Partial fractions method to find inverse Laplace transform.		
	2.3	Inverse Laplace transform using Convolution theorem (without proof).		
	2.4	Application of Inverse Laplace Transform in filters, system identification and signal reconstruction.		
3		**Fourier Series and Fourier Transform**	1,2,3,4	**9**

	3.1	Dirichlet's conditions, Fourier series of periodic function with period $2n$ and $2l$, Parseval's Identity (without proof).		
	3.2	Fourier series of even and odd functions.		
	3.3	Half range Sine and Cosine Series.		
	3.4	Fourier series in complex form		
	3.5	Fourier integral representation, Complex Fourier integral, Fourier Transform		
	3.6	Discrete Fourier transform, Fast Fourier transform		
	3.7	Application of Fourier series and transform in filtering, audio and image processing		
4		Z **−Transform**	1,2,3,4	**4**
	4.1	Definition and Region of Convergence, Transform of Standard functions: $\{k^n a^k\}$, $\{a^{\lvert k\rvert}\}$, $\{k + n_C \quad a^k\}$, n $\{c^k \sin(\alpha k + \beta)\}$, $\{c^k \sinh \alpha k\}$, $\{c^k \cosh \alpha k\}$		
	4.2	Properties of Z Transform: Change of Scale, Shifting Property, Multiplication, and Division by k, Convolution theorem.		
	4.3	Inverse Z transform: Partial Fraction Method, Convolution Method		
	4.4	Application of Z transform in Digital Signal processing		
			Total	**26**

Recommended Books:

1. Dr B.S. Grewal, "*Higher Engineering Mathematics*", Khanna Publications, 4nd Edition.
2. H. K. Das, "*Advanced Engineering Mathematics*", S. Chand, 28th Edition.
3. Erwin Kreysizg, "*Advanced Engineering Mathematics*", John Wiley & Sons, 10th Edition.
4. Jain and Iyengar, "*Advanced Engineering Mathematics*", Narosa Publications, 4th Edition.

Course Assessment:

Theory:

ISE-1: Multiple choice questions: 20 Marks
ISE-2: Multiple choice questions: 20 Marks
MSE: 30 Marks written examination based on 50% syllabus
ESE: Three hours 100 Marks written examination (with 30% weightage) based on entire syllabus

Tutorial:

S.N.	Tutorial	References
1	Laplace Transform	1,2,3,4
2	Laplace Transform	1,2,3,4
3	Inverse Laplace Transform	1,2,3,4
4	Inverse Laplace Transform	1,2,3,4
5	Fourier Series	1,2,3,4
6	Fourier Transform	1,2,3,4
7	z −Transform	1,2,3,4
8	Inverse Z −Transform	1,2,3,4

Course Assessment:

Tutorial:

ISE-1 will be conducted for three tutorials. Continuous pre-defined rubrics-based evaluation for 20 marks.
ISE-2 will be conducted for five tutorials. Continuous pre-defined rubrics-based evaluation for 30 marks.

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
PCC12EC05	Electronic Devices	L	T	P	L	T	P	Total
		2	--	--	2	--	--	2
		Examination Scheme						
			ISE 1	MSE	ISE 2	ESE	Total	
		Theory	20	30	20	100 (30% weightage)	100	
		Lab	-	–	-	–	-	

Pre-requisite Course Codes	ESC11EC02, BSC11EC02	
Course Outcomes	After the successful completion students should be able to	
	CO1	Explain the working of semiconductor devices.
	CO2	Interpret the characteristics of semiconductor devices.
	CO3	Explain characteristics of power electronics and optoelectronic devices.
	CO4	Apply the optoelectronic and power electronic devices for various applications

Module No.	Unit No.	Topics	Ref.	Hrs
1		**Bipolar Junction Transistors**		
	1.1	Minority carrier distributions and terminal currents, Generalized Biasing: The Coupled-Diode Model, Charge control analysis; switching, drift in base region, base narrowing, avalanche breakdown, thermal effects, Kirk effect.	1,3	5
	1.2	Uni-junction Transistor (UJT)		
2		**Field Effect Transistors**		
	2.1	JFET (characteristics), MOS capacitor (threshold voltage, C-V characteristics)	4	5
	2.2	MOSFET: I-V characteristics, Equivalent circuits for the MOSFET.		

3	**MOS Transistor**			
	3.1	MOS Transistor under Static Conditions, Dynamic Behaviour, Secondary Effects	2,4	5
	3.2	SPICE Models for MOS Transistor, Technology Scaling		
4	**Optoelectronic Devices**			
	4.1	Photodiodes: I-V characteristics in an illuminated junction, Solar Cells, Photodetectors	1,2,4	5
	4.2	LEDs, Semiconductor LASER		
5	**Power Semiconductor Devices**			
	5.1	SCR (Silicon Controlled Rectifier): two transistor model, protection circuits, series and parallel operation of SCR, triggering and commutation circuits	2	6
	5.2	GTO, TRIAC, DIAC, Power Diode, Power BJT, Power MOSFET, IGBT.		
			Total	**26**

Recommended Books:

1. B.G. Streetman, S. K. Banerjee, "Solid State Electronic Devices ", 7th edition, Pearson India Education Service Pvt. Ltd., 2017.
2. M.H. Rashid, "Power Electronics: Circuits, Devices & Applications", 4th Edition, Pearson India Education Service Pvt. Ltd, 2017.
3. S. M. Sze, "Physics of Semiconductor Devices", 3rd Edition, John Wiley & Sons, Inc. 2007.
4. Donald. A. Neamen, "Semiconductor Physics and Devices: Basic Principles", 4th Edition, McGraw Hill Higher Education, 2011.

Useful Links:

1. https://nptel.ac.in/courses/108/107/108107142/
2. https://www.youtube.com/playlist?list=PLF178600D851B098F
3. https://www.youtube.com/playlist?list=PLgMDNELGJ1CaNcuuQv9xN07ZWkXE-wCGP

Course Assessment:

Theory:

ISE-1: 20 marks

1. Quiz/ crossword:10 Marks
2. Poster making:10 marks

ISE-2: 20 Marks

1. 3D model making :10 Marks
2. Simulating characteristics for devices: 10 marks

MSE: 30 Marks written examination based on 50% syllabus

ESE: Three hours 100 Marks written examination (with 30% weightage) based on entire syllabus

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
PCC12EC06	Computer Organization and Architecture	L	T	P	L	T	P	Total
		2	--	2	2	--	1	3
		Examination Scheme						
			ISE1	MSE	ISE2	ESE	Total	
		Theory	20	30	20	100 (30% weightage)	100	
		Lab	20	--	30	--	50	

Pre-requisite Course Codes		PCC11EC03
Course Outcomes	CO1	Analyze design considerations of architectural units of a processor
	CO2	Explain concepts related to cache memory and Virtual memory management in Computer systems
	CO3	Contrast different types of I/O data transfers and I/O buses used in Computer systems
	CO4	Evaluate the advantages and limitations of Parallelism in systems.
	CO5	Explain the architectural enhancements in modern processors

Module No.	Unit No.	Topics	Ref.	Hrs.
1		**Overview and Data Representation**		4
	1.1	Basic Building blocks of a Computer, Evolution of x86 Computers, Von Neumann model, Harvard Model, Performance measures	1,2,5	
	1.2	Number representation: Floating-point representation, Floating point arithmetic, IEEE 754 floating point number representation	1,2,5	
	1.3	Booth's Multiplier, Restoring and Non-Restoring Division	1	
2		**Processor Organization**		6
	2.1	Instruction format, Instruction cycle, Instruction set types, Addressing Modes, Multi-Datapath Organization	1,2,5	
	2.2	Control Unit Design: Hardwired and Microprogrammed	1,2,5	
	2.3	CISC vs RISC: Design philosophy and issues	1,2,5	
	2.4	Case study: 8086 processor architecture and Instruction Set	3,8	
3		**Memory Organization**		6
	3.1	Types of memories, Performance of Memory system, Memory Hierarchy	1,2,5	
	3.2	Cache memory concepts: Principles of locality, Cache mapping, Cache architectures, Cache coherency	1,2,5	
	3.3	Virtual management concepts: Paging, Segmentation, Page Replacement policies	1,2,5	

	3.4	Case Study: Virtual Memory management in Pentium processor	1,2,7	
4		**I/O Organization**		3
	4.1	I/O interfacing: Handshaking, Interrupt handling, Direct memory Access (DMA)	1	
	4.2	I/O Buses: Protocols, Arbitration	1	
5		**Parallel processing**		3
	5.1	Introduction to Parallel processing, Flynn's Classification, Amdahl's Law	4,5	
	5.2	Pipelining, Pipeline Performance metrics, Pipeline Hazards	2,4,5	
6		**Advanced Processor Architectures**		4
	6.1	Superscalar processors, GPU, Clusters, Multi-core processors	1,5,8	
	6.2	NVIDIA GPU Case study and Programming Model	9	
			Total	**26**

Recommended Books:

1. Carl Hamacher, Zvonko Vranesic, Safwat Zaky, "Computer Organization", Tata Mc Graw-Hill, 5 th Edition.
2. William Stallings," Computer Organization and Architecture: Designing for Performance", Pearson, 8 th Edition.
3. Douglas V Hall," Microprocessor and Interfacing: Programming & Hardware", Tata-Mc Graw Hill, 3 rd Edition.
4. Andrew S. Tanenbaum," Structured Computer Organization", Pearson, 6 th Edition.
5. D. A. Patterson and J. L. Hennessy, "Computer Organization and Design – A Quantitative Approach ", Morgan Kaufmann, 6th Edition.
6. B. Govindarajulu," Computer Architecture and Organization: Design Principles and Applications", McGraw Hill, 2 nd Edition.
7. Don Anderson, Tom Shanley, "Pentium Processor System Architecture", Addison Wesley Professional, 2nd Edition.
8. Douglas V Hall," Microprocessor and Interfacing: Programming & Hardware", Tata-Mc Graw Hill, 3 rd Edition.
9. Jason Sanders, Edward Kandrot, "CUDA by Example: An Introduction to General-Purpose GPU Programming", Addison-Wesley, 1st Edition.

Course Assessment:

Theory:

ISE-1:

Activity: Quiz 10 Marks
Assignment 10 Marks

ISE-2:

Activity: Technical Report on latest Motherboard design 10 Marks
Seminar on Research paper (IEEE /ACM) 10 Marks

MSE: 30 Marks written examination based on 50% syllabus

ESE: Three hours 100 Marks written examination (with 30% weightage) based on entire syllabus

Laboratory Experiments:

S.N.	Title of experiment	References
1.	Design of a Booth Multiplier	1
2.	Implement Restoring and Non-Restoring Division Algorithm.	1
3.	Implementation of Arithmetic/Logical operations using 8086 (Assembly language)	3,8
4.	Block transfer using 8086 (String instructions)	3,8
5.	Implementation of subroutines and macros using 8086	3,8
6.	Implementation of various cache mapping techniques to measure cache hit rate.	1,2,5
7.	Implement various page replacement policies (LRU, FIFO, LFU)	1,2,5
8.	Simulate various data hazards in a pipeline (for a given program segment).	2,5

Course Assessment:

Lab:

ISE-1

Four experiments. Continuous pre-defined rubrics-based evaluation for 20 marks.

ISE-2

a. Four experiments. Continuous pre-defined rubrics-based evaluation for 20 marks.

b. Activity: **Design of Experiment** using any simulator (Cache/ Performance monitoring) 10 marks

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
PCC12EC07	Object Oriented Programming with Java	L	T	P	L	T	P	Total
		--	--	2	--	--	1	1
		Examination Scheme						
			ISE1	MSE	ISE2	ESE	Total	
		Lab	20	--	30	--	50	

Pre-requisite Course Codes	ESC11EC03	
Course Outcomes	CO1	Demonstrate Proficiency in Core Java Concepts
	CO2	Apply Object-Oriented Programming Principles
	CO3	Explore Java Programming concepts including multithreading, File I/O, and exception handling
	CO4	Develop and Debug Java Applications

Module No.	Unit No.	Topics	Ref.	Hrs
1		Introduction to Java Basics: Overview of Java programming language, setting up the development environment (IDE installation), Writing and executing your first Java program, Understanding variables and data types, Basic input/output operations, Control Structures and Functions **Suggested Experiment List: (Any One)** **Coffee Shop Problem** Develop a program for a coffee shop that calculates the total cost of a customer's order, including taxes and discounts, and prints the receipt. **Temperature conversion tool** Problem Statement: Create a temperature conversion tool that converts Celsius to Fahrenheit and vice versa, based on user input. **Parking Fee Calculator** Problem Statement: Implement a parking fee calculator that calculates the parking charges based on the duration of parking and the type of vehicle.	1,2	2
2		Introduction to object-oriented programming (OOP) concepts: Classes and objects in Java, Encapsulation, Association and polymorphism **Suggested Experiment List: (Any One)** **Banking Application** Design a simple banking application that allows users to deposit, withdraw, and check their account balance.	1,2	2

