CURRICULUM STRUCTURE

SECOND YEAR UG: B.E.

COMPUTER ENGINEERING

REVISION: FRCRCE-2-25

Effective from Academic Year 2025-26
Board of Studies Approval: 28/02/25
Academic Council Approval 14/02/2025, 08/03/25 &25/06/2025

Dr. DEEPAK BHOIR Dean Academics	Dr. Sujata P. Deshmukh HOD (Computer)	DR. SURENDRA RATHOD 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

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

Credit 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 four different options of the Degrees:

Degree/SEM	I	II	III	IV	V	VI	VII	VIII	Total
B.Tech with Multidisciplinary Minor	20	20	22	22	22	22	20	20	168
B.Tech with Double Minor (Multidisciplinary & Specialisation Minor)	20	20 +2*	22 +4*	22 +4*	22 +4*	22 +4*	20 +2$	20 +2$	188
B.Tech with Research and Multidisciplinary Minor	20	20 +2*	22 +4*	22 +4*	22 +4*	22 +4*	20 +2$	20 +2$	188

Optional Credits $ credits (2) to be earned in VII/VIII

Salient Features of Curriculum:

- ✓ Framed as per Government Resolution dated 4th July 2023 in line with National Education Policy (NEP) 2020.
- ✓ Minimum **168** 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

UG Computer Engineering 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
25BSC12CE05	BSESC	BSC	Discrete Mathematics and Graph Theory	TH	2	20	30	20	30	100	2	2
25PCC12CE05	PCPEC	PCC	Computer Organization and Architecture	TH	2	20	30	20	30	100	2	3
				PR	2	20	-	30	-	50	1	
25PCC12CE06	PCPEC	PCC	Data Structures	TH	3	20	50	30	50	150	3	4
				PR	2	20	-	30	-	50	1	
25PCC12CE07	PCPEC	PCC	Object Oriented Programming with JAVA	PR	2	20	-	30	-	50	1	1
25OE13CE1X	MDC	OE	1. Law for Engineers 2. Financial Planning, Taxation and Investment	TH	2	50	-	50	-	100	2	2
25MDMXX1	MDC	MDM	MDM Course-1	TH	2	20	30	20	30	100	2	2
25MDMXX2	MDC	MDM	MDM Course-2	TH	2	20	30	20	30	100	2	2
25AEC12CE02X	HSSM	AEC	Modern Indian Languages	TH	2	50	--	50	--	100	2	2
25VEC12CE01	HSSM	VEC	Human Values and Professional Ethics	TH	1	50	-	50	-	100	1	2
				PR	2						1	
25CEP12CE01	EL	CEFP	Community Engagement Project	PRJ	4	50	-	50	-	100	2	2
25DMX1	DM	DM	Double Minor Course	TH	2	20	30	20	30	100	2	4#
				TU	2	20	-	30	-	50	2	
25HR02	HR	HR	Honors with Research	PR							4	4*
25DM01/25RM01	DM/RM	DM/RM	Introduction to Emerging Technologies	TH	2	50		50		100	2	2$
				Total	**TH:TU:PR 16:0:12=28**			**-**	**-**	**1100**	**-**	**22**

$ DM/HR 2 credits for Later Entry Students in second year

SEM-IV

Course Code	Course Vertical	Sub-Vertical	Course Name		Contact Hours	Examination Marks (1 Credit=50 Marks)					Credits	
						ISE1	MSE	ISE2	ESE	Total	Points	Total
25BSC12CE06	BSESC	BSC	Linear Algebra and Business Statistics	TH	2	20	30	20	30	100	2	2
25PCC12CE08	PCPEC	PCC	Database Management Systems	TH	2	20	30	20	30	100	2	3
				PR	2	20	-	30	-	50	1	
25PCC12CE09	PCPEC	PCC	Analysis of Algorithm	TH	3	20	50	30	50	150	3	4
				PR	2	20	-	30	-	50	1	
25PCC12CE010	PCPEC	PCC	Operating Systems	TH	2	20	30	20	30	100	2	3
				PR	2	20	-	30	-	50	1	
25OE13CE2X	MDC	OE	1. Emerging Technology and Law 2. Principles of Management	TH	2	50	-	50	-	100	2	2
25MDMXX3	MDC	MDM	MDM Course-3	TH	2	20	30	20	30	100	2	2
25VSE12CE03	SC	VSEC	Full Stack Development	PR	4	50	-	50	-	100	2	2
25EEM12CE02	HSSM	EEMC	Technology Entrepreneurship	TH	2	50	-	50	-	100	2	2
25VEC12CE02	HSSM	VEC	Technology Innovation for Sustainable Development	TH	1	40	-	60	-	100	1	2
				PR	2						1	
25DMX2	DM	DM	Double Minor Course	TH	2	20	30	20	30	100	2	4*
				TU	2	20	-	30	-	50	2	
25HR03	HR	HR	Honors with Research	-	-	-	-	-	-	-	4	4*
BC	BC	BC	MOOC	-	-	-	-	-	-	-	-	2$
Total					TH:TU:PR 16:0:12=28			-	-	1100	-	22

$ Discipline specific additional course to Lateral Entry (Diploma) students from Swayam Plus/Swayam platform

SEM-V												
Course Code	Course Vertical	Sub-Vertical	Course Name		Contact Hours	Examination Marks (1 Credit=50 Marks)					Credits	
						ISE1	MSE	ISE2	ESE	Total	Points	Total
25PCC13CE11	PCPEC	PCC	Cryptography and System Security	TH	2	20	30	20	30	100	2	3
				PR	2	20	-	30	-	50	1	
25PCC13CE12	PCPEC	PCC	Theory of Computer Science	TH	2	20	30	20	30	100	2	3
				PR	2	20	-	30	-	50	1	
25PCC13CE13	PCPEC	PCC	System Programming and Compiler construction	TH	2	20	30	20	30	100	2	3
				PR	2	20	-	30	-	50	1	
25PCC13CE14	PCPEC	PCC	Data Warehousing and Mining	TH	2	20	30	20	30	100	2	3
				PR	2	20	-	30	-	50	1	
25VSE13CE04	SC	VSEC	Cloud Computing Lab	PR	4	50	-	50	-	100	2	2
25PEC1CEXX	PCPEC	PEC	Program Elective Course	TH	2	20	30	20	30	100	2	3
				PR	2	20	-	30	-	50	1	
25PECL1CEX	PCPEC	PEC	Program Elective Lab	PR	2	20	-	30	-	50	1	1
25OE13CE3X	MDC	OE	1. Health, Wellness and Psychology 2. Emotional and Spiritual Intelligence	TH	2	50	-	50	-	100	2	2
25MDMXX4	MDC	MDM	MDM Course-4	TH	2	20	30	20	30	100	2	2
25DMX3	DM	DM	Double Minor Course	TH	2	20	30	20	30	100	2	4*
				TU	2	20	-	30	-	50	2	
25HR04	HR	HR	Honors with Research								4	4*
				Total	**TH:TU:PR 14:0:16=30**			-	-	**1100**	-	**22**

SEM-VI												
Course Code	Course Vertical	Sub-Vertical	Course Name		Contact Hours	Examination Marks (1 Credit=50 Marks)					Credits	
						ISE1	MSE	ISE2	ESE	Total	Points	Total
25PCC13CE15	PCPEC	PCC	Distributed Computing	TH	2	20	30	20	30	100	2	3
				PR	2	20	-	30	-	50	1	
25PCC13CE16	PCPEC	PCC	Software Engineering	TH	2	20	30	20	30	100	2	3
				PR	2	20	-	30	-	50	1	
25PCC13CE17	PCPEC	PCC	Artificial Intelligence Lab	PR	2	20	-	30	-	50	1	1
25PCC13CE18	PCPEC	PCC	Mini Project	PRJ	2	20	-	30	-	50	1	1
25PCC13CE19	PCPEC	PCC	Mobile App development	PR	2	20	-	30	-	50	1	1
25PCC13CE20	PCPEC	PCC	DevOps Lab	PR	2	20	-	30	-	50	1	1
25PCC13CE21	PCPEC	PCC	Advanced Microprocessors	TH	2	20	30	20	30	100	2	3
				PR	2	20	-	30	-	50	1	
2525PEC3CEXX	PCPEC	PEC	Program Elective Course	TH	2	20	30	20	30	100	2	3
				PR	2	20	-	30	-	50	1	
25PCC13CE22	PCPEC	PCC	Competitive Coding	PR	2	20	-	30	-	50	1	1
25PECL3CEX	PCPEC	PEC	Program Elective Lab	PR	2	20	-	30	-	50	1	1
25OE13CE4X	MDC	OE	Public Relations and Corporate Communication	TH	2	50	-	50	-	100	2	2
25MDMXX05	MDC	MDM	MDM Course-5	TH	2	50	-	50	-	100	2	2
25DMX4	DM	DM	Double Minor Course	TH	2	20	30	20	30	100	2	4*
				TU	2	20	-	30	-	50	2	
25HR05	HR	HR	Honors with Research								4	4*
				Total	**TH:TU:PR 12:0:20=32**			-	-	**1100**	-	**22**

Structure of Credits to be completed in Final Year (SEM-VII and/or SEM-VIII):

SEM-VII and/or SEM-VIII												
Course Code	Course Vertical	Sub-Vertical	Course Name		Contact Hours	Examination Marks (1 Credit=50 Marks)					Credits	
						ISE1	MSE	ISE2	ESE	Total	Points	Total
	PCPEC	PEC	Program Elective		Online	As Per SWAYAM					12	12
MDMXX06	MDC	MDM	MDM Course-6 @		Online	As Per SWAYAM					4	4
RMC14CE01	EL	RM	Essentials of Research Methodology		Online	As Per SWAYAM					2	2
RMC14CE02	EL	RM	Intellectual Property Rights		Online	As Per SWAYAM					2	2
PRJ14CE01	EL	PR	Capstone Project	PR	12	100	-	100	-	200	6	6
	PCPEC	PEC	Course Seminar		Online	As per Rubrics for Seminar					2	2
DMX5/HR06	DM/HR	DM/RMM	Seminar/Project	PR	4	As per Rubrics for Seminar/Project					2*	2*
INT14CE01	EL	INT	Semester long Internship	PR	36-40 hrs	As Per Internship Manual					12	12
			Total								**40**	**40**

@MDM should be **Technical courses** related to **MDM**

Project or Internship is mutually exclusive in SEM-VII or SEM-VIII

Remaining credits can be acquired in SEM-V to SEM-VIII

Online course 1 Credit=4 Week course from SWAYAM can be taken in SEM V to SEM VIII

Online min 8 week course from SWAYAM can be taken in SEM V to 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 V to SEM VIII to complete 3 credit course

List of Program Elective Courses:

Track	Sem. V-PCE1 (Th+Pr) Credits 3	Sem.VI-PCE2 (Th+Pr) Credits 3
Block chain	25PEC13CE11: Block chain Technology	25PEC13CE21: Decentralized finance
AIML	25PEC13CE12: Deep Learning and Reinforcement Learning	25PEC13CE22: LLM and GenAI
Security	25PEC13CE13: Cyber Security	25PEC13CE23: Digital Forensic
Data science	25PEC13CE14: Big data analytics	25PEC13CE24: Business Intelligence
ARVR	25PEC13CE15: Computer Graphics	25PEC13CE25: ARVR
UI	25PEC13CE16: HMI	25PEC13CE26: UX/UI Design
Computing	25PEC13CE17: Geographical Information Systems	25PEC13CE27: Quantum Computing
Networking	25PEC13CE18:Computer Network	25PEC13CE28: Advanced Network Communication

Sem. V- PECL1: (Lab) Credits 1	Sem.VI- PECL2: (Lab) Credits 1
25PECL13CE11: Image processing Lab	25PECL13CE21: Social Media Analytics Lab
25PECL13CE12: Natural Language Processing Lab	25PECL13CE22: Ethical Hacking Lab
25PECL13CE13: IIOT lab	25PECL13CE23: Advance Java Lab
25PECL13CE14: Innovative Product Development Lab-Phase1 (Start-up)	25PECL13CE24: Innovative Product Development Lab-Phase2 (Start-up)
25PECL13CE15: Open-Source Intelligence and Threat Intelligence lab	25PECL13CE25: Explainable AI Lab
	25PECL13CE26: Software testing and Quality Assurance

B.Tech in Computer Engineering with Minor Communication Engineering:

Course Code	Communication Engineering Minor Courses	Credits
25MDMCM1	Signals and System	2
25MDMCM2	Analog and Digital Communication	2
25MDMCM3	Microcontrollers and Applications	2
25MDMCM4	Communication and Computer Networks	2
25MDMCM5	Mobile Communication and Computing	2

B.Tech in Computer Engineering with Minor Mechanical Engineering:

Course Code	Mechanical Engineering Minor Courses	Credits
25MDMME1	Elements of Mechanical Engineering	2
25MDMME2	Manufacturing Engineering	2
25MDMME3	Product Design and Development	2
25MDMME4	Industrial Engineering	2
25MDMME5	Supply Chain Management	2

B.Tech in Computer Engineering with Minor in Business Management

Course Code	Business Management Minor Courses	Credits
25MDMBM1	Financial Accounting	2
25MDMBM2	Economics for Business	2
25MDMBM3	Business Administration	2
25MDMBM4	Human Resource Management	2
25MDMBM5	Digital Marketing	2

B.Tech in Computer Engineering with Minor in Healthcare Management

Course Code	Healthcare Management Minor Courses	Credits
25MDMHM1	Biomedical Instrumentation & Imaging	2
25MDMHM2	Hospital Administration Fundamentals	2
25MDMHM3	Operations Management for Healthcare Systems	2
25MDMHM4	Digital Transformation in HealthCare	2
25MDMHM5	Bioinformatics and Computational Biology	2

B.Tech in Computer Engineering with Minor in Design

Course Code	Design Minor Courses	Credits
25MDMDE1	Industrial and Product Design	2
25MDMDE2	Communication Design	2
25MDMDE3	Graphic Design and Animation	2
25MDMDE4	Interaction Design	2
25MDMDE5	Mobility and Vehicle Design	2

Double Minor Degree in 'Emerging Areas' Offered to CE Students:

1. Name: VLSI Design and Verification (offered to Comp and CSE)

1. **25DM11:** VLSI Design Flow
2. **25DM12:** FPGA Programming
3. **25DM13:** Verification using System Verilog
4. **25DM14:** AI and ML for VLSI

2. Name: Internet of Things (offered to Comp, CSE and Mech)

1. **25DM21:** Sensors and Actuators
2. **25DM22:** Fundamentals of IoT
3. **25DM23:** Embedded System and RTOS
4. **25DM24:** System Design

3. Name: Automation and Robotics (offered to Comp, CSE and ECS)

1. **25DM31:** Introduction to CAD/CAM
2. **25DM32:** 3D Printing
3. **25DM33:** Mechatronics
4. **25DM34:** Industrial Robotics and Automation

4. Name: Sustainability (offered to all)

1. **25DM41:** Design Thinking for Sustainability
2. **25DM42:** Green Computing
3. **25DM43:** Emerging Technologies for Sustainability
4. **25DM44:** Sustainable Product Design

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

- 25AEC12CE021 Sanskrit for Beginners
- 25AEC12CE022 Telugu for Beginners
- 25AEC12CE023 Kannada for Beginners
- 25AEC12CE024 Tamil for Beginners

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
25BSC12CE05	Discrete Mathematics and Graph Theory	2	--	--	2	--	--	2
		Examination Scheme						
			ISE1	MSE	ISE2	ESE	Total	
		Theory	20	30	20	30	100	

Pre-requisite Course Codes		BSC11CE01, BSC11CE03
Course Outcomes	CO1	Apply propositional and predicate logic to solve problems and represent mathematical statements
	CO2	Apply algebraic structures of groups, rings, and lattices in the context of discrete mathematics
	CO3	Solve problems with graph algorithms for traversal, shortest paths, and minimum spanning trees
	CO4	Analyze the implications of different types of relations and functions in various mathematical and real-world contexts
	CO5	Display a strong foundation to pursue advanced courses in graph theory, AI, and related disciplines.
	CO6	Apply statistics methods to solve real world problems.