		Student Management System Create a student management system that stores student information (name, roll number, marks) and provides functionality to add, delete, and update student records.		
3		Inheritance: Types of Inheritance, Interface, Abstract class and methods, super and final keywords **Suggested Experiment List: (Any One)** **Shape Drawing Application** Design a shape drawing application that allows users to draw different shapes (circle, rectangle, triangle) on a canvas and perform operations like resizing and rotating. **Employee Payroll Processing** Create a program for managing employee payroll information, including salary calculation, deductions, and tax withholding. Allow HR personnel to add new employees, update salary information, and generate pay stubs.	1,2	2
4		Arrays and Vector: Arrays in Java, Vector. **Suggested Experiment List: (Any One)** **Library Management App:** Develop a program for a library that manages book inventory, allowing users to search for books by title or author **Contact Management App:** Build a contact management application that stores contact information (name, phone number, email) and provides features like searching, sorting, and exporting contacts.	1,2	2
5		Strings: Introduction to strings and string manipulation **Suggested Experiment List: (Any One)** **String Encoding:** Design a Java application that efficiently compresses a given string using any encoding technique, balancing between compression ratio and computational complexity. **Word Frequency:** Create a Java application for generating word clouds from textual data. Implement algorithms for frequency analysis, word weighting, and layout optimization to produce visually appealing representations of word distributions. **NLP:** Create a Java application for natural language processing that extracts named entities from a text corpus. Implement algorithms for recognizing and categorizing entities such as	1,2	2

		persons, organizations, locations, and dates.		
6		Exception Handling: Handling exceptions in Java (try-catch-throw- throws-finally), User defined Exceptions **Suggested Experiment List: (Any One)** **Flight Booking System** Develop a program for a flight booking system that handles exceptions such as invalid input, seat availability, and payment errors. **Transportation Management** Create a Java program for a transportation management system that handles exceptions related to route planning, vehicle breakdowns, traffic congestion, and delivery delays. Implement resilience patterns like circuit breakers and retry mechanisms."	1,2	2
7		Multithreading: Introduction to Multithreading- lifecycle, creation of threads. Synchronization and Thread Communication, Handling Thread Interruption and Thread Pools. **Suggested Experiment List: (Any One)** **Chat Application** Develop a real-time chat application that allows multiple users to communicate with each other concurrently using separate threads for sending and receiving messages. **Social Media Platform** Build a simple social media platform where users can create profiles, connect with friends, and share posts. Implement features such as news feed, notifications, and privacy settings.	1,2,3	2
8		Introduction to JavaFx: Setting Up a JavaFX Application, Creating UI Elements, Event Handling in JavaFX **Suggested Experiment List: (Any One)** **Inventory management app** Design a simple inventory management system for a retail store that allows employees to add, update, and remove products from inventory using a graphical user interface. **Educational Game:** Create an educational game using JavaFX for teaching complex concepts in mathematics, physics, or computer science. Design engaging gameplay mechanics, interactive tutorials, and	4	2

		challenging puzzles to facilitate learning through exploration and experimentation.		
9		Database Connection with Java: Setting Up Database Environment (MySQL/PostgreSQL), Establishing Database Connection, Executing SQL Queries, basics of Exception Handling Demonstration • Program on Database Connection and Queries handling	1,2	2
10		File Handling: File Input/ Output with Streams, Serialization and Deserialization, Random Access Files **Suggested Experiment List: (Any One)** **File Master App** Create a file management tool that allows users to organize and manage files and folders on their computer, including operations like creating, deleting, and renaming files. **Weather Forecasting Application** Develop a weather forecasting application that retrieves data from a file and displays current weather conditions and weather stats.	1,2	2
11		**Mini Project:** Defining the problem statement and objectives. Create UML diagram (Class diagram/ Use case diagram) Implement the idea of Mini Project based on the content of the syllabus (Group of 2-3 students)		4
			Total	**24**

Text Books:

1. "Java: The Complete Reference" by Herbert Schildt
2. "Programming with JAVA" by E. Balaguruswamy

Reference Books:

1. "Head First Java" by Kathy Sierra and Bert Bates
2. "Effective Java" by Joshua Bloch
3. "Java Concurrency in Practice" by Brian Goetz et al.
4. "JavaFX 8: Introduction by Example" by Carl Dea, Gerrit Grunwald, and José Pereda

Online References:

1. Java Course Online for Beginners by Scaler Topics - https://www.scaler.com/topics/course/java-beginners/
2. Object-Oriented Programming in Java by Coursera-https://www.coursera.org/learn/object-oriented-java

3. Java Tutorial for Complete Beginners by Udemy- https://www.udemy.com/course/java-tutorial/
4. Java Programming by Great Learning-https://www.mygreatlearning.com/academy/learn-for-free/courses/java-programming
5. Core Java Basics by UpGrad-https://www.upgrad.com/software-engineering-course/core-java/
6. Practice Java by Building Projects on Udemy-https://www.udemy.com/course/practice-java-by-building-projects/
7. Java for Absolute Beginners by Udemy-https://www.udemy.com/course/java-for-absolute-beginners-learn-java-from-zero/

Course Assessment:

Term work should consist of 8-10 experiments.
Mini Project based on the content of the syllabus (Group of 2-3 students)

ISE:

ISE-1 will be conducted for 50% experiments. Continuous pre-defined rubrics-based evaluation for 20 marks.
ISE-2 will be conducted for remaining experiments. Continuous pre-defined rubrics-based evaluation for 30 marks (20 marks for lab performance + 10 marks for project).

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
MDM01	Law for Engineers	L	T	P	L	T	P	Total
		2	--	--	2	--	--	2
		Examination Scheme						
			ISE1	MSE	ISE2	ESE	Total	
		Theory	50	--	50	--	100	
		Lab	--	--	--	--	--	

Pre-requisite Course Codes		--
Course Outcomes	CO1	To demonstrate awareness of basic structure of Indian Legal System
	CO2	To demonstrate awareness of principles of contract
	CO3	To demonstrate awareness of legal aspects related to establishment of factory and various legislations related to employees, labours, and workmen's welfare
	CO4	To demonstrate awareness about right to information, intellectual creations from infringement and laws related to energy, food and environment

Module No.	Unit No.	Topics	Ref.	Hrs.
1		**Foundation of Legal System**	1,2,3	4
	1.1	Indian Legal System: An Introduction, Human Rights, Fundamental Rights, The Supreme Court of India, Statutory Commissions– NHRC, NCW, NCM, NC-SC/ST etc.,		
	1.2	Representation of Peoples Act 1950, Prevention of Corruption Act, 1988, Understanding the Importance of Stamp Duty		
	1.3	Few Illustrated Cases of Supreme Court of India		
2		**General Principles of Contract: India Contract Act 1872**	2,3	8
	2.1	Contract Law: Agreement and Its Kinds,		
	2.2	Who Can Enter into a Contract, Contract and Its Enforceability, Offer and Acceptance in a Contract,		
	2.3	Essentials of Valid Contract- Lawful Consideration and Lawful Object, Essentials of Valid Contract- Free Consent,		
	2.4	Types of Contracts, Contract of Agency, Performance of Contracts, Government Contracts, Standard Form Contracts		
3		**Industrial and Labour Laws**	2,3	8
	3.1	Labour Laws in India: An Overview, Industrial Disputes Act, 1947, Industrial Employment (Standing Orders) Act, 1946		
	3.2	Factories Act, 1948, Industries (Development and Regulation) Act, 1951		
	3.3	Contract Labour (Regulation and Abolition) Act, 1970, Bonded Labour System (Abolition) Act, 1976, Child and Adolescent Labour (Prohibition and Regulation) Act, 1986		
	3.4	Workmen's Compensation Act, 1923, Equal Remuneration Act, 1976, Payment of Bonus Act, 1965, Payment of Gratuity Act,		

		1972, Employees' State Insurance Act, 1948, Employees' Provident Funds and [Miscellaneous Provisions] Act, 1952, Payment of Wages Act, 1936, Minimum Wages Act, 1948, Employees' Pension Scheme 1995		
	3.5	Apprentices Act, 1961, Maternity Benefit Act, 1961, Fatal Accidents Act, 1855, Trade Unions Act, 1926, Sexual Harassment of Women at Workplace Act, 2013, Collective Bargaining		
4		**Right to Information**	2,3	2
	4.1	Official Secret Act, 1923, Indian Evidence Act, 1872		
	4.2	Right to Information Act, 2005, Impact of Right to Information Act		
5		**Intellectual Property Rights**	2,3	2
	5.1	Types of Intellectual Property, Indian Copyright Act 1957, Indian Trademark Act 1999, Indian Patent Act 1970		
6		**Other Important Laws**	2,3	2
	6.1	Electricity Act 2003, Atomic Energy Act 1962, Motors Vehicle Act 1988, Food Safety and Standards Act 2006, National Food Security Act 2013, Environment Protection Act 1986		
			Total	**26**

Recommended Books:

1. N. S. Nappinai, "*Technology Laws Decoded*," LexisNexis, 2017
2. Vibha Arora and Kunwar Arora, "*Law for Engineers*" Central Law Publications, 2017
3. Vandana Bhatt and Pinky Vyas, "*Laws for Engineers*", ProCare, 2015

Course Assessment:

ISE-1:

Quiz: 20Marks
Activity: Debating Session: 20 Marks
Activity: Poster Making: 10 Marks

ISE-2:

Quiz: 20 Marks
Activity: Client Counselling: 10 Marks
Activity: Animation Making: 20 Marks

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
OEEC11	Database Management Systems	L	T	P	L	T	P	Total
		1	--	2	1	--	1	2
		Examination Scheme						
			ISE1	MSE	ISE2	ESE	Total	
		Theory	10	15	10	50 (30% weightage)	50	
		Lab	20	--	30	--	50	

Pre-requisite Course Codes		--
Course Outcomes	CO1	Explain the basic concepts and the applications of database management systems.
	CO2	Design ER/EER diagrams for real-world scenario.
	CO3	Convert ER/EER diagram to relational model and write relational algebra queries.
	CO4	Formulate SQL queries to retrieve, manipulate, and analyze data stored in a relational database.
	CO5	Apply the concept of normalization to relational database to improve the database design.
	CO6	Describe the concepts of transaction and concurrency control.

Module No.	Unit No.	Topics	Ref.	Hrs.
1		**Module 1: Introduction To Database Systems**	1,2,6	2
	1.1	Characteristics of Database systems		
	1.2	File System Vs. Database systems		
	1.3	Three Schema Architecture and Data Independence		
	1.4	DBMS Architecture, Applocations of DBMS		
2		**Module 2: Conceptual Data Modelling using Entity-Relation Diagram**	1,2,6	2
	2.1	The Entity-Relationship (ER) Model: Entity types, Types of Attributes, Types of Keys		
	2.2	Relationships**:** Types of Relationships (Unary, Binary, Ternary, N-ary), Constraints on Relationship (Cardinality and Participation)		
	2.3	Extended ER Diagram**:** Generalization, Specialization, and Aggregation.		
3		**Module 3: Relational Model and Relational Algebra**	1,2,6	2
	3.1	Introduction to Relational Model: Relational Schema and Concepts of keys.		
	3.2	Mapping the ER and EER Model to the Relational Model		

	3.3	Relational Algebra**:** Operators and Relational Algebra Queries		
4		**Module 4: Structured Query Language**	1,2	3
	4.1	DDL commands**:** CREATE, ALTER, DROP, TRUNCATE, Integrity constraints**:** Key constraints, Domain constraints, Referential integrity constraints, and Check constraints		
	4.2	DML Commands: Insert, Update, Delete, WHERE clause, OrderBy clause.		
	4.3	Aggregate Functions, GroupBy – Having clause		
	4.4	SQL Joins, Set operations, Nested queries		
5		**Normalization**	1,2,4,6	2
	5.1	Pitfalls in Relational Database designs, Concept of Normalization, Function Dependencies.		
	5.2	1NF, 2NF, 3NF, BCNF		
6		**Transaction and Concurrency Control**	1,2	2
	6.1	Introduction to Transaction, Transaction States, ACID properties, Serial and Concurrent Schedules, Serializability**:** Conflict and View serializability. Transaction Control Commands (TCL)		
	6.2	Introduction to Concurrency Control**:** Lock-based protocols, Timestamp-based protocols.		
			Total	**13**

Recommended Books/References:

1. Korth, Slberchatz, Sudarshan, Database System Concepts, 6th Edition, McGraw Hill
2. Elmasri and Navathe, Fundamentals of Database Systems, 5th Edition, Pearson education.
3. Raghu Ramkrishnan and Johannes Gehrke, Database Management Systems, TMH.
4. G. K. Gupta, Database Management Systems, McGraw Hill., 2012.
5. SQL Tutorial (w3schools.com)
6. Course: Database Management System by Prof. Partha Pratim Das, Prof. Samiran Chattopadhyay, IIT Kharagpur: https://onlinecourses.nptel.ac.in/noc22_cs91/preview

Course Assessment:

Theory:

ISE-1: Two hours (10 Marks)
Activity: Database Design Contest (Group Activity)
Assessment will be done by the panel of internal teachers

ISE-2: Two hours (10 Marks)
Activity: Quiz and assignments

MSE: 15 Marks written examination based on 50% syllabus

ESE: Two hours 50 Marks written examination (with 30% weightage) based on entire syllabus

Laboratory Experiments:

S.N.	Title of experiment	References
1.	Identify the case study and formulate the detailed problem statement. Design Entity-Relationship (ER)/Extended Entity-Relationship (EER) Model for the same.	1,2,6
2.	Map the ER/EER Diagram designed in Experiment 1 into relational model and write SQL queries to create all PRIMARY KEY TABLES using DDL commands (Apply the constraints like PRIMARY KEY, NOT NULL, and DOMAIN Constrains)	1,2,6
3.	Create all FOREIGN KEY tables. Apply Referential Integrity constraints.	1,2,5
4.	Perform operations involving ALTER, DELETE, and UPDATE commands on the tables created in Experiment 2 and 3.	1,2,5
5.	Write SQL queries to implement JOINS and Nested queries for tables created in Experiment 2 and 3.	1,2,5
6.	Write the query for implementing the aggregate functions MAX(), MIN(), AVG(), COUNT(), SUM() with Group by and Having clause for the previously created tables.	1,2,5
7.	Implement PL/SQL and TRIGGERS for the previously created tables.	1,2,5
8.	Create Views and Indices for the previously created tables.	1,2,5

Course Assessment:

Lab:

ISE-1 (20M)

Four experiments. Continuous pre-defined rubrics-based evaluation for 20 marks.