Module No.	Unit No.	Topics	Ref.	Hrs.
1	1.1	**Sets and Propositions:** Finite and Infinite sets, Principle of Inclusion and Exclusion, Proof Templates, Mathematical Induction	1,2,5	4
	1.2	Logic: Logical Connectives, Conditionals and Biconditionals, Well-formed Formulas, Tautologies, Logical Equivalences, Statement functions, Variable and Quantifiers, Free and Bound Variables, Inference Theory of Predicate Calculus, Euclidean Algorithm		
2	2.1	**Relations and functions:** Closure of Relations, Warshall's algorithm, Equivalence Relations and Partitions, Partial Ordering Relations and Lattices, Chains and Antichain, Job Scheduling Problem, Relational Databases, and its operations.	1,2,4	4
	2.2	Functions: Composition of Functions, Invertible functions, Recursive functions, , Hashing, Pigeonhole principles		
3	3.1	**Algebraic Structures:** Algebraic structures with one binary operation, Semi group, Monoids, Groups, subgroups, abelian group, Isomorphism	1,2,3	4
	3.2	Algebraic structures with two binary operations: Ring and Field		
4	4.1	**Graph Theory:** The Handshaking Problem, Connectivity and Paths, Matrix representation of graphs, Konigsberg Bridge problem, Eulerian and Hamiltonian graphs, Spanning trees and Minimal spanning trees,	4,5	4
	4.2	Applications: Graph Algorithms, Graph coloring		
	4.3	Case Study: Web Graph, Google Maps		
5	5.1	**Coding Theory**: Encoding, Decoding	4,5	4
	5.2	Discrete Numeric Functions & Generating Functions, Applications in AoA, cryptography, & Optimization		
	5.3	Counting & Combinatorics, Travelling Salesperson's problem		
6	6.1	**Statistics**: Role of Statistics in Computer Engineering, Descriptive vs. Inferential Statistics, Types of Data: Categorical and Numerical,	6	6

		Measures of Central Tendency, Measures of Dispersion: Range, Variance, Standard Deviation, Quartiles and Percentiles, Data Visualization Techniques		
	6.2	Probability Distributions, Combinatorics and Permutations, Statistical Inference: Sampling Techniques, Central Limit Theorem, Confidence Intervals		
	6.3	Hypothesis Testing: Null and Alternative Hypotheses, p-values and Significance Levels, Parametric vs. Nonparametric Tests, Introduction to Regression Analysis, Correlation Coefficient, and its Interpretation		
Total				**26**

Module No.	Sr.no	Suggested List of Tutorials/Assignments
1	**1**	Solve question based on set operation, Inference Theory of Predicate Calculus, Euclidean Algorithm
2	**2**	Using innovative teaching method(e.g.think pair share)solve problem based on, Warshall's algorithm, Equivalence Relations and Partitions, Partial Ordering Relations and Lattices, Chains and Antichain, Job Scheduling Problem
3	**3**	Discuss real time problems on algebraic structures with one binary operation, Semi group, Monoids, Groups, subgroups, abelian group, Isomorphism
4	**4**	Discuss and solve problem based graph theory such as Web Graph, Google Maps
5	**5**	Solve questions based on Discrete Numeric Functions & Generating Functions, Counting & Combinatorics
6	**6**	Discuss various applications of statistics with detail mathematical explanation.

Course Assessment

Theory:

ISE-1: 20 Marks

Tutorials including Problem Solving using Sets, Logic, Relations, and Functions
Evaluation based on 50% tutorials/ Assignments

ISE-2: 20 Marks

Evaluation during Tutorials including Problem Solving using Algebraic structures & Graph Theory, Statistics, Comprehensive study on a Case Study/ Solving Applications on Graph Theory
Evaluation based on remaining 50% tutorials /Assignments

MSE: 90 minutes 30 Marks written examination based on 50% syllabus

ESE: 90 minutes 30 Marks written examination based on remaining syllabus after MSE

Recommended Books:

1. Rosen Kenneth: "Discrete Mathematics and its applications." McGraw Hill-New Delhi.
2. C L Liu, Mohapatra: "Elements of discrete mathematics: a Computer Oriented approach", McGraw Hill-New Delhi.
3. Kolman, Busby, Ross: "Discrete Mathematical Structures" Pearson
4. Doughlas west "Introduction to Graph theory," Prentice Hall India
5. Gary Haggard, John Schlipf, Sue Whitesides: "Discrete Mathematics for Computer Science, Cengage Learning
6. S. C. Gupta and V. K. Kapoor,"Fundamentals of Mathematical Statistics"

Course Code	Course Name	Teaching Scheme(Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
		2	--	2	2	--	1	3
		Examination Scheme						
25PCC12CE05	Computer Organization and Architecture		ISE1	MSE	ISE2	ESE	Total	
		Theory	20	30	20	30	100	
		Lab	20	--	30	--	50	

Pre-requisite Course Codes		PCC11CE03
Course Outcomes	CO1	Describe the basic structure of computer and compare architecture models
	CO2	Implement algorithms for arithmetic operations.
	CO3	Design and analyze control units for microprocessors, considering 8086 architecture as the case study.
	CO4	Classify different types of memory and implement various mapping techniques for Cache and virtual memory
	CO5	Describe I/O organization and analyze different parallel processing and pipelining concepts.
	CO6	Examine emerging trends in computer architecture

Module No.	Unit No.	Topics	Ref.	Hrs.
1		**Overview of Computer Organization and Architecture**	1	2
	1.1	Introduction of Computer Organization and Architecture, Basic organization of Computer and block level description of the functional units, Von Neumann model, Harvard model, Evolution of Intel processors.		
	1.2	Performance: Processor clock, basic performance equation, complier, performance measurement, Multiprocessor & Multicomputer, Multicore architecture.		
2		**Data Representation and Arithmetic Algorithms**		4
	2.1	Number representation: Floating point representation, floating point arithmetic, IEEE754 floating point number representation.		
	2.2	Booth's algorithm for multiplication, Restoring and non-restoring division algorithm		
3		**Processor Organization and Control Unit design**	1,2	10
	3.1	CPU Architecture, Register Organization, Instruction formats, basic instruction cycle, instruction interpretation and sequencing.		
	3.2	Control unit: Micro-programmed and Hardwired Control unit design methods, Micro instruction sequencing and execution, micro-operations		
	3.3	Concepts of Pipelined and Non-Pipeline architecture		

	3.4	8086CPU Architecture, Programmer's Model,Functional Pin Diagram, Memory Segmentation,Memory Banking,Maximum and Minimum Mode of 8086.		
4		**Memory Organization**	1,2,4	6
	4.1	Memory Systems: Types of memory: RAM, ROM, Cache Memory hierarchy and its importance, Cache organization and principles, mapping techniques.		
	4.2	Virtual Memory: Paging and segmentation, Page tables and translation look aside buffers(TLBs),Memory management unit(MMU),page Replacement policies.		
5		**I/O Organization and Introduction to Parallel Processing**	1,2,4	03
	5.1	Buses: Synchronous, Asynchronous, Interface circuits: Parallel port, Serial port, Standard I/O Interfaces: PCI, SCSI, USB, CAN bus		
	5.2	Parallelism in Computer Architecture: Pipelining and its advantages, Superscalar and VLIW architectures, SIMD and MIMD architectures		
6		**Emerging Trends in Computer Architecture**	5,6,7	01
	6.1	Power efficiency and low Neuro morphic computing and AI accelerators		
Total				**26**

Sr.no	Suggested List of experiments
1	Write ALP to Addition of two 8/16/32 numbers(8086,80386)
2	Write ALP to for 8/16/32-bit multiplication and division.(8086,80386)
3	Write ALP for code conversion (Hex to BCD and BCD to Hex)/ (ASCII to BCD and BCD to ASCII) (8086,80386)
4	Write ALP based on string instructions (Block transfer using string instructions)(8086,80386)
5	Write ALP to display the contents of the flag register.(8086,80386)
6	Write ALP to sort numbers in ascending/ descending order (8086,80386)
7	Write ALP to find minimum/ maximum number from a given array. (8086,80386)
8	Write ALP to 3 X 3 Matrix Addition/Multiplication(8086,80386)
9	Write ALP to display a message in different color with blinking (8086,80386)
10	Assembly language programs using DOS interrupts.(8086,80386)
11	Program and interfacing using 8259
	Mini project/Presentation/Group activity/ Simulation using modern tools

Course Assessment:

Theory:

ISE-1:20Marks

Activity based on Data Representation and Arithmetic Algorithms(10marks)

ISE-2:20 Marks

Activity: Group Discussion on Benchmarking and Performance Evaluation, Influence of Computer Architecture on Software Development, Ethical Considerations in Computer Architecture, Security Implications in Computer Architecture, Parallel Processing in Real- world Applications, Impact of Cache Memory on System Performance: (10 Marks)
Assignments (10 Marks)

MSE: 90 minutes 30 Marks written examination based on 50% syllabus

ESE: 90 minutes 30 Marks written examination based on remaining syllabus after MSE

Lab:

ISE: -1 will be conducted for four experiments. Continuous pre-defined rubrics-based evaluation for 20 marks.
ISE: -2 Will be conducted for next Four experiments. Continuous pre-defined rubrics-based evaluation for 30 marks

Recommended Books:

1.Carl Hamacher, Zvonko Vranesic, SafwatZaky,"Computer Organization",Tata McGraw-Hill,5th Edition.
2.William Stallings,"ComputerOrganizationandArchitecture,Pearson,8thEdition.
3.Morris Mano,Computer System Architecture",Pearson,3rdEdition.
4.JohnP.Hayes,"ComputerArchitectureandOrganization",TataMcGraw-Hill,3rdEdition.
5.John Uffenbeck, "8086/8088 family: Design Programming and Interfacing", PHI.
6.Yu-Cheng Liu, Glenn A. Gibson, "Microcomputer System: The 8086/8088 Family, Architecture, Programming and Design", Prentice Hall
7.Barry B. Brey, "Intel Microprocessors", 8thEdition, Pearson Education India.
8.Douglas Hall, "Microprocessor and Interfacing", Tata McGraw Hill.
9.YanDu,'The Influence and Application of Computer Technologyon Architectural Design", International conference on Network and Information system for computers2022.
10.Yoon Seok Yang, Yongtae Kim, "Recent Trend of Neuromorphic Computing hardware: Intel's Neuromorphic System Perspective", Iternational SoC Design Conference,2020.
11.Mark Barnelli, Courtney Raymond, Lisa Loomis, DarrekI sereau, Daniel Brown, Francesca Vidal, Steven Smiley, "Advanced Ultra Low Power Deep Learning Applications with Neuromorphic Computing", High Performance Extreme Computing,2023

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
25PCC12CE06	Data Structures	3	- -	2	3	--	1	4
		Examination Scheme						
			ISE	MSE	ISE	ESE	Total	
		Theory	20	50	30	50	150	
		Lab	20	--	30	--	50	

Pre-requisite Course Codes		ESC11CE03
Course Outcomes	CO1	Implement various operations of linear data structures.
	CO2	Implement various operations of non-linear data structures.
	CO3	Implement appropriate searching and hashing techniques on a given problem
	CO4	Apply appropriate data structure to solve different computing problems.

Module No.	Unit No.	Topics	Ref.	Hrs
1	1.1	**Introduction:** Introduction to Data Structures, Concept of ADT, Types of Data Structures: Linear and Nonlinear	1,2,3	3
2	2.1	**Stack and Queue:** **Stack:** Introduction, Stack as ADT, Operations, Implementation using array, Applications of stack: Infix to Postfix conversion, Evaluation of Postfix using stack	1,2,3	5
	2.2	**Queue:** Introduction, Queue as ADT, Operations, Implementation using array, Types of queue - Circular queue, Priority queue, Double ended queue, operations on these queues.	1,2,3	6
3	3.1	**Linked List:** Linked list as an ADT, Types of Linked List: Singly Linked List, Doubly linked list, Circular linked list concept, Operation on Singly and Doubly linked list, Applications of Linked List: Stack and Queue using Linked List. Polynomial representation and addition of two polynomials using Linked List.	1,2,3	8
4	4.1	**Tree:** Basic Terminology, Array and Linked Representation of Binary Tree ADT, Traversal of Binary Tree, Binary Search Tree and operations on it, AVL trees, Rotations, Operations on AVL Tree, Applications of these binary trees. Introduction to B tree and B+ tree.	1,2,3	8
5	5.1	**Graphs:** Basics Terminology, Adjacency List and Adjacency Matrix Representation, Graph traversals BFS and DFS.	1,2,3	5
6	6.1	**Searching Techniques and Hashing:** Linear Search and Binary Search, Hashing: Basic concepts, Hash function, Collision Resolution Techniques.	2,3	4
			Total	**39**

Course Assessment:

Theory:

ISE-1 & ISE-2: Activities (50 Marks)

- Quiz/ Problem solving score of hacker rank / code chef/ leetcode
- Assignments/Internal coding competition / certification course of 10-12 hrs duration on platform like courser/ Udemy/ NPTEL

MSE: 120 minutes 50 Marks written examination based on 50% syllabus
ESE: 120 minutes 50 Marks written examination based on remaining syllabus after MSE

Practical:

ISE1: Continuous predefined rubrics based evaluation of experiments based on Module 1 to 3 for 20 Marks

ISE2:

- Continuous predefined rubrics based evaluation of experiments based on Module 4 to 6 for 20 Marks
- Mini Project of 10 Marks

Exp. No.	Name of the Experiment	CO
1	Implement a given problem using Stack. (Basic and Applications)	CO1
2	Implement a given problem using Queue. (Basic and Applications)	CO1
3	Implement a given problem using Singly Linked List. (Basic and Applications)	CO1
4	Implement a given problem using Doubly Linked List.	CO1
5	Implement a given problem using Binary Search Tree. (Basic and Applications)	CO2
6	Implement Min Heap and Max Heap operations / create a priority queue using Heap.	CO2, CO3
7	Apply graph traversal techniques (BFS and DFS) to solve a given problem.	CO2
8	Implement hash functions with different collision resolution techniques (chaining, open addressing).	CO4
9	Mini Project: Develop a working prototype demonstrating real-life applications of data structures.	CO1, CO2, CO3, CO4

Recommended Books:

1. "Data Structures using C and C++" by Yedidyah Langsam, Moshe J. Augenstein, Aaron M. Tenenbaum, 2nd edition, Prentice Hall
2. "Data Structures using C", Reema Thareja, Third Edition, Oxford University Press.
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. John Wiley & Sons.
5. "Data Structures and Pseudocode approach with C", 2nd Edition by Richard F. Gilberg; Behrouz A. Forouzan, Thomson Publishing.

Online Resources:

1. https://nptel.ac.in/courses/106/102/106102064/
2. https://www.coursera.org/specializations/data-structures-algorithms
3. https://visualgo.net
4. www.leetcode.com
5. www.hackerrank.com
6. www.codechef.com

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
25PCC12CE07	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		ESC11CE03
Course Outcomes	CO1	Demonstrate Proficiency in Fundamentals of Java
	CO2	Apply Object-Oriented Programming Principles
	CO3	Explore multithreading, File I/O, and exception handling
	CO4	Develop Real world Java Applications

Module No.	Exp. No.	Topics
1	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.
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. **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	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.
4	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.
5	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 persons, organizations, locations, and dates.
6	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.
7	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.
8	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 challenging puzzles to facilitate learning through exploration and experimentation.
9	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
10	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.
11	11	Mini Project: Defining the problem statement and objectives. Design Class diagram and Implement the idea of Mini Project based on the content of the syllabus(Group of 2-3 students)

Course Assessment:

ISE-1: will be conducted for (40-50%) 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 20 marks, Mini project for 10 marks

Recommended Books:

1. Herbert Schildt, "Java: The Complete Reference", Ninth edition, McGraw Hill Education Publication
2. E. Balaguruswamy, "Programming with JAVA", Sixth edition, McGraw Hill Education Publication

3. Kathy Sierra and Bert Bates, "Head First Java: A Brain-Friendly Guide, 2Nd Edition", O'REILLY publication
4. Joshua Bloch, "Effective Java", third edition, Addison-Wesley Professional publication
5. Brian Goetz et al., "Java Concurrency in Practice", first edition, Addison-Wesley Professional publication
6. Mark Heckler, Gerrit Grunwald, José Pereda, Sean Phillips, Carl Dea, "JavaFX 8: Introduction by Example" second edition, Apress publication

Online Repository:

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 Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
25OE13CE11	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 ot 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 Contract, 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	Workmens 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	
	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		2
			Total	**26**

Course Assessment:

ISE-1:

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

ISE-2:

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

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 Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
25OE13CE12	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			
		L	T	P	L	T	P	Total
25AEC12CE021	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**

Course Assessment:

ISE-1: Activities and Assignments: 20 Marks
Oral Examination: 30 Marks
ISE-2: Activities and Assignments: 20 Marks
Oral Examination: 30 Marks

Recommended Books:

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 Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
		2	--	--	2	--	--	2
25AEC12CE022	Tamil for Beginners	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**

Course Assessment:

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

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

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 Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
		2	--	--	2	--	--	2
25AEC12CE023	Kannada for Beginners	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
	1.2 1.3 1.4	Learning Kannada Alphabets Pronunciation and visual learning Greetings and Common expressions		1 2 2
2	2.1	**Basic Grammar and Sentence Structure with Subject, Verb, Objective (SVO**) Basics of Sentence Formation		2
	2.2 2.3	Present tense, Past tense, Future tense, and Introduction to Adjectives Common Nouns, Pronouns with negative imperatives		2 2
3	3.1	**Conversation Phrases and Language Vocabulary** Learning Numerals (Cardinal Numbers) 1-20 / 100 -1000		2
	3.2 3.3	Classified Sentences and Useful expressions 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 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.		3
	4.2	Role play exercises in common situations		3
			Total	**26**

Course Assessment:

ISE-1: Activities and Assignments: 20 Marks
Oral Examination : 30 Marks
ISE-2: Activities and Assignments: 20 Marks
Oral Examination : 30 Marks

Recommended Books:

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

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
25AEC12CE024	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
	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)		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		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.		3
	4.2	Role Play Exercises in Common situations, presentation on Telugu culture, Telugu scripts, Telugu classical music, Telugu festivals.		3
			Total	**26**

Course Assessment:

ISE-1: Activities and Assignments: 20 Marks
Oral Examination : 30 Marks
ISE-2: Activities and Assignments: 20 Marks

Oral Examination : 30 Marks

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 Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned				
		L	T	P	L		T	P	Total
		1	--	2	1		--	1	2
			Examination Scheme						
25VEC12CE01	Human Values and Professional Ethics [HVPE]		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**		
	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**		
	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**		
	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**

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**

Recommended Books:

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 Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
25CEP12CE01	Community Engagement Project	L	T	P	L	T	P	Total
		--	--	4	--	--	2	2
		Examination Scheme						
			ISE1	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 behavioural 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			
25HMM11CE01	Introduction to Emerging Technologies	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	Recognize the dynamic nature of emerging technologies and their evolving landscape.
	CO2	Demonstrate knowledge of the key characteristics and potential applications of emerging technologies.
	CO3	Identify the value, innovative solutions or applications for real-world challenges using emerging technologies
	CO4	Analyse the implications of emerging technologies on society, business, and various industries
	CO5	Identify various emerging technologies relevant to his/her discipline for personal and professional growth
	CO6	Recognize the need for continuous learning to keep pace with technological advancements.