ISE-2 (30M)

a. Four experiments. Continuous pre-defined rubrics-based evaluation for 20 marks.
b. Activity: Internal Hackathon (Group Activity) for 10 marks

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
OEEC21	Software Engineering for Web Applications	L	T	P	L	T	P	Total
		1	--	2	1	--	1	2
		Examination Scheme						
			ISE1	MSE	ISE2	ESE	Total	
		Theory	10	15	10	50 (30% weightage)	50	
		Lab	20	--	30	--	50	

Pre-requisite Course Codes		PCC11EC02
Course Outcomes	CO1	Perform requirement analysis for the selected case study
	CO2	design UML models for the selected case study.
	CO3	use Project Management Tools for project scheduling and risk management.
	CO4	design static web pages using HTML5, CSS3, Bootstrap and AJAX
	CO5	design a website using suitable JavaScript framework
	CO6	design a progressive web app using suitable JavaScript framework
	CO7	perform web testing using suitable testing tools

Module No.	Unit No.	Topics	Ref.	Hrs.
1		**Introduction to Software Engineering and Process Models**	1	**2**
	1.1	Software Engineering- a layered technology	1	
	1.2	Process Models: The waterfall model, Spiral model	1	
	1.3	Agile Methodology	1,6	
2		**Software Requirement Engineering and Modelling**		**4**
	2.1	IEEE Software Requirement Specifications (SRS)	1	
	2.2	Requirement Model: Scenario based model, class-based model, behavioral model	1	
	2.3	Class diagrams, sequence diagrams and UML diagrams	5	
3		**Design Engineering**		**3**
	3.1	Design concepts, design principles	1	
	3.2	Architecture design, component level design, system level design, UI design	1	
4		**Project Scheduling**		**2**
	4.1	Project scheduling, defining a task set	1	
	4.2	Project scheduling using GANTT chart / Jira Software	1	
	4.3	Software project estimation: LOC based, FP based	1	
5	**5.1**	**Software Risk Management and Testing**		**2**
	5.2	Types of software risks, risk identification, risk assessment, RMMM	1	

	5.3	Unit testing, white-box testing, Basis-path testing, black-box testing	1	
			Total	**13**

Recommended books / References:

1. Roger Pressman, "Software Engineering: A practitioner's approach", 9th edition, McGraw-Hill.
2. Ian Sommerville, "Software Engineering" (10th Edition), Pearson Education
3. Hans Van Vilet, "Software Engineering Principles and Practice", 3rd edition, Wiley
4. Laplante, Phillip A., and Mohamad Kassab. "What every engineer should know about software engineering", CRC Press, 2022.
5. Rumpe, Bernhard. Modeling with UML. Cham: Springer, 2016.
6. https://agilemodeling.com/
7. https://www.w3schools.com/
8. https://nextjs.org/
9. https://expressjs.com/
10. https://learn.microsoft.com/en-us/microsoft-edge/progressive-web-apps- chromium/how-to/
11. https://www.selenium.dev/

Assignments:

1. Create SRS document in IEEE format for the selected problem scenario
2. Identify software process model for the selected problem scenario and draw class diagram, sequence diagram and UML diagram for the problem scenario
3. Schedule the execution of selected project using Jira software / GANTT chart
4. Identify risks associated with your project and prepare risk mitigation plan
5. Do the testing of your software using appropriate tools

Course Assessment:

Theory

ISE-1 : Assignment 1 and 2 – 10 marks
ISE-2 : Assignment 3, 4 and 5 – 10 marks
MSE : 15 Marks written examination based on 50% syllabus
ESE : Two hours 50 Marks written examination (with 30% weightage) based on entire syllabus

Laboratory Experiments:

Week No	Topic / Experiment	Title of Topic / Experiment	References
1	Topic 1	Revision: HTML / CSS / JavaScript	7
2	Experiment 1	Design a website using HTML / CSS / JavaScript	7
3	Topic 2	Introduction to Bootstrap and AJAX	7
4	Experiment 2	Addition of Bootstrap and Ajax in the website designed in Experiment 1	7
5	Topic 3	Introduction to Angular JS	7
6	Experiment 3	Design a website on the selected problem statement using Angular JS **(Single page application)**	7
7	Topic 4	Introduction to React JS and Next JS	7, 8
9	Experiment 4	Design a website on the selected problem statement using Next JS **(User interface enhancements)**	7, 8
10	Topic 5	Introduction to NodeJS and Express JS	9
	Experiment 5	Design a website on the selected problem statement using Express JS **(Use of APIs to connect front end and database)**	9
11	Topic 6	Introduction to Progressive Web App (PWA) design	10
12	Experiment 6	Design a progressive web app on the given problem statement using suitable technology and perform web testing using Selenium	10,11

Course Assessment:

Lab ISE:

1. **ISE -1**
   a. Experiment 1, 2 and 3 – 20 marks
2. **ISE – 2**
   a. Experiment 4, 5 and 6 – 20 marks
   b. Hackathon on complete laboratory syllabus - 10 marks

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
EEM12EC01	Financial Planning, Taxation and Investment	L	T	P	L	T	P	Total
		2	--	--	2	--	--	2
		Examination Scheme						
			ISE1	MSE	ISE2	ESE	Total	
		Theory	--	--	--	--	--	
		Lab	50	--	50	--	100	

Pre-requisite Course Codes		--
Course Outcomes	CO1	To prepare financial plan by understanding owns need
	CO2	To demonstration awareness of taxation policies and show respect towards government norms and regulations
	CO3	To prepare investment plan by understanding owns futuristic needs

Financial Planning: It is possible to manage income more effectively through financial planning. Managing income helps to understand how much money is required for tax payments, other expenditures and savings. It increases cash flows by carefully monitoring the spending patterns and expenses. Knowledge of comprehensive financial planning will help students to make right financial decisions in their life. It gives guidance in helping choose the right types of investments to fit needs, personality, and goals of their life. In this activity students need to prepare the financial plan for their life.

Taxation Policies: Taxes are levied in almost every country of the world, primarily to raise revenue for government expenditures, although they serve other purposes as well. The simple fact in economics is that there are certain common public goods and public needs that require some form of government and regulation to provide or promote. Taxation is the way to pay for these common goods. In this activity student will learn various types of taxes like Income tax, Corporate tax, Capital gains, Property tax, Inheritance and Sales tax.

Investments: Investments are important because in today's world, just earning money is not enough. But that may not be adequate to lead a comfortable lifestyle or fulfil our dreams and goals. Money lying idle in the bank account is an opportunity lost. Therefore, students should have a knowledge to invest money smartly to get good returns out of it. This activity will give insight to the students about investment in the form of Stocks, Mutual Funds, Fixed Deposits, Recurring Deposit, Public Provident Fund, Employee Provident Fund and National Saving Schemes.

Methodology: Guest lectures or workshops by professionals shall be arranged on Financial Planning, Taxation and Investments. Invite guest speakers, such as tax professionals or financial advisors, shall conduct a tax planning workshop for students. The workshop can cover topics such as tax-efficient investment strategies, retirement planning, and tax-saving opportunities for individuals and businesses. Students should be engaged in assessment driven activities throughout

the course. For better learning outcomes following methods of content delivery via student engagement can be adopted.

Investment Simulation Game: Divide students into groups and have them participate in a simulated investment game. Each group is given a virtual budget to invest in stocks, bonds, mutual funds, or other investment vehicles. Throughout the course, they track the performance of their investments and make decisions based on real-world market trends and economic indicators.

Financial Planning Board Game: Design a board game that simulates the process of financial planning, including setting financial goals, creating budgets, managing debt, and making investment decisions. Students play the game in groups, competing or collaborating to achieve their financial objectives.

Stock Market Simulation: Use online stock market simulation platforms that allow students to buy and sell stocks in a virtual trading environment. They can experiment with different investment strategies, track the performance of their portfolios, and compete against their classmates or other teams.

Course Assessment:

ISE-1:

Quiz: **20 Marks**

Activity: Presentation on Financial Instruments: **10 Marks**

Activity: Preparing Investment Portfolio (20 Marks): Assign each student or group of students to create a hypothetical investment portfolio based on specific criteria such as risk tolerance, time horizon, and financial goals. They research different investment options, analyze their potential returns and risks, and justify their portfolio allocations in a written report or presentation.

ISE-2:

Quiz: **20 Marks**

Activity: Tax Return Case Studies (*Perquisite: Pan Card (if not available, student should immediately apply and get pan card))* (10 Marks): Consider case study of fictional individuals or families and prepare tax returns based on their financial situations. This hands-on activity allows students to apply their knowledge of taxation laws and regulations in a practical context.

Activity: Financial Literacy Podcast (10 Marks): Have students create their own podcasts or audio recordings discussing key concepts related to financial planning, taxation, and investments. They can ***interview experts***, share personal finance tips, or discuss current events and trends in the financial industry.

Activity: Personal Finance Blog (10 Marks): Students create their own personal finance blogs or websites where they share articles, tutorials, and resources related to financial planning, taxation, and investments. This activity helps them develop their writing and research skills while sharing valuable information with their peers

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned				
VEC12EC01	Human Values and Professional Ethics [HVPE]	L	T	P	L		T	P	Total
		1	--	2	1		--	1	2
			Examination Scheme						
			ISE-I	MSE	ISE-II		ESE		Total
		Theory	50	---	50		---		100
		Lab	---	---	---		---		---

Pre-requisite Course Codes		--
Course Outcomes	CO1	Adhere to the core rights and shape one's values.
	CO2	Display the role and responsibility of Engineering professionals
	CO3	Holds moral and Ethical solutions to problems through case studies.
	CO4	Apply the knowledge of human values to contemporary ethical and global issues.

Module No.	Unit No.	Topics	Ref.	Hrs.
1		**Background and Approach: Fundamental Rights and Duties**	7,8	**3**
	1.1	Fundamental Rights and Duties, Right to Compensation for being Illegally Deprived of one's Right to Life or Liberty, Right to Travel Abroad and Return to one's Country		2
	1.2	Promotion of Inter-Religious harmony and inter-faith values, Composite Culture		1
2		**Professional Ethics and Human Values**	1-5	
	2.1	Sense of Engineering Ethics - Variety of moral issues- Types of inquiry- Moral dilemmas –Moral Autonomy Moral dilemmas, Moral Autonomy, Kohlberg's theory Gilligan's theory, Consensus and Controversy, Profession& Professionalism, Models of professional roles, Theories about right action Codes of Ethics, Plagiarism		3
	2.2	Human Values. Morals, values, and Ethics – Integrity- Academic integrity- Work Ethics- Service Learning- Civic Virtue Respect for others- Living peacefully- Caring and Sharing- Honestly- Cooperation Commitment Empathy-Self Confidence -Social Expectations.		2
	2.3	Managing conflict- Respect for authority- Collective bargaining- Confidentiality, Role of confidentiality in moral integrity-Conflicts of interest		2
3		**Global Ethical Concerns**	2	
	3.1	Multinational Corporations- Environmental Ethics- Business Ethics- Computer Ethics		2
	3.2	Engineers as Expert witnesses and advisors-Moral leadership- case studies		1
			Total	**13**

Recommended Books/ References:

1. Mike W Martin and Roland Schinzinger, Ethics in Engineering,4th edition, Tata McGraw Hill Publishing Company Pvt Ltd, New Delhi,2014
2. Charles D Fleddermann, Engineering Ethics, Pearson Education/ Prentice Hall of India, New Jersey,2004.
3. Charles E Harris, Michael S Protchard and Michael J Rabins, Engineering Ethics-Concepts and cases, Wadsworth Thompson Learning, United States,2005.
4. M Govindarajan, S Natarajan and V S Senthil Kumar, Engineering Ethics, PHI Learning Private Ltd, New Delhi,2012.
5. R S Naagarazan, A textbook on professional ethics and human values, New Age International (P) limited, New Delhi,2006.
6. http://www.slideword.org/slidestag.aspx/human-values-and-Professional-ethics.