Module No.	Unit No.	Topics	Ref.	Hrs.
1	1.1	Introduction to Industrial Revolution, Important Inventions during various Industrial Revolutions (IR).	1,2	2
	1.2	Role of data, Enabling devices, Network and Human to Machine Interaction during IR	1,2	1
2	2.1	Data Science: Overview of data science, Data Science Life Cycle, Cloud Computing with examples of available Clouds, Big Data, Big data Life Cycle with Hadoop	1,2	3
	2.2	Artificial Intelligence and Machine Learning: Philosophy of AI, Components of AI, Important terminologies, AI Problem-Solving, Real-World AI, Types of Machine Learning, Neural Networks, Applications: Computer Vision, Robotics, NLP. Societal Implications of AI.	1,2	3
	2.3	Fundamentals of Blockchain, Blockchain applications and architecture. Introduction to Cyber Security, Cyber-attacks and defences. Case studies.	1,2	3
	2.4	Robotic Process Automation, RPA Tools, and Applications		1
3	3.1	Internet of Things (IoT): Introduction, IoT Sensors, IoT Data acquisition & platforms, IoT Data Communication, IoT data storage and Retrieval, IoT data analytics & visualization and IoT Security, IoT Product Development Life Cycle, Industrial IoT, Concept of Edge Computing. Case studies	1,2	3

	3.2	Introduction to Immersive Technologies (AR, VR and MR), AR /VR systems with IOT, AI and Haptics, Tools needed to build AR Apps, use cases, Human Centric UX design	3	2
4	**4.1**	Semiconductor and Nanotechnology: Evolution of Semiconductor Industry, Trends, and Innovations in Semiconductor Technologies with respect to material, devices, circuits, architecture and applications. Indian Semiconductor Industry: present status, market trends, challenges, policy initiatives by GoI	4	3
	4.2	Digital Manufacturing, Principles of 3D Printing, Classification and material used in 3D printing, software tools and applications to various fields. Introduction to Robotics, Drones and Autonomous Systems. Fundamentals of tools, software and hardware required to build robot and autonomous systems. Applications and Case studies.	1,6	3
	4.3	Other Trends in emerging technologies: 5G telecom networks and Electric Vehicles	6	2
			Total	**26**

Course Assessment:

Theory:

ISE-1: 50 Marks

Rubric based assessment for activities conducted.

ISE-2: 50 Marks

Rubric based assessment for activities conducted

Recommended Books:

1. Vasudha Tiwari. Sunil Kumar Chaudhary and Iqbal Ahmed Khan, "*Emerging Technology For Engineers*", Vayu Education of India, 1st Edition.
2. Chanagala Shankar, "*Emerging Technologies*", Bluerose Publishers Pvt. Ltd, 1st Edition
3. Chandradev Yadav, "*The Evolution of Immersive Technologies: A Journey into the Extraordinary*", 1st Edition
4. Website of India Semiconductor Mission (https://ism.gov.in/)
5. SWAYAM course on 'An Introduction to Artificial Intelligence'
6. Other relevant online resources to be used.

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
25BSC12CE06	Linear Algebra and Business Statistics	2	--	--	2	--	--	2
		Examination Scheme						
			ISE1	MSE	ISE2	ESE	Total	
		Theory	20	30	20	30	100	

Pre-requisite Course Codes	BSC11CE01, BSC11CE03 At the end of the course learner will be able to	
Course Outcomes	CO1	Demonstrate basic knowledge about the vector spaces as an algebraic structure.
	CO2	Able to optimize the given function using linear programming problems
	CO3	Able to optimize the given function using non-linear programming problems
	CO4	Apply the concept of Correlation and Regression to engineering problems in data science, machine learning, and AI.

Theory:

Module No.	Unit No.	Topics	Ref.	Hrs.
1	Title	**Linear Algebra - Vector Spaces**	1,2	**06**
	1.1	Vector spaces		02
	1.2	Subspaces of vector spaces		02
	1.3	Basis and dimension		01
	1.4	The Gram-Schmidt orthogonalization process		01
2	Title	**Linear programming Problems (LPP)**	3,4	**07**
	2.1	Types of solutions, Standard and Canonical of LPP, Basic and Feasiblesolutions, slack variables, surplus variables, Simplex method.		03
	2.2	Artificial variables, Big-M method (Method of penalty)		02
	2.3	Duality, Dual of LPP and Dual Simplex Method		02
3	Title	**Non-linear Programming Problems (NLPP)**	3,4	**06**
	3.1	NLPP with one equality constraint (two or three variables) using themethod of Lagrange's multipliers		02
	3.2	NLPP with two equality constraints		02
	3.3	NLPP with inequality constraint: Kuhn-Tucker conditions		02
4	Title	**Correlation and Regression**	5,6,7	**07**
	4.1	Karl Pearson's Coefficient of correlation (r) and related concepts with problems.		02
	4.2	Spearman's Rank correlation coefficient (R) (Repeated & non repeated ranks problems)		01
	4.3	Lines of regression		02

	4.4	Introduction to multiple linear regression		02
			Total	**26**

Tutorial:

Exp. No.	Suggested List of Tutorials
1	Vector spaces and subspaces
2	Basis and dimension of a vector space
3	LPP: Simplex method and Big M method
4	LPP: Dual of LPP and dual simplex method
5	NLPP: Optimization with equality constraints
6	NLPP: Optimization with inequality constraints
7	Correlation
8	Regression

Course Assessment:

Theory:

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 20 Marks
MSE: 90 minutes 30 Marks written examination based on 50% syllabus
ESE: 90 minutes 30 Marks written examination based on remaining syllabus after MSE

Recommended Books:

[1] Robert M. Thrall, Leonard Tornheim, "*Vector Spaces and Matrices*", Dover Publications, Inc.
[2] Gilbert Strang, "*Linear Algebra for Everyone*", Wellesley Publisher.
[3] Prem Kumar Gupta, D. S. Hira, "*Operations Research*", S. Chand and Company Limited, Reprint edition (2017).
[4] Hamdy A. Taha, "*Operations Research: An Introduction*", Pearson/Prentice Hall Publisher, 6th edition.
[5] Dr B.S. Grewal, "*Higher Engineering Mathematics*", Khanna Publications, 4nd Edition.
[6] H. K. Dass, "*Advanced Engineering Mathematics*", S. Chand, 28th Edition.
[7] Erwin Kreysizg, "*Advanced Engineering Mathematics*", John Wiley & Sons, 10th Edition.