Course Assessment:

ISE-1:
AICTE & UNESCO's certificate course on Self-directed Emotional Learning for Empathy and Kindness (SEEK) **30 marks**
Link : https://www.framerspace.com/course/seek (Select SEEK self- directed cohort under the category of youth courses)

Activity: Quiz and assignments **20 Marks**

ISE-2:
AICTE & UNESCO'S certificate course on Social Emotional Learning for Youth Waging Peace (SEL4YWP)- UNESCO **30 Marks**
Link: https://www.framerspace.com/course/ywp?cid=5eaff2c239109c2c12ef8bd3

**Participants need to register themselves in the link https://docs.google.com/spreadsheets/d/1dECtZbAmcPhKKelSEimVv-hzPV7dA_g-Brty2rxC2vE/edit?usp=sharing, before accessing the course content.

Activity: Article Discussion, Quiz and Assignments **20 Marks**

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
CEP12EC01	Community Engagement Project	L	T	P	L	T	P	Total
		--	--	4	--	--	2	2
		Examination Scheme						
			ISE 1	MSE	ISE2	ESE	Total	
		Theory	--	--	--	--	--	
		Lab	50	--	50	--	100	

Pre-requisite Course Codes		--
Course Outcomes	CO1	Identify and address community needs and challenges which help learners to develop problem-solving skills and creativity in finding innovative solutions.
	CO2	Enhance their cultural competence and ability to work effectively in multicultural settings
	CO3	Critically think on complex issues considering multiple view points
	CO4	Demonstrate collaboration, team work, civic engagement, empathy and compassion while engaging directly with community
	CO5	Develop a lifelong commitment to social justice and making a positive impact in the world

This course requires students to participate in field-based learning/projects generally under the supervision of faculty. The curricular component of 'community engagement and service' involve activities that would expose students to the socio-economic issues in society so that the theoretical learnings can be supplemented by actual life experiences to generate solutions to real-life problems.

At the end of the course, it is expected that students will have valuable learnings in terms of enhanced communication skills, increased cultural competence, improved critical thinking, leadership skills, collaboration skills, empathy & compassion, civic engagement, problem-solving skills, self-reflection & personal growth and long-term commitment to social justice.

It is expected that 26-30 hours of contact time per credit in a semester (52 to 60 hours in a semester for 2 credits) along with 13-15 hours of activities such as preparation for community engagement and service, preparation of reports, etc., and independent reading and study.

Other Guidelines to students for successful Community Engagement:

Community engagement is the process of working collaboratively with and through groups of people affiliated by geographic proximity, special interest, or similar situations to address issues affecting the well-being of those people It is a powerful vehicle for bringing about environmental and behavioral changes that will improve the health of the community and its members. It often involves partnerships and coalitions that help mobilize resources and influence systems, change relationships among partners, and serve as catalysts for changing policies, programs, and practices.

Community engagement project is different as compared to traditional consultation. It is a regular engagement of community for achieving an identified goal or vision. It recognizes the role of community engagement in its broadest sense in the development of local democracy, while noting that the focus of the report is on the practice of community engagement as it relates to local authority activity.

Communication, diplomacy, patience, and flexibility are essential to engage with a community. For successful engagement conditions include: Shared and defined purpose. Willingness to collaborate. Commitment to contributing. Participation of the right people. Open and credible process. Involvement of a champion with credibility and clout. Ensure that the engagement process is complex but manageable. Initially the team will: Discuss and define the initiative and its potential impact. Set the purpose and goals for community engagement. Define the community. Know and respect the community's characteristics. Develop a relationship with the community, build trust, work with formal and informal leadership, find the community gatekeeper, identify the project champion, meet with the local organizations, and learn the assets and challenges for that community. Find the common interests.

The following four phases provide broad outline for the community engagement process:

Phase-I: Outreach

Go to the community instead of having the community come to you. Invite the stakeholders to a conversation. Create a constructive environment for dialogue allowing time to get to know the participants remembering that the community's time is valuable and must be respected. Identify the person or the organization that has convened the group and will provide initial leadership and organizational management. Outline the purpose and process for the conversation. Use a facilitator when appropriate. Define the issue and why it is important. Outline what is broken and focus on what is working. Is the issue a people problem or a situation problem? Can the problem be solved with technical expertise or will it require something else? Determine the interest and merit in hosting future discussions.

Phase-II: Gather Facts, Brainstorm and Select

Create an environment for discussion where people are comfortable asking questions, expressing doubts, and brainstorming new ideas. Gather the facts related to the issue and its impact. Use a SWOT, appreciative inquire, asset mapping, and other tools during the factfinding stage. Clarify the issue's alignment with the community's values and ethics. Establish the common ground on which conversations will be based. Brainstorm and gather alternative solutions. Ask the "what if" questions. Spend time discussing the options and the potential impact. Allow the process to equip the participants to see the change, feel the change, and then be prepared to change. Select the best practice/solution. If required use decision-making tools to reduce the number of options.

Phase-III: Plan and Review

Write the implementation action plan. Include the evaluation procedure that will answer the question "What will it look like when the change has happened?". Discuss the proposal with the appropriate stakeholders searching for insight and response. Use the feedback to assess and revise the plan. Stay focused on the solution.

Phase-IV: Implement and Evaluate

Implement the plan. Remember, groups want a rapid success. Identify an action that will provide a "meaningful win" within the "immediate reach." Evaluate the impact. Report the status to the community and gather feedback. Revise the plan and evaluate again.

Keep the participants informed through discussion agendas, written summaries of previous discussions, goals/assignments for the next discussion, and progress reports providing accountability for delivering what was promised.

Course Assessment:

ISE-1:
Activity: Report Submission: 20 Marks
Activity: Report Presentation: 30 Marks

ISE-2:
Activity: Report Submission: 20 Marks
Activity: Report Presentation: 30 Marks

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
		2	--	2	2	--	1	3
		Examination Scheme						
			ISE1	MSE	ISE2	ESE	Total	
PCC11EC03	Digital Electronics	Theory	20	30	20	100 (30% weight age)	100	
		Lab	20	–	30	–	50	

Pre-requisite Course Codes		Binary number system and codes, binary arithmetic
Course Outcomes	After the successful completion students should be able to	
	CO1	Compare TTL and CMOS families w.r.t. their characteristic parameters
	CO2	Construct combinational circuits using given MSI devices.
	CO3	Apply the knowledge of flip-flops and MSI devices to design sequential circuits.
	CO4	Analyze the given sequential circuits to identify the state transitions and race conditions.
	CO5	Implement the given logic function using programmable logic devices.

Module No.	Unit No.	Topics	Ref	Hrs.
1		**Implementation of Logic functions**		
	1.1	Logic gates, Implementation of functions using basic gates and using Universal gates	1,2, 3,4	4
	1.2	Formulating a logic function, Sum of Products (SOP), Product of Sums (POS), Minimization using Boolean Algebra, De Morgan's Theorems, Minimization using Karnaugh map (up to 4 variables), Quine-McClusky Technique	1,2, 3,4	
2		**Logic Families**		
	2.1	Characteristic parameters of logic families: Voltage and Current parameters, Fan in, Fan out, Noise margin, Power Dissipation, Propagation Delay	1,2, 3,4	3
	2.2	TTL NAND gate and its transfer characteristics, CMOS inverter and transfer characteristics, comparison of TTL and CMOS logic families		
3.		**Combinational Circuit Design**		
	3.1	Full adders, ripple carry adders, Carry Look ahead Adders, Binary Subtractors	1,2, 3,4	5
	3.2	Multiplexer/ Demultiplexer, Encoders, Priority Encoders, Parity Generators, Code Converters, comparator, ALU		
	3.3	Static and dynamic hazards in combinational circuits		
4 .		**Elements of Sequential Circuit**		

	4.1	Storage elements: Latches and Flip-flops (S-R, J-K, D, T Flip-flop), Master Slave Flip-flop	1,2, 3,4	5
	4.2	Synchronous and Asynchronous counters, Shift registers and their applications	1,2, 3,4	
5.		**Analysis of Sequential circuits**		
	5.1	Analysis of Moore and Mealy type Finite State Machines (FSM), State Reduction	1,2, 3,4	5
	5.2	Introduction to Asynchronous Sequential circuits, Essential hazards in asynchronous sequential circuits	1,2, 3,4	
6.		**Programmable devices**		
		Structure of Programmable Logic Devices (PLDs), Function implementation with PAL and PLAs, Introduction to CPLD and FPGA	1,2, 3,4	4
			Total	**26**

Recommended Books:

1. John F. Wakerly, "Digital Design Principles and Practice"- Pearson Publications, 4th edition
2. Morris Mano, Michael D. Ciletti, " Digital Design with introduction to Verilog HDL" Pearson, 5th edition
3. John M. Yarbrough, "Digital Logic Applications and Design" – Thomson Publications
4. Stephen Brown and Zvonko Vranesic, "Fundamentals of digital logic design with Verilog design", McGraw Hill, 3rd Edition
5. Roth and Kinney, "Fundamentals of Logic Design", Cengage learning,7th edition
6. William I. Fletcher, "An Engineering Approach to Digital Design", Prentice Hall of India
7. J. Bhaskar, A Verilog HDL Primer, Third Edition, Star Galaxy Publishing
8. Sameer Palnitkar, "Verilog HDL: A guide to digital design and synthesis"

Online References:

https://archive.nptel.ac.in/content/storage2/courses/106108099//Digital%20Systems.pdf

Course Assessment:

Theory:

ISE-1: 20 marks

Quiz/ crossword …10 Marks
Open book test ….10 marks

ISE-2: 2**0 Marks**

Case study …10 Marks
Oral examination….10 marks

MSE: 30 Marks written examination based on 50% syllabus

ESE: Three hours 100 Marks written examination (with 30% weightage) based on entire syllabus

Laboratory Experiments:

S.N.	Title of experiment	References
1.	To implement the combinational logic for a given function using basic gates and Universal gates.	**1,2**
2.	To simulate a CMOS inverter and to plot the transfer characteristics (using SPICE)	**1,2**
3.	a. To verify the function of 8-bit binary adder IC7483 b. To implement a BCD adder using IC7483	**1,2**
4.	a. To implement the function of 8-bit Multiplexer using IC74151 b. To implement a given 4 variable Boolean function using Multiplexer IC 74151	**1,2**
5.	To implement an 8-bit binary comparator using IC 7485	**1,2**
6.	a. To implement a Mod n asynchronous counter using flip-flops b. To implement a Mod n counter using IC 74163	**1,2**
7.	Implementation of a combinational circuit using reconfigurable devices a. To write an HDL code for the parity generator and simulate verify the operation by simulation. b. To implement the HDL code on FPGA and verify the operation.	**7,8**
8.	Implementation of a sequential circuit using reconfigurable devices a. To write an HDL code for a 4-bit shift register and verify the operation by simulation. b. To implement the HDL code on FPGA and verify the operation.	**7.8**

Course Assessment:
Lab:

40 Marks (08 experiments of 05 marks each) + 10 Marks (activity based) = 50 Marks

ISE-1
Four experiments. Continuous pre-defined rubrics-based evaluation for 20 marks.
ISE-2
a. Four experiments. Continuous pre-defined rubrics-based evaluation for 20 marks.
b. Activity based: Testing and debugging activity for 10 marks

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
		--	--	2	--	--	1	1
		Examination Scheme						
PCC11EC01	Innovation and Design Thinking		ISE1	MSE	ISE2	ESE	Total	
		Theory	--	--	--	--	--	
		Lab	20	--	30	--	50	

Pre-requisite Course Codes		--
	At the end of the course the students will be able	
Course Outcomes	CO1	To discuss case studies of innovative products and services.
	CO2	To identify the market needs and customer demand analysis.
	CO3	To generate ideas through brainstorming and frame product/service idea
	CO4	To empathize with the customer.
	CO5	To design and develop a prototype.
	CO6	To pitch their idea.

Module No.	Unit No.	Topics	Ref.	Hrs.
1		**Innovation and Creativity:** **(Takeaway)** Innovation, Invention and Creativity. Mindset. Convergent and Divergent Thinking. Case Studies – levels and types of Innovations. Market Impact. Linear and Non-Linear Innovations. **(Key Exercises)** 1. Exercises/Games/Activities to boost creativity and Inspiration 2. Article/Case Studies Discussion 3. Digital Market Survey Report and Customer Demand Analysis, preparing competencies report to identify desired level of innovation & domain definition.	1	04
2		**Introduction of Design Thinking:** **(Takeaway)** Five stage model of design thinking. Empathize, Define, Ideate, Prototype, Testing. Non-linearity of the Model. **(Key Exercises)** 1. Live examples and videos 2. Design Thinking Activity for given problem 3. Find the impact and value of Innovation	1,2	04
3	3.1	**Empathize:** **(Takeaway)** Empathize with users. Step into the customer's shoes. Ask right	1,2	04

		questions. What? Why? Empathy Map. Draw inference from research. **(Key Exercises)** 1. Immersion Activity-Body Storming. 2. Finding the user needs in the market by using Social, Physical, Identity, Communication, Emotional (SPICE) Framework 3. Creation of Empathy Map, Affinity Map, Mind Map, Journey Map 4. Story Telling, K-Scripts for case study, Role Playing		
4	**4.1**	**Definition and Ideation:** **(Takeaway)** Idea Generation, Themes, Thinking for refinement, Storytelling and Tools for Innovation **(Key Exercises)** 1. Brainstorming, Sketch 2. Situation, Constraints, Objectives, People, Estimates and Scope (SCOPES) tool 3. Social. Technology, Economy, Environment and Political (STEEP) trend analysis for opportunity framing by using steep matrix template. 4. Defining the strategic priorities of customer demand and stakeholder mapping 5. Generating new ideas with Substitute, Combine, Adapt, Magnify/Minify, Reverse, Eliminate, put to other use (SCAMPER) tool.	3,4	04
5	**5.1**	**Prototyping:** Prototyping, Testing for Desirable, Feasible and viable solution, Product Market Fit, Business Model validation **(Takeaway)** **(Key Exercises)** 1. Value Proposition Canvas 2. Business Model canvas	3,4	06
6		**The Design Challenge:** **(Takeaway)** Define Design Challenge, Prototyping Iteration, Pitching, Media **(Key Exercises)** 1. Demo day	4	04
			Total	**26**

Recommended Books:

1. Prof. Bala Ramadurai, "*Karmic Design Thinking*", ISBN-13 January 2020.
2. Idris Mootee, "*Design Thinking For Strategic Innovation: What They Can't Teach You at Business or Design School*", 2013, Wiley Publications.
3. Christoph Meinel, Larry Leifer, Hasso Plattner, "*Design Thinking: Understand – Improve – Apply",* Springer, 2011.

4. Roger Martin, "*The Design of Businesses: Why Design Thinking is the next Competitive Advantage*", Harward Business Press, 2009

Reference Books:

1. Peter F. Drucker, "*Innovation and Entrepreneurship*", Routledge.
2. Tim Brown, "*Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation"*, 2009 Harper Business.
3. Blake Masters, Peter Thiel, "*Zero to One: Notes on Start Ups, or How to Build the Future*"
4. Eric Ries, "*The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses"* 2011 Penguin
5. Andrew King, Jeanne Liedtka, Kevin Bennett, *"Solving Problems with Design Thinking: Ten Stories of What Works"***,** Columbia Business School Publishing, 2013.
6. Maurício Vianna, Ysmar Vianna, Isabel K. Adler, Brenda Lucena, Beatriz Russo, *"Design Thinking: Business Innovation Kindle Edition*", MJV Press 2011
7. Robert A. Burgelman, Clayton M. Christensen, Steven C Wheelwright, *"Strategic Management of Technology and Innovation",* McGraw-Hill, 2017, 5th Edition.

Online Courses:

1. https://www.classcentral.com/course/youtube-design-thinking-transforming-teams-110078
2. https://www.coursera.org/learn/uva-darden-design-thinking-innovation
3. https://www.coursera.org/learn/creative-thinking-techniques-and-tools-for-success
4. https://www.coursera.org/specializations/uva-darden-design-thinking
5. learning.edx.org: Design Thinking and Creativity for Innovation

Course Assessment:

Lab:

ISE-1 will be conducted for first three experiments. (Article discussion, Design thinking workshop for a sample idea, Empathy Map). Continuous pre-defined rubrics-based evaluation for 20 marks.

ISE-2

a. Idea Competition. Continuous pre-defined rubrics-based evaluation for 10 marks.
b. Business Model Canvas for identified Idea for 10 marks
c. Demo Day – Prototype for 10 marks

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
BSC12EC06	**Mathematics and Numerical Methods**	L	T	P	L	T	P	Total
		2	1	0	2	1	0	3
		Examination Scheme						
			ISE1	**MSE**	**ISE2**	**ESE**	**Total**	
		Theory	20	30	20	100 (30% weightage)	100	
		Tutorial	20	--	30	--	50	

Pre-requisite Course Codes	BSC11EC01, BSC11EC03 At the end of the course learner will be able to	
Course Outcomes	CO1	Apply probability distributions of Poisson and Normal to some of the real-life situations.
	CO2	Apply the concept of sampling distribution in hypothesis testing of small samples using sampling theory.
	CO3	Demonstrate basic knowledge about the vector spaces as an algebraic structure.
	CO4	Execute numerical methods to solve a system of linear equations, root of an equation

Theory:

Module No.	Unit No.	Topics	Ref.	Hrs.
1		**Probability Distribution and Sampling Theory-I**	1,2,3	**08**
	1.1	Probability Distribution: Poisson and Normal distribution		03
	1.2	Sampling distribution, Test of Hypothesis, Level of Significance, Critical region, One-tailed, and two-tailed test, Degree of freedom.		03
	1.3	Students' t-distribution (Small sample). Test the significance of single sample mean and two independent sample means and paired t- test)		02
2		**Sampling Theory-II**	1,2,3	**06**
	2.1	Chi-square test: Test of goodness of fit and independence of attributes (Contingency table) including Yate's Correction.		03
	2.2	Analysis of variance: F-test (significant difference between variances of two samples)		03
3		**Linear Algebra - Vector Spaces**	4,5	**08**
	3.1	Vector spaces		03

	3.2	Subspaces of vector spaces		02
	3.3	Basis and dimension		02
	3.4	The Gram-Schmidt orthogonalization process		01
4		**Numerical Solutions of transcendental equations and system of linear equations**	6,7	**04**
	4.1	Solution of Transcendental Equations: Solution by Newton Raphson method, and Regula-Falsi method.		02
	4.2	Solution of system of linear algebraic equations by Gauss-Jacobi method, Gauss-Seidel method		02
			Total	**26**

Recommended Books:

[1] Dr B.S. Grewal, "*Higher Engineering Mathematics*", Khanna Publications, 4nd Edition.

[2] H. K. Dass, "*Advanced Engineering Mathematics*", S. Chand, 28th Edition.

[3] Erwin Kreysizg, "*Advanced Engineering Mathematics*", John Wiley & Sons, 10th Edition.

[4] Robert M. Thrall, Leonard Tornheim, "*Vector Spaces and Matrices*", Dover Publications, Inc.

[5] Gilbert Strang, "*Linear Algebra for Everyone*", Wellesley Publisher.

[6] James F. Epperson, "*An Introduction to Numerical Methods and Analysis*", Wiley, Revised edition.

[7] Dr. J. S. Chitode, "*Numerical Techniques*", Technical Publication, 1st edition.

Course Assessment:

Theory:

ISE-1: MCQ: 20 Marks

ISE-2: MCQ: 20 Marks

MSE: 30 Marks written examination based on 50% syllabus

ESE: Three hours 100 Marks written examination (with 30% weightage) based on entire syllabus

Tutorial:

Exp. No.	Tutorial Details	Marks
1	Probability distributions	**06**
2	Testing of hypothesis	**08**
3	Chi-square test	**06**
4	F-Test	**06**
5	Vector spaces and subspaces	**06**
6	Basis and dimension of a vector space	**06**
7	Numerical solutions of transcendental equations	**06**
8	Numerical solutions of the system of linear equations	**06**
	Total Marks	**50**

Tutorial:

1. ISE-1 will be conducted for three tutorials. Continuous pre-defined rubrics-based evaluation for 20 marks.

2. ISE-2 will be conducted for five tutorials. Continuous pre-defined rubrics-based evaluation for 30 marks.

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
PCC12EC08	Analog Electronics	L	T	P	L	T	P	Total
		2	--	2	2	--	1	3
		Examination Scheme						
			ISE1	MSE	ISE2	ESE	Total	
		Theory	20	30	20	100 (30% weightage)	100	
		Lab	20	–	30	–	50	

Pre-requisite Course Codes		ESC11EC02
Course Outcomes	CO1	Evaluate performance of diode applications
	CO2	Evaluate the performance of amplifiers
	CO3	Analyze Electronics circuits using BJT and FET (DC & AC analysis)
	CO4	Analyze differential amplifiers for various performance parameters
	CO5	Design an application with the use of integrated circuits.

Module No.	Unit No.	Topics	Ref.	Hrs
1		**Applications of Diodes**		4
	1.1	Rectifier: Half wave, Full wave Rectifiers	1,2	
	1.2	Clippers and Clampers		
2		**Filters and Regulators**		4
	2.1	Filters: Different types of Filters such as C, L, LC and π	1,2	
	2.2	Discrete level regulator: Series and shunt type regulators		
3		**Amplifiers**		5
	3.1	DC Analysis with types of biasing of the Amplifier and its need.	1,2,5	
	3.2	AC Analysis: (Av, Ai, Zi, Zo and B.W.) Devices (BJT, FET and MOSFET) with and without Feedback		
	3.3	Power Amplifier: Class A, B, C and AB		
4		**DIFF-AMP and OP-AMP**		4
	4.1	Types of DIFF-AMP and the comparison	1,2,3, 4	
	4.1	Functional Block Diagram of OP-AMP, Transfer Characteristics and Specifications of Op-amp		
5		**Waveform Generator**		5
	5.1	Oscillators (sinusoidal Waveform Generator)	3,4	
	5.2	Multivibrators (Square and Triangular Waveform Generators)		
6		**Design of Power supply and Signal Generator**		4
	6.1	Design of the power Supply for the given specifications	1,2,3, 4	
	6.2	Signal Generator for the given Amplitude and frequency		
			Total	**26**

Recommended Books:

1. Donald A. Neamen, "Electronic Circuit Analysis and Design", TATA McGraw Hill, 2nd Edition
2. Robert Boylestead and Louis Nashelsky " Electronic Devices and Circuit Theory", Pearson Education 10th Edition
3. D. Roy Choudhury and S. B. Jain, "Linear Integrated Circuits", New Age International Publishers, 4th Edition.
4. Sergio Franco, "Design with operational amplifiers &analog integrated circuits", Tata McGraw Hill, 3rd edition
5. Muhammad H. Rashid, "Microelectronics Circuits Analysis and Design", Cengage

Course Assessment:

Theory:

ISE-1: 20 marks

1. Quiz/ crossword for 10 Marks
2. Mini-project on Power supply Design for 10 marks

ISE-2: 2**0 Marks**

1. Open book test :10 Marks
2. Mini-project on Signal Generator: 10 marks

MSE: 30 Marks written examination based on 50% syllabus

ESE: Three hours 100 Marks written examination (with 30% weightage) based on entire syllabus

Laboratory Experiments:

S.N.	Title of experiment	References
1.	Design the rectifier and compare the performance.	1,2
2.	Use diode to achieve clipping and clamping of the circuits. Try different circuits and compare the performance.	1,2
3.	Compare the performance of various filters to get better performance.	1,2
4.	Design the voltage regulator circuit to get proper regulation and determine % load and Line regulation	1,2
5.	Analyze CE and CS amplifier both DC analysis (At-least two different devices) (Perform simulation)	1,2
6.	AC analysis for CE amplifier (Determine Av, Zi and Zo)	1,2
7.	Simulate the transfer characteristics for the DIFF-AMP	3,4
8.	Oscillator design: Wien bridge as well as Phase shift oscillator using OP-AMP	3.4

Course Assessment:

Lab:

ISE-1 will be conducted for four experiments. Continuous pre-defined rubrics-based evaluation for 20 marks.

ISE-2:

a. Four experiments. Continuous pre-defined rubrics-based evaluation for 20 marks.
b. Activity based: Mini project debugging for 10 marks

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
PCC12EC09	Discrete Structures and Automata Theory	L	T	P	L	T	P	Total
		2	1	--	2	1	--	3
		Examination Scheme						
			ISE 1	MSE	ISE2	ESE	Total	
		Theory	20	30	20	100 (30% weight age)	100	
		Tutorial	20	--	30	--	50	

Pre-requisite Course Codes		Number theory, Set theory
Course Outcomes	CO1	Apply the concepts of relations, functions, lattices and recurrence relations to solve problems
	CO2	Apply the concepts of graph and trees for traversal, shortest path algorithms.
	CO3	Design finite automaton for a regular expressions and languages.
	CO4	Design Context free grammar, pushdown automata to recognize the language

Module No.	Unit No.	Topics	Ref.	Hrs.
1		**Relations, Functions and Lattices**	1,2	5
	1.1	Sets, Product Sets and Partitions, Function, Paths in relations and Diagraphs, Properties of Relations, Closure of Relation, Equivalence Relations, Operations on Relations, Warshall's Algorithm, Partially Ordered Sets, External Elements of Partially Ordered Sets, Hasse Diagram		
	1.2	Lattice, Sub lattice, Isomorphic Lattices, Properties of Lattice		
2		**Algebraic Structures**	2,4	3
	2.1	Algebraic Structures - Semi group, Monoids, Groups, Cyclic groups		
	2.2	Abelian groups, Normal Subgroups		
3		**Graph Theory**	2,3,4	4
	3.1	Concepts and terminologies, Graphs as Model, Isomorphism, Bipartite Graphs, Directed Graphs		
	3.2	Definitions, Paths and circuits: Eulerian and Hamiltonian, Planner Graph. Isomorphism of graphs, Dijkstra Shortest Path Algorithm		
	3.3	Trees, Types of Trees, Minimal Spanning Trees-Prim's Algorithm and Kruskal's Algorithm		
3		**Finite Automata**	5,6,7	5
	3.1	Regular languages and regular expressions		
	3.2	Finite Automata, Nondeterministic Finite Automata,		

		Nondeterministic Finite Automata with ϵ-transitions, NFA to DFA Conversion		
	3.3	Finite Automata with output (Moore and Mealy Machine)		
4		**Regular Languages**	5,6,7	4
	4.1	Regular Language, The pumping lemma for regular languages, Applications of the pumping lemma		
	4.2	Closure properties for regular languages		
	4.3	Decision Properties for Regular Languages		
5		**Context Free Grammar (CFG) and Push Down Automata (PDA)**	5,6,7	5
	5.1	Grammars: Chomsky hierarchy, CFG- Definition, Sentential forms, Leftmost and Rightmost derivations.		
	5.2	Context Free languages (CFL): Parsing and Ambiguity. CFLs: Simplification and Applications.		
	5.3	Normal Forms: Chomsky Normal Form		
	5.4	PDA- Definition, Transitions (Diagrams, Functions and Tables), Design of PDA with Graphical Notation and Instantaneous Descriptions.		
			Total	**26**

Recommended Books:

1. Kenneth H. Rosen, "Discrete Mathematics and it's applications", Tata McGraw-Hill, 7th Edition
2. Bernad Kolman, Robert Busby, Sharon Cutler Ross, Nadeemur-Rehman, "Discrete Mathematical Structures", Pearson Education, 6th Edition.
3. C L Liu, Mohapatra: "Elements of discrete mathematics: a Computer Oriented approach", McGraw Hill-New Delhi.
4. Doughlas west "Introduction to Graph theory," Prentice Hall India
5. John E. Hopcroft, Rajeev Motwani, Jeffrey D. Ullman, "Introduction to Automata Theory, Languages, and Computation", Pearson Education, 3rd Edition.
6. Michael Sipser, "Introduction to the Theory of computation", Cengage, 3rd Edition
7. John C. Martin, "Introduction to Languages and the Theory of Computation", McGraw-Hill, 4th Edition.