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
		2	--	2	2	--	1	3
25PCC12CE08	Database Management Systems	Examination Scheme						
			ISE1	MSE	ISE2	ESE	Total	
		Theory	20	30	20	30	100	
		Lab	20	--	30	--	50	

Pre-requisite Course Codes		25PCC12CE05
Course Outcomes	CO1	Describe various components of DBMS
	CO2	Design ER/EER Model for real life applications and convert it into relational model
	CO3	Apply Relational Algebra operation on a given schema
	CO4	Demonstrate SQL commands for a given task
	CO5	Apply normalization to database design to remove redundancies
	CO6	Describe concurrency control mechanism to achieve Serializability and deadlock Handling

Module No.	Unit No.	Topics	Ref.	Hrs.
1		**Introduction Database Concepts**	1,2	02
	1.1	Introduction, Characteristics of databases, File system v/s Database system,		
	1.2	Data abstraction and data Independence, DBMS system architecture, Database Administrator		
2		**Entity–Relationship Data Model**	1,2	04
	2.1	The Entity-Relationship (ER) Model: Entity types: Weak and strong entity sets, Entity sets, Types of Attributes, Keys, Relationship constraints: Cardinality and Participation,		
	2.2	Extended Entity-Relationship (EER) Model: Generalization, Specialization and Aggregation		
	2.3	Introduction to the Relational Model, ER to relational model rules and problems		
	2.4	Case studies and practice problems		
3		**Relational Algebra**	1,2	04
	3.1	Introduction to relational query language, Role of Relational Algebra in DBMS		
	3.2	Relational Algebra operators and Queries		
	3.3	Conversion of Relational Algebra into SQL		
4		**Structured Query Language (SQL)**	1,2	4
	4.1	Overview of SQL, Data Definition Language Commands, key constraints, Domain Constraints		
	4.2	Data Manipulation commands ,DQL, Aggregate function-group by, having, Views in SQL, joins, Nested and complex queries		

	4.3	Data Control commands, Set and string operations		
	4.4	Triggers, PLSQL		
5		**Relational-Database Design**	1,2	04
	5.1	Pitfalls in Relational-Database designs, Concept of normalization		
	5.2	Function Dependencies, First Normal Form, 2NF, 3NF, BCNF.		
	5.3	Converting Relational Schema to higher normal form		
	5.4	Problems based on Normalization		
6		**Transactions Management and Concurrency and Recovery**	1	04
	6.1	Transaction concept, Transaction states, ACID properties, Transaction Control Commands		
	6.2	Concurrent Executions, Serializability-Conflict and View		
	6.3	Problems based on Conflict and View Serializability		
	6.4	Concurrency Control: Lock-based, Timestamp-based protocols,		
	6.5	Recovery System: Log based recovery, Deadlock handling		
7	**7.1**	NoSQL database concepts: NoSQL data modeling, Benefits of NoSQL, comparison between SQL and NoSQL database system, Replication and sharding, Distribution Models Consistency in distributed data, CAP theorem, Notion of ACID Vs BASE, handling Transactions, consistency and eventual consistency, Types of NoSQL databases: Key-value data store, Document database and Column Family Data store, Comparison of NoSQL databases w.r.t CAP theorem and ACID properties	7	04
Total				**26**

Course Assessment:

Theory:

ISE-1: Two hours-20 Marks, Activity: Quiz / assignments

ISE-2: Two hours -20 Marks, Activity: Quiz/Assignments/ Article discussion

MSE: 90 minutes 30 Marks written examination based on 50% syllabus

ESE: 90 minutes 30 Marks written examination based on remaining syllabus after MSE

Lab:

ISE:

1. **ISE-1** will be conducted for five experiments. Continuous pre-defined rubrics-based evaluation for 20 marks.
2. **ISE-2** a. Five experiments.
   a. Continuous pre-defined rubrics-based evaluation for 20 marks.
   b. Implementation of Mini project for 10 marks

Sr.no	Suggested List of experiments
1	Write a problem statement for a selected case study. Design an Entity-Relationship (ER) / Extended Entity-Relationship (EER) Model
2	Convert ER/EER model to relational model
3	Create and populate database using Data Definition Language (DDL) and DML Commands for the specified System without integrity constraint.
4	Create and populate database using Data Definition Language (DDL) and DML Commands for the specified System with integrity constraint
5	Perform Simple queries and Date operations
6	Perform Join operations and Complex queries
7	Perform nested sub-queries in SQL
8	To implement PL/SQL and Procedures and Functions
9	To implement Triggers and Cursors
10	To implement Transaction and Concurrency control
11	Mini project based on suggested List of topics

Recommended Books:

1. Korth, Silberchatz, Sudarshan, Database System Concepts, 6thEdition, McGraw Hill
2. Elmasri and Navathe, Fundamentals of Database Systems, 5thEdition, Pearson Education
3. Raghu Ramkrishnan and Johannes Gehrke, Database Management Systems, TMH
4. Peter Rob and Carlos Coronel, Database Systems Design, Implementation and Management, Thomson Learning, 5thEdition.
5. Dr. P.S. Deshpande, SQL and PL/SQL for Oracle 10g, Black Book, Dreamtech Press.
6. G. K. Gupta, Database Management Systems, McGraw Hill, 2012
7. Michael Kaufmann, Andreas Meier, SQL and NoSQL Databases: Modeling, Languages, Security and Architectures for Big Data Management

Online Resources:

1. https://www.db-book.com/db6/slide-dir/index.html- Korth, Slberchatz, Sudarshan, 6th Edition
2. http://www.tutorialspoint.com/sql/
3. https://www.w3schools.com/sql/default.asp
4. http://www.mysqltutorial.org/ or https://www.tutorialspoint.com/postgresql/
5. https://academy.vertabelo.com/course/standard-sql-functions#
6. www.postgresqltutorial.com/postgresql-grouping-sets/
7. www.postgresqltutorial.com
8. https://www.freeprojectz.com/entity-relationship-diagram
9. https://www.w3schools.com/sql/sql_any_all.asp
10. https://www.geeksforgeeks.org/sql-all-and-any/

Further Reading:

1. Pramod Sadalge, Martin Fowler, NoSQL Distilled: A Brief Guide to the Emerging World of Polyglon Persistence, Addison Wesely/ Pearson
2. Adam Fowler, NoSQL for dummies, John Wiley & Sons, Inc
3. Shashank Tiwari, Professional NOSQL, John Willy & Sons. Inc
4. MongoDB Manual: https://docs.mongodb.com/manual

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
25PCC12CE09	Analysis of Algorithms	3	- -	2	3	--	1	4
		Examination Scheme						
			ISE1	MSE	ISE2	ESE	Total	
		Theory	20	50	30	50	100	
		Lab	20	--	30	--	50	

Pre-requisite Course Codes		25PCC12CS05
Course Outcomes	CO1	Analyze the time and space complexity of algorithms.
	CO2	Apply divide and conquer strategy to solve problems.
	CO3	Apply greedy strategy to solve optimization problems.
	CO4	Apply dynamic programming strategy to solve optimization problems.
	CO5	Apply backtracking and branch and bound strategies to solve problems.
	CO6	Implement various string-matching algorithms to solve pattern matching problems

Module No.	Unit No.	Topics	Ref.	Hrs.
1	1.1	**Introduction:** Performance analysis, space and time complexity calculations, Asymptotic notations. **Complexity class**: Solving Recurrence equations using Substitution, Recursion tree and Masters theorem	1,2	10
	1.2	**Divide and Conquer strategy:** General Concept, Quick sort, Merge sort, multiplying long Integers OR Finding minimum and maximum element of an array		
2	2.1	**Greedy Strategy:** General concept, Minimum Coin Change problem, Activity Selection problem. Fractional Knapsack Problem, Minimum Spanning Tree (Prim's and Kruskal's Algorithm), Dijkstra's Algorithm	1,2	8
3	3.1	**Dynamic Programming:** General Method, 0/1 knapsack problem, longest common subsequence, Bellman ford algorithm, Floyd Warshall algorithm, Multistage Graph, Assembly line scheduling	1,2	8
4	4.1	**Backtracking and Branch and bound:** Backtracking: General Method, N-queen problem, Graph coloring Problem, Sum of subsets Branch and Bound: Travelling Salesperson Problem, 15 Puzzle problem	1,2	8
5	5.1	**String Matching Algorithms:** The Naïve string-matching algorithm, The Rabin Karp algorithm, The Knuth-Morris-Pratt algorithm	1,2	5
			Total	**39**

Course Assessment:

Theory: ISE-1 & ISE-2: Activities (50 Marks)

- Quiz/ Problem solving score of hacker rank / code chef/leetcode/
- Assignments/Internal Coding Competition /Certification course of 10-12hr duration on platform like courser /Udemy/NPTEL/ Design of an experiment

MSE: 120 minutes 50 Marks written examination based on 50% syllabus
ESE: 120 minutes 50 Marks written examination based on remaining syllabus after MSE

Lab:

ISE-1: Will be conducted on experiments based on module 1 to 3. Continuous predefined rubrics-based evaluation for 20 marks

ISE-2: Will be conducted on experiments based on module 4 to 6 Continuous pre-defined rubrics-based evaluation for 20 marks. Practical Exam on full syllabus for 10 marks

Note: i) Programs can be implemented using any programming language.

ii) Time and Space complexity calculation needs to be performed for each algorithm.