Course Assessment:

Theory:

ISE-1:

Activity: -

1. MCQ: 10 Marks
2. Case study presentation discussing applications of Discrete Structures: 10 Marks

ISE-2:

Activity: -

1. MCQ: 10 Marks
2. Case study presentation discussing applications of Automata: 10 Marks

MSE: 30 Marks written examination based on 50% syllabus

ESE: Three hours 100 Marks written examination (with 30% weightage) based on entire syllabus

Tutorial:

S.N.	Tutorial	References
1	**Tutorial 1:** Set theory, Functions	1,2,3,4
2	**Tutorial 2:** Relations, Lattices	1,2,3,4
3	**Tutorial 3:** Graph Theory	1,2,3,4
4	**Tutorial 4:** Algebraic Structures	1,2,3,4
5	**Case Study Presentation**: Graph Algorithms, Web Graph, Google maps etc.	1,2,3,4
6	**Tutorial 5:** Finite Automata	5,6,7
7	**Tutorial 6:** Regular Language	5,6,7
8	**Tutorial 7:** Context Free Grammer	5,6,7
9	**Tutorial 8:** PDA and Turing Machine	5,6,7
10	**Case Study Presentation:** Applications of Automata	5,6,7

Course Assessment:

Tutorial:

ISE-1: - Four tutorials based on Set theory, Relations, Functions and Lattice, Graph Theory, Algebraic Structures. Continuous pre-defined rubrics-based evaluation for 20 marks.

ISE-2: - Four tutorials based on Finite automata, Regular Languages and grammar will be conducted for five tutorials. Continuous pre-defined rubrics-based evaluation for 30 marks.

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
PCC12EC10	Embedded Systems	L	T	P	L	T	P	Total
		--	--	2	--	--	1	1
		Examination Scheme						
			ISE1	MSE	ISE2	ESE	Total	
		Lab	20	--	30	--	50	

Pre-requisite Course Codes		ESC11EC02
Course Outcomes	CO1	Interface various sensors and actuators to embedded cores
	CO2	Generate timing delays for Embedded applications
	CO3	Write code using RTOS for multi-tasking Embedded systems
	CO4	Design applications using different embedded cores

S.N.	Title of experiment	References
1	**I/O port programming** Interfacing of LEDs and switches with any embedded core. (8051/ARM/STM32)	1,2,3,4
2	**Sensor Interfacing** Interfacing of Temperature sensor with any embedded core. (8051/ARM/STM32)	1,2,3,4
3	**Display Interfacing** Interfacing of LCD/ Seven segment display with any embedded core. (8051/ARM/STM32)	1,2,34,
4	**Motor Interfacing** Interfacing of a DC motor/Stepper motor control (speed and Direction control) with any embedded core (8051/ARM/STM32)	1,2,3,4
5	**PWM generation** Using the Internal PWM module of ARM controller, generate PWM and vary its duty cycle.	1,2,34,
6	**Timer programming** Generate a timing delay using the timer section of any embedded core (8051/ARM/STM32)	1,2,3,4
7	**I2C Communication** Implement I2C communication to connect to DS1307 RTC(any embedded core)	1,2,3,4
8	**Programming with FreeRTOS** i. Porting of FreeRTOS to Arduino/STM32. ii. Task switching using FreeRTOS iii. Inter-process communication using FreeRTOS (Semaphore/ Message Queue)	5,6

Recommended Books/References:

1. M. A. Mazidi, J. C. Mazidi, Rolin D. McKinlay, "The 8051 Microcontroller and Embedded Systems Using Assembly and C ", Pearson Education, 2nd Edition.
2. Joseph Yiu, "The Definitive guide to ARM CORTEX-M3 & CORTEX-M4 Processors", Elsevier, 3rd Edition.
3. Rajkamal, "Embedded Systems: Architecture, Programming and Design", McGraw Hill ,3rd Edition.
4. https://www.keil.com
5. https://www.freertos.org
6. https://www.arduino.cc

Course Assessment:

Lab:

ISE-1 will be conducted for four experiments. Continuous pre-defined rubrics-based evaluation for 20 marks.

ISE-2

a. Four experiments. Continuous pre-defined rubrics-based evaluation for 20 marks.
b. Activity: Mini- Project (10 marks)

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
MDM02	Emerging Technology and Law	L	T	P	L	T	P	Total
		2	--	--	2	--	--	2
		Examination Scheme						
			ISE1	MSE	ISE2	ESE	Total	
		Theory	50	--	50	--	100	
		Lab	--	--	--	--	--	

Pre-requisite Course Codes		--
Course Outcomes	CO1	To recognize the importance of legal technology domain
	CO2	To demonstrate awareness of the laws related to emerging technologies and legal implications of their work
	CO3	To demonstrate understanding of the impact of emerging/contemporary technologies on the legal ecosystem
	CO4	To demonstrate awareness about company laws, FEMA and few other important acts related to engineering design and consumer protection

Module No.	Unit No.	Topics	Ref.	Hrs.
1		**Tech Legal Market**	1	4
	1.1	Legal Marketplace, Impact of Technology on Legal Profession		
	1.2	How technologists can help reshape legal system		
	1.3	Career Development in Legal Tech Domain		
2		**Emerging Technologies and Legal Implications-1**	1	8
	2.1	Cyber Crimes, Cyber Threats and Issues: Information Technology Act 2000		
	2.2	Blockchain and Legal Issues		
	2.3	Legal Implications of Artificial Intelligence		
	2.4	Electronic and Digital Signatures		
	2.5	Implications of social media Laws		
3		**Emerging Technologies and Legal Implications-2**	1	6
	3.1	Legal Ecosystem for Autonomous Vehicles and Unmanned Aerial Vehicles (UAV)		
	3.2	Privacy and Data Protection with a Trillion Connected & Cognitive Devices		
	3.3	Legal Ecosystem for 5G		
4		**Company Laws**	2,3	4
	4.1	Companies Act, 1956- Nature and Meaning, Classification of Companies, Incorporation of Companies		
	4.2	Sources of Capital, Board of Directors, Company Meetings	2,3	
5		**Regulation and Management of Foreign Exchange**		2
	5.1	Foreign Exchange Management Act FEMA 1999		
6		**Other Important Laws**	2,3	2
	6.1	Consumer Protection Act, Competition Act 2002,		

		Semiconductor Integrated Circuits Layout-Design Act 2000, Designs Act 2000, Bureau of Indian Standards Act 2016,		
			Total	**26**

Recommended Books:

1. N. S. Nappinai, "*Technology Laws Decoded*," LexisNexis, 2017
2. Vibha Arora and Kunwar Arora, "*Law for Engineers*" Central Law Publications, 2017
3. Vandana Bhatt and Pinky Vyas, "*Laws for Engineers*", ProCare, 2015

Course Assessment:

ISE-1: Quiz: 20 Marks
Activity: Negotiation: 30 Marks

ISE-2: Quiz: 20 Marks
Activity: Moot Court: 30 Marks

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
		1	--	2	1	--	1	2
		Examination Scheme						
			ISE1	MSE	ISE2	ESE	Total	
OEEC31	Operating Systems	Theory	10	15	10	50 (30% weightage)	50	
		Lab	20	--	30	--	50	

Pre-requisite Course Codes		ESC11EC03
Course Outcomes	CO1	Describe the various objectives, functions and structure of OS
	CO2	Analyze the concept of process management and scheduling algorithms
	CO3	Apply the concepts of synchronization and deadlocks
	CO4	Evaluate performance of Memory allocation and replacement policies
	CO5	Summarize the concepts of file and I/O management and disk scheduling

Module No.	Unit No.	Topics	Ref.	Hrs.
1		**Introduction to Operating System (OS)**		2
	1.1	Definition, Objectives, Functions, Structures of OS, Types of OS	1,2	
	1.2	Kernel, Shell and System Calls	1, 2	
2		**Process Management**		3
	2.1	Process, Process Control Block (PCB), Process state transition, Process vs Threads	2.3	
	2.2	Process Scheduling, Scheduling algorithms and their comparison, Problems on Scheduling algorithms	2, 3	
3		**Synchronization and Deadlock**		2
	3.1	Process synchronization, Race condition, Critical section problem (CSP), Requirements of the Solution to CSP, Mutual Exclusion, Semaphores	2,3	
	3.2	Deadlock and conditions for deadlock, strategies-for-handling-deadlocks: Prevention, Avoidance, Detection and Recovery	2, 3	
4		**Memory Management**		3
	4.1	Memory management requirements, Memory partitioning and allocation strategies, Problems on Memory allocation strategies, Virtual memory	3,4	
	4.2	Paging and Segmentation, Page replacement policies, Problems on page replacement policies	3, 4	
5		**File and I/O Management**		3
	5.1	File organization, File access methods, File allocation, techniques, Comparison of Windows and Linux based File System: exFAT and ext4	3, 4	
	5.2	Organization of I/O Function, Disk Scheduling Algorithms,	3, 4	

		Problems on Disk Scheduling Algorithms		
			Total	**13**

Recommended Books:

1. William Stallings, Operating System: Internals and Design Principles, Prentice Hall, 8thEdition, 2014, ISBN-10: 0133805913 • ISBN-13: 9780133805918.
2. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, Operating System Concepts, John Wiley &Sons, Inc., 9thEdition, 2016, ISBN 978-81-265-5427-0.
3. Achyut Godbole and Atul Kahate, Operating Systems, McGraw Hill Education, 3rd Edition.
4. Andrew Tannenbaum, Operating System Design and Implementation, Pearson, 3rd Edition.
5. Maurice J. Bach, "Design of UNIX Operating System", PHI
6. Sumitabha Das, "UNIX: Concepts and Applications", McGraw Hill, 4thEdition.

Online References:

1. Gate Smashers (Youtube Channel): https://www.youtube.com/watch?v=WJ-UaAaumNA
2. Swayam: https://onlinecourses.nptel.ac.in/noc20cs04/preview
3. Stanford University: http://web.stanford.edu/~ouster/cgi-bin/cs140- spring14/lectures.ph

Course Assessment:

Theory:

ISE-1:
Quiz and assignments on first two modules for 10 Marks

ISE-2:
Quiz and assignments on next three modules for 10 Marks

MSE: 15 Marks written examination based on 50% syllabus

ESE: Two hours 50 Marks written examination (with 30% weightage) based on entire syllabus

Laboratory Experiments:

S.N.	Title of experiment	References
	Linux Commands	
1	Explore Linux File System, Environment Variables, Execution of Linux Commands	1, 2
2	Implementation of Shell Scripts and File related System Calls	1, 2
	Process Management	
3	Implementation of Process related System Calls	2, 3
4	Implementation of Non Pre-emptive and Pre-emptive scheduling algorithms	2, 3
	Process Synchronization	
5	Implementation of Process Synchronization	2 , 3
6	Implementation of Deadlock Detection and Avoidance Strategies	2, 3
	Memory Management	
7	Implement various Memory Management techniques and evaluate their performances	3, 4
8	Implement various page replacement policies and evaluate their performances	3, 4
	File and I/O Management	
9	Implementation of various File organization & allocation techniques	3, 4
10	Implementation of various Disk Management techniques and evaluate their performance	3, 4
	Case Study	
11	Case Study on Modern Operating Systems	1, 2
12	Interfacing an operating system with electronics hardware	3, 4

Course Assessment:

Lab:

ISE-1 will be conducted for first five experiments. Continuous pre-defined rubrics-based evaluation for 20 marks.