Module No.	Exp. No.	Suggested List of experiments
1	1	**Sorting:** Implement and analyze time and space complexity of Modified bubble, Insertion and Selection sort to display exam result of students based on their total marks scored.
	2	**Divide and Conquer:** Implement and analyze time and space complexity of Quick and Merge sort to display records of an employee working in any organization based on their work experience.
	3	**Divide and Conquer: (Any one)** I. Implement and Analyze time and space complexity of multiplying long Integers using divide and conquer strategy. II. Implement and Analyze time and space complexity of finding minimum and maximum element of an array using divide and conquer strategy
2	4 5	**Greedy Strategy**: **(Any 2)** I. Identify and implement an algorithm to be used to solve the challenge faced by airline and shipping companies of maximizing revenue while adhering to weight and space constraints when loading cargo onto airplanes or ships. determine the optimal selection and allocation of cargo items based on their values (revenue) and weights, ensuring efficient use of cargo space. II. Identify and implement an algorithm to be used in the construction of communication networks (telephone or internet networks) where a telecommunication company needs to lay down cables to connect several cities to establish a reliable network infrastructure. The company wants to minimize the cost

		of laying down cables while ensuring that all cities are connected and there is no redundancy in the network. III. Identify and implement an algorithm to be used by vending machines to determine the optimal combination of coins to give as change to customers.
3	6 7	**Dynamic Programming: (Any 2)** I. Identify and implement an algorithm to be used in disaster management and emergency response systems to find the shortest path for emergency vehicles, such as ambulances or fire trucks, to reach affected areas or victims. II. Identify and implement an algorithm to be used to compare DNA /RNA sequences to identify similarities and evolutionary relationships between organisms. III. Identify and implement an algorithm to be used by city planners and urban developers to determine the shortest paths between all pairs of locations, such as residential areas, commercial centers, and public facilities, to improve accessibility, reduce traffic congestion, and enhance urban mobility.
4	8	**Backtracking: (Any 1)** I. Implement N queen problem II. Identify and implement an algorithm to be used for coloring regions on a map such that adjacent regions do not have same color.
5	9	**String Matching:** Identify and implement an algorithm to be used by search engines to quickly locate documents containing specific keywords or phrases, improving search efficiency and response time.

Recommended Books:

1. T. H. Cormen, C.E. Leiserson, R. L. Rivest, and C. Stein, "Introduction to algorithms",PHI Publication, 2nd Edition, 2005.
2. Ellis Horowitz, Sartaj Sahni, S. Rajsekaran. "Fundamentals of computer algorithms",2nd Edition, University Press, 2007
3. Steven S. Skiena , "Algorithm Design Manual", Springer Publication, 2nd Edition, 2008
4. Sanjoy Dasgupta, Christos Papadimitriou, Umesh Vazirani, "Algorithms", Tata McGraw Hill, 1st Edition, 2006
5. S. K. Basu, "Design Methods and Analysis of Algorithm", PHI, 2nd Edition, 2013.

Online Resources:

1. https://nptel.ac.in/courses/106/106/106106131/
2. https://www.coursera.org/specializations/algorithms
3. https://www.mooc-list.com/tags/algorithms
4. https://www.youtube.com/watch?v=aGjL7YXI31Q&list=PLEbnTDJUr_IeHYw_sfBOJ6gk5pie0yP-0
5. https://www.geeksforgeeks.org/design-and-analysis-of-algorithms/
6. Algorithm visualization tool https://visualgo.net/
7. LeetCode/ HackerRank platform to solve challenging problems

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
25PCC12CE010	Operating Systems	L	T	P	L	T	P	Total
		2	--	2	2	--	1	3
		Examination Scheme						
			ISE1	MSE	ISE2	ESE	Total	
		Theory	20	30	20	30	100	
		Lab	20	--	30	--	50	

Pre-requisite Course Codes		
Course Outcomes	CO1	Describe the architecture and functioning of operating systems.
	CO2	Evaluate process scheduling algorithms for efficiency and performance optimization.
	CO3	Apply concurrency and synchronization techniques in software development.
	CO4	Implement and analyze algorithms for memory management and file systems to enhance resource utilization and system performance.
	CO5	Analyze advanced operating system architectures and functionalities through case studies of modern systems

Module No.	Unit No.	Topics	Ref.	Hrs.
1	1	**Overview of Operating Systems-**	1,2, 3,4	4
	1.1	Introduction, Objectives, Functions and Evolution of Operating System		
	1.2	Operating system structures: Layered, Monolithic and Microkernel		
	1.3	Linux Kernel, Shell and System Calls		
2	2	**Process Management-**	1,2, 3,4	6
	2.1	Concept of a Process, Process States, Process Description, Process Control Block		
	2.2	Uniprocessor Scheduling-Types: Preemptive and Non-preemptive scheduling algorithms (FCFS, SJF, SRTN, Priority, RR)		
	2.3	Threads: Definition and Types, Concept of Multithreading		
3	3	**Inter-process Communication and Deadlock Management**	1,2, 3,4	6
	3.1	Concurrency: Principles of Concurrency, Inter-Process Communication, Process Synchronization		
	3.2	Mutual Exclusion: Requirements, Hardware Support (TSL), Operating System Support (Semaphores), Producer and Consumer problem		
	3.3	Principles of Deadlock: Conditions and Resource, Allocation Graphs, Deadlock Prevention, Deadlock Avoidance: Banker‟s Algorithm, Deadlock Detection and Recovery, Dining		

		Philosophers Problem		
4	**4**	**Memory Management**	1,2, 3,4	6
	4.1	Memory Management Requirements, Memory Partitioning: Fixed, Partitioning, Dynamic Partitioning, Memory Allocation Strategies: Best-Fit, First Fit, Worst Fit, Paging and Segmentation, TLB		
	4.2	Virtual Memory: Demand Paging, Page Replacement Strategies: FIFO, Optimal, LRU, Thrashing		
5	**5**	**File Systems and I/O Management**	1,2, 3,4	6
	5.1	File Systems - File attributes, directory structures, and access methods File allocation techniques: Contiguous, Linked, and Indexed		
	5.2	Disk Scheduling- FCFS, SSTF, SCAN, C-SCAN.		
	5.3	I/O devices, Organization of the I/O Function, Disk Organization, I/O Management and Disk Scheduling: FCFS, SSTF, SCAN, CSCAN, LOOK, C-LOOK		
	5.4	I/O Management-Device drivers, interrupts, and buffering.		
6	**6**	**Advances in Modern Operating Systems**	5,6, 7,8, 9	2
	6.1	Case Studies- Cloud and Mobile OS, Real-Time and Edge OS, AI and Quantum Computing OS,Modern Linux-Based Systems, Experimental OS		
			Total	**30**

Module No.	**Sr.no**	**Suggested List of experiments**	**Ref.**	**Hrs.**
	1	Implement basic scheduling algorithms	1,2, 3,4	2
	2	Simulate producer-consumer synchronization.	1,2, 3,4	2
	3	Simulate a system with processes and resources to detect and resolve deadlocks using a resource allocation graph.	1,2, 3,4	2
	4	Write a program to simulate page replacement algorithms	1,2, 3,4	2
	5	Write a program to simulate memory allocation techniques.	1,2, 3,4	2
	6	Simulate file allocation techniques	1,2, 3,4	2
	7	Implement disk scheduling algorithms.	1,2, 3,4	2
	8	Implement buffering techniques for a simulated I/O device to manage data streams efficiently.	1,2, 3,4	2
	9	Analyze Linux kernel logs for specific events (e.g., scheduling, I/O operations) using tools like dmesg or syslog.	9	2
	10	Explore OS vulnerabilities using a controlled virtual environment.	1,2,	2

		Analyze patching or mitigation strategies.	3,4	
	11	Simulator based experiments (EduMIPS64, GAIL (General Algorithm Interactive Learning) ,NS-3 etc)	10	2
			Total	**22**

Course Assessment:

Theory:

ISE-1:
Activity: Quiz and assignments 20 Marks
ISE-2: Two hours 20 Marks
Activity: Article Discussion, Quiz and Assignments
Outcome: Reflective Journal

MSE: 90 minutes 30 Marks written examination based on 50% syllabus
ESE: 90 minutes 30 Marks written examination based on remaining 50% syllabus after MSE

Lab:

ISE:
1. ISE-1 will be conducted for four or 50% of experiments. Continuous pre-defined rubrics-based evaluation for 20 marks.
2. ISE-2
a. Remaining Four experiments or 50% of experiments. Continuous pre-defined rubrics-based evaluation for 20 marks.
b. Simulation using modern tools to solve the given problem statement for 10 marks

Recommended Books:

1. Silberschatz A., Galvin P., Gagne G. "Operating Systems Principles", Willey Eight edition
2. Achyut S. Godbole , Atul Kahate "Operating Systems" McGraw Hill Third Edition
3. "Operating System-Internal & Design Principles", William Stallings, Pearson
4. Andrew S. Tanenbaum, "Modern Operating System", Prentice Hall.
5. "Cloud Computing: Concepts, Technology & Architecture" by Thomas Erl, Ricardo Puttini, and Zaigham Mahmood
6. "Mobile Operating Systems: Concepts and Practices" by Dr. R. Latha and S. Pavithra
7. "Embedded and Real-Time Operating Systems" by K.C. Wang
8. "Quantum Computing: A Gentle Introduction" by Eleanor Rieffel and Wolfgang Polak
9. "Linux Kernel Development" by Robert Love
10. Official Website of GAIL on GitHub,NS-3 Official Website,EduMIPS64 Official Website

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc21_cs72/preview
2. https://www.scaler.com/topics/course/free-operating-system-course/

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
25OE13CE21	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**

Course Assessment:

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

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

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 Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
25OE13CE22	Principles of Management	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	After completing the given assignments and experiments, students will be able to:	
	CO1	Understand the evolution of management theories and their relevance today
	CO2	Apply planning tools and techniques to real-world business scenarios
	CO3	Understand effective organizational structures based on business requirements
	CO4	Study different leadership styles and apply appropriate leadership techniques in various situations.
	CO5	Recognize ethical dilemmas in management and apply responsible decision-making frameworks.
	CO6	Study critical thinking and problem-solving techniques to organizational issues.