ISE-2

a. Next five experiments. Continuous pre-defined rubrics-based evaluation for 20 marks.

b. Case Study presentation for 10 marks

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned		
		L	T	P	L	T	P	Total
VSE12EC03	Data Structures	0	0	4	0	0	2	2
		Examination Scheme						
		ISE 1		MSE	ISE2	ESE		Total
		50		--	50	--		100

Pre-requisite Course Codes		C programming
Course Outcomes	CO1	Implement various operations of linear data structures.
	CO2	Implement various operations of non-linear data structures.
	CO3	Implement appropriate sorting and searching technique for a given problem
	CO4	Develop solutions for real world problems by selecting appropriate data structure and algorithms.
	CO5	Analyse the complexity of the given algorithms.

Exp. No.	Name of the experiment	Hrs
Types of Data structures: Linear and Non-linear, Stack ADT, Operations on stack, Applications of stack		
1	a. Implement Stack ADT using array b. Analyze time complexities of all operations of stack.	2
2.	a. Convert Infix to Postfix and evaluate the postfix using Stack ADT.	4
Queue ADT, Operations on queue, Types of queues: Linear, Circular, Priority, Applications of queue		
3	a. Implement Linear Queue ADT using array. **OR** b. Implement Circular Queue ADT using array.	2
4	a. Implement Priority Queue ADT using array. b. Analyze time complexities of all operations of queue	2
Linked List ADT, Types of Linked List: Singly, Circular, Doubly LL, Applications of linked list.		
5	a. Implement following operations on Singly Linked List ADT. 1. Insert (all three) 2. Delete (all three) 3. Split 4. Concatenate 5. Copy 6. Reverse 7. Traverse b. Analyze time complexities of all operations of linked list.	4
6	a. Implement following operations on Circular Linked List ADT 1. Insert (all three) 2. Delete (all three) 3. Traverse b. Analyze time complexities of all operations of circular linked list.	2

7	a. Implement Doubly Linked List ADT. 1. Insert (all three) 2. Delete (all three) 3. Traverse Forward 4. Traverse Backward b. Analyze time complexities of all operations of doubly linked list.	4
8	a. Addition of two polynomials using linked list	2
Tree terminologies, Binary Tree, Tree traversal techniques, BST ADT, Expression Tree. Applications of Binary Tree		
9	a. Implement following operations on Binary Search Tree ADT using Linked List. 1. Insert 2. Delete (All three cases) 3. Search 4. Display b. Analyze the time complexities of all the operations on BST.	4
10.	a. Construct an expression tree from given postfix form of expression.	4
11	b. Implement a program to represent infix, prefix and postfix form of arithmetic expressions using binary tree traversal techniques. The expression is represented as a binary tree, where each operator is a parent node, and its operands are the left and right children	2
Graph terminologies, Graph representations, Graph traversal techniques.		
12	a. Implement a program to represent a graph using an adjacency list or adjacency matrix data structure. Then, perform non recursive breadth-first search (BFS)	2
13	a. Implement non recursive depth-first search (DFS) traversal algorithms on Graph represented using Adjacency matrix..	2
Sorting: Insertion sort, selection sort, quick sort, merge sort		
14	a. Implement Modified Bubble Sort, Insertion sort and Selection sort. b. Analyze the time complexity of the algorithms.	2
15	a. Implement Quick sort. b. Analyze the time complexity of the algorithm.	2
16	a. Implement Merge sort b. Analyze the time complexity of the algorithm.	2
Searching and Hashing: Binary search, Hashing, Hash functions, Collision resolution techniques		
17	a. Implement the binary search algorithm to search for a key element in a sorted array. b. Analyze the time complexity of the algorithm.	2
18	a. Implement a hash table data structure using an array and handle collisions using chaining (linked lists) b. Analyze the time complexity of the algorithm	2
19	a. Implement a hash table data structure using an array and handle collisions using linear probing **b.** Analyze the time complexity of the algorithm	2

Mini Project: (Suggested list of Mini Project Topics)		
20	a. Text Edition Application: Implement a text editor with an undo feature using a stack. Every time a change is made to the text, push the previous state onto the stack. When the user performs an undo operation, pop the last state from the stack and revert the text to that state b. Develop a print job scheduler using a queue. Users submit print jobs to the queue, and they are processed in the order they were received. Once a job is completed, it is dequeued from the queue. c. Implement a task management system using a singly linked list. Each task is represented as a node in the linked list, containing information such as task description, priority, and deadline. Users can add, edit, delete, and search for tasks within the linked list d. Create a browser history manager using a doubly linked list. Each webpage visited is represented as a node in the linked list, with pointers to the previous and next pages. Users can navigate forward and backward through their browsing history, add new pages, delete visited pages, and search for specific pages. e. Implement a dictionary using a binary search tree (BST). Each node in the tree represents a word and its associated meaning. The tree is organized such that for any node, all words to the left have lexicographically smaller values, and all words to the right have lexicographically greater values. f. Given a network of cities connected by roads with different weights representing distances, find the minimum spanning tree to connect all cities with minimum total distance.	4
	Total	**52**

Recommended Books:

1. "Data Structures using C and C++" Yedidyah Langsam, Moshe J. Augenstein, Aaron M. Tenenbaum
2. "Data Structures using C", Reema Thareja, Third Edition.
3. "Data Structures and Program Design in C++", Robert L. Kruse, Alexander J. Ryba, Prentice-Hall India.
4. "Data Structures and Algorithm in Java", Goodrich and Tamassia, John Wiley and Sons, Sixth Edition 2014.
5. "Data Structures and Pseudocode approach with C", 2nd Edition by Richard F. Gilberg & Behrouz A. Forouzan

Course Assessment:

ISE-1: (50 Marks)

Activity 1: Mock Practical Exam after completing first five experiments **(20 Marks)**

Activity 2: Online Coding Challenge **(30 Marks)**

Participation in online coding platforms like LeetCode, HackerRank, or Codeforces, where students can practice solving algorithmic problems related to data structures.

ISE-2: (50 Marks)

Activity: Mini Project (**20 Marks**)

Final Practical Exam based on full syllabus. (**30 Marks**)

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
AEC12EC02 AEC12CE02 AEC12CS02 AEC12ME02	Sanskrit for Beginners	2	--	--	2	--	--	2
		Examination Scheme						
			ISE1	MSE	ISE2	ESE	Total	
		Theory	50	--	50	--	100	
		Lab	--	--	--	--	--	

Pre-requisite Course Codes		Basic Language skills
Course Outcomes	CO1	Demonstrate understanding of the Fundamentals of Sanskrit Language
	CO2	Apply Vocabulary and grammar skills for day to day conversation
	CO3	Developing Speaking and Learning skills

Module No.	Unit No.	Topics	Ref.	Hrs.
1	1.1	Introduction: Some Unique characteristics of Sanskrit The Sounds of Sanskrit: Its Alphabet Sentence Construction and Its underlying logic Introduction of Self and Others Basic verbs and some conjugations	1-8	6
2	2.1	Introduction to Genitive (6^{th} Case) Counting and Reading the Time Plural of Pronouns and Nouns Conjugation of Basic Verbs in the Plural Introduction to the Locative (7^{th} Case)	1-8	6
3	3.1	Days of the week, Months, Future Tense Past Tense and More Verbs Introduction to the Accusative (2^{nd} Case) Introduction to the Instrumental (3^{rd} Case)	1-8	6
4	4.1	Introduction to the Ablative (5^{th} Case) Introduction to the Dative (4^{th} Case) Introduction to the Vocative (8^{th} Case)	1-8	6
	4.2	Stories and Motivational Shlok with word by word meaning	1-8	2
			Total	**26**

Recommended Books/ References:

1. Kumari, S. "*Sanskrita Chitrapadakoshah*," Mysuru: Bharatiya Bhasha Sansthanam, 1993
2. *Samkrita-vyavahaara-sahasri* (Samskrit-English), New Delhi: Sanskrita Bharati
3. Sampad, & Vijay, "*The Wonder that is Sanskrit*" Pondicherry: Sri Aurobindo Society, 2005.
4. Satvlekar, S. D. "*Sanskrit Swayam Shikshak,"* Delhi: Rajpal & Sons, 2013
5. Shastri, V K. "*Teach Yourself Samskrit: Prathama Diksha*" Delhi: Rashtryia Sanskrita Samsthana, 2012
6. Vishwasa "*Abhyāsa-pustakam*", New Delhi: Samskrita Bharati, 2014

7. https://onlinecourses.nptel.ac.in/
8. https://www.learnsanskrit.org/

Course Assessment:

ISE-1: Activities and Assignments: 50 Marks
ISE-2: Activities and Assignments: 50 Marks

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
AEC12EC02	Tamil for Beginners	L	T	P	L	T	P	Total
		2	--	--	2	--	--	2
		Examination Scheme						
			ISE1	MSE	ISE2	ESE	Total	
		Theory	50	--	50	--	100	
		Lab	--	--	--	--	--	

Pre-requisite Course Codes		Basic Language skills
Course Outcomes	CO1	Demonstrate understanding of the Fundamentals of Tamil Language
	CO2	Apply Vocabulary and grammar skills for day to day conversation
	CO3	Developing Speaking and Learning skills

Module No.	Unit No.	Topics	Ref.	Hrs.
1	1.1	**Introduction to Tamil Alphabets and Pronunciation** History of Tamil language		1
	1.2	Learning Tamil Alphabets		1
	1.3	Basic Pronunciation and Oral drills with visual learning		2
	1.4	Greetings and common expressions		2
2	2.1	**Basic Grammar and Sentence Structure** Sentence Construction: Subject, Verb, Object (SVO)		2
	2.2	Present tense, Past tense and Future tense		2
	2.3	Common Nouns, Pronouns with negative imperatives		2
3	3.1	**Building Vocabulary for Everyday Conversation** Learning Numerals (Cardinal numbers) 1-20, 100. 200…1000		2
	3.2	Forming Simple sentences with interactive lessons		3
	3.3	Learning Days of week, Months of the year, Fruit, Food grains, Parts of the Body, Names of Common places like Hospitals, Market place, shops, Saloons etc.		3
4	4.1	**Daily life and Survival Phrases** Day to day usage of language for daily routines in conversation with Student to Teacher, Vegetable shop vendor, Railway Station, conversation with Auto Drivers, Hospitals etc.		3
	4.2	Role Play exercises in common situations		3
			Total	**26**

Recommended Books:

1. Kesav." A practical course to learn tamil for Absolute beginners (Standard and Colloquial), Notion Press, 2020
2. Dr.R.Kalidasan, Dr.S.Velayuthan, " English Grammar-An easy way to learn with Tamil Explanation and key, Shanlax publisher, 2019
3. Oxford English-English Tamil Dictionary, Oxford.

Course Assessment:

ISE-1: Activities and Assignments: 20 Marks
ISE-2: Activities and Assignments: 20 Marks

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
AEC12EC02 AEC12CE02 AEC12CS02 AEC12ME02	Kannada for Beginners	2	--	--	2	--	--	2
		Examination Scheme						
			ISE1	MSE	ISE2	ESE	Total	
		Theory	50	--	50	--	100	
		Lab	--	--	--	--	--	

Pre-requisite Course Codes		Basic Language skills
Course Outcomes	CO1	Demonstrate understanding of the Fundamentals of Kannada Language
	CO2	Apply Vocabulary and Grammar skills for day-to-day conversation
	CO3	Developing Speaking and listening skills

Module No.	Unit No.	Topics	Ref	Hrs
1	1.1	**Introduction to Kannada Alphabets and Pronunciation** History of Kannada Language	1-4	1
	1.2	Learning Kannada Alphabets		1
	1.3	Pronunciation and visual learning		2
	1.4	Greetings and Common expressions		2
2	2.1	**Basic Grammar and Sentence Structure with Subject, Verb, Objective (SVO)** Basics of Sentence Formation	1-4	2
	2.2	Present tense, Past tense, Future tense, and Introduction to Adjectives		2
	2.3	Common Nouns, Pronouns with negative imperatives		2
3	3.1	**Conversation Phrases and Language Vocabulary** Learning Numerals (Cardinal Numbers) 1-20 / 100 -1000	1-4	2
	3.2	Classified Sentences and Useful expressions		3
	3.3	Learning Days of week, Months of the year, Fruits, Food grains, Parts of the body, Names of common places like Hospitals, markets, shops, saloons, gender, weather etc.		3
4	4.1	**Developing Language fluency and Proficiency.** Day to day usage of Language for daily routine in conversation with Student to Teacher, vegetable vendor, in Railway station, with Auto driver, in Hospitals, etc.	1-4	3
	4.2	Role play exercises in common situations		3
			Total	**26**

Recommended Books:

1. Upadhaya,U.P & N.K.Krishnamurthy, "Conversational Kannada"Prism Books, 2018
2. Thomas Hodson, "Grammar of the Kannada or Canarese language", Gyan publishing house, 2020
3. Ramanja Reddy Merugu , "Learn kannada through English" 2021
4. Dr.Prabhu sankara & B.V.Sridhar," Oxford English-English-Kannada dictionary", Oxford Publications.

Course Assessment:

ISE-1:
a) Activities and Assignments : 20 Marks
b) Oral Examination : 30 Marks

ISE-2:
a) Activities and Assignments : 20 Marks
b) Oral Examination :30 Marks

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
AEC12EC02	Telugu for Beginners	L	T	P	L	T	P	Total
		2	--	--	2	--	--	2
		Examination Scheme						
			ISE1	MSE	ISE2	ESE	Total	
		Theory	50	--	50	--	100	
		Lab	--	--	--	--	--	

Pre-requisite Course Codes		Basic Language Skills
Course Outcomes	CO1	Demonstrate understanding of the fundamentals of Telugu Language
	CO2	Apply vocabulary and grammar skills for day to day conversation
	CO3	Developing Speaking and Listening skills

Module No.	Unit No.	Topics	Ref.	Hrs.
1	1.1	**Introduction to Telugu Alphabets and Pronunciation** History of Telugu language	1-4	1
	1.2 1.3 1.4	Learning Telugu Alphabets and Symbols Basic Pronunciation Greetings and Common expressions		1 2 2
2	2.1	**Basic Grammar and Sentence Structure** Sentence Structure: Subject, verb, Object (SVO)	1-4	2
	2.2 2.3	Present tense, Past tense and Future tense Common nouns, Pronouns, Adjectives		2 2
3	3.1	**Conversation Phrases for Daily Situations** Learning numerals (Cardinal Numbers) 1- 20, 100 -1000	1-4	 2
	3.2 3.3	Forming Simple sentences / Listening and Speaking skills Days of week, Months of the year, Gender, Fruits, Parts of the body, Names of common places like hospitals, markets, shops, saloons etc.		3 3
4	4.1	**Common Phrases and Developing Language Fluency and Proficiency** Day to day usage of Telugu language for daily routines in conversation with Student to teacher, Vegetable Shop vendor, Railway passengers, Auto drivers, in Hospitals etc..	1-4	3
	4.2	Role Play Exercises in Common situations, presentation on Telugu culture, Telugu scripts, Telugu classical music, Telugu festivals.		3
			Total	**26**

Recommended Books:

1. Sanjay,D, " Spoken Telugu for Absolute Beginners", Notion Press, 2019.
2. Praveen Ragi, "Learn Telugu Through English. V1" Evincepub Publications, 2020
3. Oxford compact English-English Telugu Dictionary
4. English- Telugu Conversation guide / Aarthi Janyavula , 2018

Course Assessment:

ISE-1: Activities and Assignments: 20 Marks
ISE-2: Activities and Assignments: 20 Marks

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
EEM12EC02	Technology Entrepreneurship	L	T	P	L	T	P	Total
		2	--	--	2	--	--	2
		Examination Scheme						
			ISE1	MSE	ISE2	ESE	Total	
		Theory	20	30	20	30	100	
		Lab	--	--	--	--	--	

Pre-requisite Course Codes	--	
Course Outcomes	CO1	Identify problems worth solving
	CO2	Craft value proposition
	CO3	Prepare B-Plan
	CO4	Register virtual company

Module No.	Unit No.	Topics	Ref.	Hrs.
1		**Opportunity Discovery**	1	6
	1.1	Self-discovery		
	1.2	Effectuation Principle		
	1.3	Identification of problem worth solving		
	1.4	Looking for solutions		
	1.5	Present the problem		
2		**Value Proposition Canvas and Business Model**	2,3	7
	2.1	Craft your value proposition		
	2.2	Presentation of Value Proposition Canvas		
	2.3	Business Model and Lean Approach (Finance, Marketing, Operations)		
	2.4	Presentation of Lean Canvas		
3		**Business Plan**	4	6
	3.1	Creation of Business Plan		
4		**Company Formation**	5	7
	4.1	Promoters, Capital, Shareholders		
	4.2	Directors, DIN		
	4.3	Company Name, Registrations		
	4.4	Branding		
			Total	**26**

Recommended Books:

1. Sarasvathym "*Elements of Entrepreneurial Expertise (New Horizons in Entrepreneurship Series)*" Edward Elgar Publishing.
2. Alexander Osterwalder "*Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers"*
3. Alex Osterwalder, Yves Pigneur, Greg Bernarda, Alan Smith, Trish Papadakos "*Value Proposition Design: How to create Products and Services Customers Want*"
4. Garrett Sutton "*Writing Winning Business Plans*"
5. M.C. Bhandari "*Company Law Procedures*" LexiNexis, 2018

Course Assessment:

ISE-1:
Quiz: 10 Marks
Assignment: Effectuation case study: 10Marks
MSE:
Activity: Presentation of Value Proposition Canvas: 30 Marks Rubric Based assessment

ISE-2:
Quiz: 10 Marks
Assignment: Presentation of Lean Canvas: 10Marks
ESE:
Activity: Virtual Company registration: 30 Marks Rubric Based assessment

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
VEC12EC02	Technology Innovation for Sustainable Development	L	T	P	L	T	P	Total
		1	--	2	1	--	1	2
		Examination Scheme						
			ISE1	MSE	ISE2	ESE	Total	
		Theory	--	--	--	--	--	
		Lab	40	--	60	--	100	

Pre-requisite Course Codes	--	
Course Outcomes	CO1	Demonstrate a broad and coherent knowledge of United Nations Sustainable Development Goals (SDGs)
	CO2	Build the vocabulary and develop a nuanced understanding of the SDG themes: people, planet, prosperity, peace and partnership
	CO3	Identify technological solutions to address challenges of SDGs
	CO4	Build the vision to explain how to create a technological solution for sustainability

Module No.	Unit No.	Topics	Ref.	Hrs.
1		**What are SDGs**	1,2,3	3
	1.1	Concept of Sustainability. The Role of UN and the Need for SDGs. Why SDGs are important.		
	1.2	Introduction to 17 SDGs		
2		**People Theme**	4,5	4
	2.1	Sustainable development goals 1-5		
	2.2	Technological Solutions to advance people theme		
3		**Planet Theme**		6
	3.1	Sustainable development goals 6, 12-15	4,5	
	3.2	Technological Solutions to advance planet theme		
4		**Prosperity Theme**		7
	4.1	Sustainable development goals 7-11		
	4.2	Technological Solutions to advance prosperity theme		
5		**Peace Theme**	4,5	3
	5.1	Sustainable development goal 16		
	5.2	Technological Solutions to advance peace theme		
6		**Partnership Theme**	4,5	3
	4.1	Sustainable development goals 17		
	4.2	Technological Solutions to advance partnership theme		
			Total	**26**

Recommended Books/ References:

1. https://sdgs.un.org/goals
2. https://sdgs.un.org/tfm
3. Himanshu Sharma, Tina Sobti "*An Introduction to Sustainable Development Goals*" 2018
4. Henrik Skaug Sætra "*Technology and Sustainable Development*" Routledge, 2023
5. Sinan Kufeoglu "*Emerging Technologies: Value Creation for Sustainable Development*", Springer International Publishing, 2022

Course Assessment:

ISE-1: Quiz: 20 Marks
Activity: Case Study Presentation: 20 Marks

ISE-2: Quiz: 20 Marks
Activity: Short Film Creation and Presentation: 30 Marks

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
BC12EC01	Electromagnetic Theory	2	1	--	2		--	3
		Examination Scheme						
			ISE1	MSE	ISE2	ESE	Total	
		Theory	20	30	20	100 (30% weightage)	100	
		Tutorial	20	--	30	--	50	

Pre-requisite Course Codes		--
Course Outcomes	CO1	Solve problems related to electrostatics and magnetostatics.
	CO2	Describe the Laws of Electromagnetism
	CO3	Demonstrate practical skills through laboratory experiments involving electromagnetism.

Module No.	Unit No.	Topics	Ref.	Hrs.
1		**Vector Calculus** Scalar and Vector fields. Gradient, Divergence and Curl. Vector integration, Line, Surface and Volume integrals, Fundamental theorems of Gradient Divergence and Curl. Scalar and Vector potentials.	T1	5
2		**Electrostatics** Calculation of electric field and electrostatic potential for a charge distribution; Divergence and curl of electrostatic field; Laplace's and Poisson's equations for electrostatic potential. Electrostatic field and potential of a dipole. Solving simple electrostatics problems.	T1	6
3		**Magnetostatics** Bio-Savart law, Divergence and curl of static magnetic field, Ampere's Law, vector potential and calculating it for a given magnetic field using Stokes' theorem	T1	5
4		**Electromagnetic Waves** Faraday's law in terms of EMF produced by changing magnetic flux; equivalence of Faraday's law and motional EMF; Lenz's law Maxwell's equations,	T1	5
5		The wave equation; Plane electromagnetic waves in vacuum, their transverse nature and polarization; relation between electric and magnetic fields of an electromagnetic wave	T1	5
				26

Text Books:

1.Introduction to Electrodynamics: D J Griffiths, 4th Edition, Pearson.
2. Solid State Electronic Devices: Ben G. Streetman & Sanjay Kumar Banerjee, 7th Edition, Pearson.

Recommended Books:

1. Halliday and Resnick, Physics

2. Electromagnetics Vol-1: Steven W. Ellingson, VT Publishing, Virginia Tech(open Textbook)
3. Electricity, Magnetism & Electromagnetic Theory: S. R. Manohara & Shubha A, S.Chand Publications
4. Electricity and Magnetism: E. M. Purcell and D. J. Morin
5. Classical Electricity and Magnetism: Panofsky and Phillips
6. NPTEL/SWAYAM Course

Course Assessment:

Theory:

ISE-1: 20 Marks
Activity: Assignments on Electromagnetics

ISE-2: 30 Marks
Activity: Article Discussion, Quiz and Assignments
Outcome: Reflective Journal

MSE: 30 Marks written examination based on 50% syllabus

ESE: Three hours 100 Marks written examination (with 30% weightage) based on entire syllabus

Tutorials:

ISE-1: 20 Marks
Activity: Module wise Tutorials on Electromagnetics

ISE-2: 30 Marks
Activity: Module wise Tutorials on Electromagnetics

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
VSE11EC02	Creative Coding in Python	L	T	P	L	T	P	Total
		--	--	4	--	--	2	2
		Examination Scheme						
			ISE1	MSE	ISE 2	ESE	Total	
		Lab	50	--	50	--	100	

Pre-requisite Course Codes	--	
Course Outcomes	CO1	Demonstrate awareness of skills of 21st century engineer
	CO2	Demonstrate basic concepts of python programming.
	CO3	Identify, install and utilize python packages.
	CO4	Illustration of data analytics and data visualization using Python libraries
	CO5	Create GUI Applications using Python.
	CO6	Demonstrate creativity while implementing solution for a given problem using python

Module No.	Unit No.	Topics
1		**21st century skills**
		Introduction and Importance of 21st Century skills, case studies of creativity in engineering, Creator Tool PictoBlox, Github
2		**Python Fundamentals:**
	2.1	***Basic Data Types:*** Letter Counter App, Right Triangle Solver App, Multiplication Exponent Table Program
	2.2	***Lists:*** Grade Sorter App, Grocery List App, Basketball Roster Program
	2.3	***Dictionaries:*** Thesaurus App, Code Breakers App
3		**Decision Flow Control Statements**
	3.1	***For Loops:*** Binary Hexadecimal Conversion App, Grade Point Average Calculator App
	3.2	***Conditionals:*** Voter Registration App, Rock, Paper, Scissors App
	3.3	***While Loops:*** Guess the Word App, PowerBall Simulation App
4		***Functions***
	4.1	***Functions:*** Head-to-Head Tic-Tac-Toe App, Bank Deposit and Withdrawal Program
	4.2	***Classes:*** Casino Blackjack App
5		***Graphics and GUI***
	5.1	***Turtl***e - Hirst Painting
	5.2	***Tkinter***- Building a Password Manager GUI App.
6		***Python in Data Sciences for Beginner***
	6.1	***NumPy, Pandas, Matplotlib:*** Data Analysis and visualization of any data set (Stock market/healthcare/weather/Agriculture)
7		**Project Development using Python for various engineering domains like**

		electronics, mechanical etc.

Recommended Books:

1. Yashvant Kanetkar, "Let us Python: Python is Future, Embrace it fast", BPB Publications; 1st edition (8 July 2019).
2. Dusty Phillips, "Python 3 object-oriented Programming", Second Edition PACKT Publisher, August 2015.
3. John Grayson, "Python and Tkinter Programming", Manning Publications (1 March 1999).
4. Core Python Programming, Dr. R. Nageswara Rao, Dreamtech Press
5. Beginning Python: Using Python 2.6 and Python 3.1. James Payne, Wrox publication
6. Introduction to computing and problem solving using python, E Balagurusamy, McGraw Hill Education

Online Resources:

1. Python 3 Documentation: https://docs.python.org/3/
3. "The Python Tutorial", http://docs.python.org/release/3.0.1/tutorial/
4. http://spoken-tutorial.org
5. Python 3 Tkinter library Documentation: https://docs.python.org/3/library/tk.html
6. Numpy Documentation: https://numpy.org/doc/
7. Pandas Documentation: https://pandas.pydata.org/docs/
8. Matplotlib Documentation: https://matplotlib.org/3.2.1/contents.html
9. Scipy Documentation: https://www.scipy.org/docs.html
10. Machine Learning Algorithm Documentation: https://scikit-learn.org/stable/
11. https://nptel.ac.in/courses/106/106/106106182/
12. NPTEL course: "The Joy of Computing using Python"

Course Assessment:

Lab:

ISE-1
Experiments: 20 Marks
Quiz: 10 Marks
Design contest: 20 Marks

ISE-2
Experiments: 20 Marks
Quiz: 10 Marks
Mini Project: 20 Marks