Module No.	Topic	Ref	Hours
1	**Introduction to Management** Definition and Nature of Management: Understanding management as a process and its significance in organizations. Historical Evolution: Exploration of classical management theories, including contributions from Henri Fayol and Frederick Taylor. Managerial Roles and Skills: Analysis of the roles managers play and the skills required at different managerial levels.	1-5	04
2	**Planning** Strategic and Tactical Planning: Differentiating between long-term strategic planning and short-term tactical planning. Decision-Making Processes: Tools and techniques for effective managerial decision-making. Goal Setting and Management by Objectives	4-7	05

	(MBO): Establishing clear objectives and aligning them with organizational goals		
3	**Organizing** Organizational Structure and Design: Examining various organizational structures and their impact on efficiency. Delegation and Authority: Understanding the distribution of authority and responsibility within an organization. Coordination and Communication: Strategies for effective internal communication and coordination among departments.	**4-7**	**04**
4	**Leading** Leadership Theories and Styles: Study of different leadership models and their applicability. Motivation Techniques: Exploring theories of motivation and their implementation in the workplace. Team Dynamics and Group Behavior: Insights into managing teams and understanding group behavior.	**5-7**	**05**
5	**Control Systems and Processes** Establishing standards and monitoring performance. Financial Controls: Budgeting, financial reporting, and variance analysis. Quality Management: Introduction to quality control techniques and continuous improvement processes.	**5-7**	**04**
6	**Contemporary Issues in Management** Ethics and Social Responsibility: The role of ethics in managerial decisions and corporate social responsibility. Globalization and Management: Challenges and strategies in managing international operations. Innovation and Change Management: Managing organizational change and fostering innovation.	**5-7**	**04**
	Total		**26**

Assessment:

ISE-1: Quiz based on Module 1,2 and 3 (20 Marks)
Case study / Application with PPT Presentation (Group of 4 students) of Decision Making Process Approach, MBO (30 Marks)

ISE-2: Quiz based on Module 4,5 and 6 (20 Marks)
Case Study / Application / Research Literature Studies with PPT Presentation (Group of 4 students) on Leadership in Organization, Innovation and Change Management, continuous improvement processes (30 Marks)

Note: ISE will be based on Continuous predefined rubrics based evaluation

References:

1. **Koontz, H., & Weihrich, H.** (2010). *Essentials of Management: An International Perspective* (8th ed.). McGraw-Hill Education.
2. **Robbins, S. P., & Coulter, M.** (2017). *Management* (13th ed.). Pearson Education.
3. **Daft, R. L.** (2018). *Management* (13th ed.). Cengage Learning.

4. **Stoner, J. A. F., Freeman, R. E., & Gilbert, D. R.** (1995). *Management* (6th ed.). Prentice Hall.
5. **Drucker, P. F.** (2006). *The Practice of Management*. HarperBusiness.
6. **Academy of Management Journal** – Provides peer-reviewed research articles on management theory and practices.
7. **Journal of Management Studies** – Features cutting-edge research in all fields of management.

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
25VSE12CE03	Full Stack Development Lab	--	--	4	--	--	2	2
		Examination Scheme						
			ISE1	MSE	ISE2	ESE	Total	
		Theory	--	--	--	--		
		Lab	50	--	50	--	50	

Pre-requisite Course Codes		ESC11CE03
Course Outcomes	CO1	Demonstrate Foundational Understanding of Web Technologies
	CO2	Develop Proficiency in Frontend Development with React.js
	CO3	Develop Backend Development with Node.js and Express.js
	CO4	Integrate Full-Stack Application Development with MongoDB
	CO5	Deploy Web Applications using MERN Stack

Module No.	Expt. No.	Topics
1		Introduction to Full Stack Development, understanding the client-server architecture. **Static Website Design** Introduction to frontend and backend technologies, HTML5 and CSS3 fundamentals. CSS: web page using CSS (Cascading Style Sheets)
	1	**Suggested Experiments (Any one)** • Build Tourism Website by using HTML5, • CSS3, and Bootstrap. • Personal Portfolio Website • Online Book store
2		**Responsive Website Design** JavaScript Essentials- JavaScript syntax and data types, DOM manipulation and event handling, Functions, closures, and scope.
	2	**Suggested Experiments (Any one)** ● Notes Organizer website ● Build a responsive fitness fuel website by using HTML5, CSS and JavaScript ● Build a Wikipedia Search Application using HTML5, CSS3, JS.
3		**Frontend Frameworks-**MERN stack, Introduction to React.js or Vue.js, Components and props, State management with Redux or Vuex, Routing (Query parameters, Path parameters) and navigation
	3	**Suggested Experiments (Any one)** ● Build an E-commerce application using React JS. ● Food Delivery Application ● Entertainment application like BookMyShow
4		**Backend Frameworks** Development with Node.js or Django or Express.js. Introduction to Node.js or Django framework. Setting up a development environment. Building

		RESTful APIs.
	4	**Suggested Experiments (Any one)** ● Build an E-commerce application using React JS. ● Food Delivery Application ● Entertainment application like BookMyShow
5		Database Management, Relational databases with SQL (MySQL, PostgreSQL), NoSQL databases (MongoDB), Database modelling and design.
	5	**Suggested Experiments (Any one)** ● Content Management System (CMS) ● Task Management Application ● Online Learning Platform (Employ a relational database to manage user accounts, course details, lesson content, user progress, and forum posts.)
6	**6**	**Design Assignment** Add features to any existing web application (e.g., Shopify, WordPress, WooCommerce, Twitter, Drupal, Joomla, Airbnb etc.)
7	**7**	**Mini Project:** Working on a full-stack project from start to finish. Create a GitHub link to showcase a completed project. Peer review and feedback sessions.

Course Assessment:

Lab:

ISE-1: will be conducted for coding assignments and quizzes. Continuous pre-defined rubrics-based evaluation for **50 marks.**

ISE-2: Project development and presentation (Mini Project). Continuous pre-defined rubrics-based evaluation for **50 marks.**

Recommended Books:

1. HTML & CSS: The Complete Reference Thomas A. Powell, Fifth Edition, Tata McGraw Hill
2. WEB PROGRAMMING with HTML5, CSS and JavaScript, John Dean, Jones & Bartlett Learning, First Edition, 2019
3. Full-Stack React Projects: Learn Mern Stack Development, Shama Hoque, Second Edition, Packt Publishing Limited, 2020
4. The Full Stack Developer, Chris Northwood, First Edition, Apress publication, 2018
5. Full Stack JavaScript: Learn Backbone.js, Node.js and MongoDB, AZAT MARDAN, Second Edition, Apress publication.
6. Learning SQL: Generate, Manipulate, and Retrieve Data, Alan Beaulieu, Third Edition
7. O'Reilly publication.
8. MongoDB: The Definitive Guide. Shannon Bradshaw, Kristina Chodorow, and Michael Dirolf, Second Edition, O'Reilly publication

Online Resources:

1. Web links and Video Lectures (e-Resources)
   https://onlinecourses.swayam2.ac.in/aic20_sp11/preview
2. https://www.w3.org/html/
3. http://www.htmlref.com/

4. http://w3schools.org/
5. http://www.tutorialspoint.com/css/

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
25EEM12CE02	Technology Entrepreneurship	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	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**

Course Assessment:

ISE-1:

Quiz: 10 Marks
Assignment: Effectuation case study: 10Marks

Activity: Presentation of Value Proposition Canvas: 30 Marks Rubric Based assessment

ISE-2:

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

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 Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
25VEC12CE02	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**

Course Assessment:

ISE-1: Quiz: 20 Marks
Activity: Case Study Presentation: 20 Marks
ISE-2: Quiz: 20 Marks

Activity: Short Film Creation and Presentation: 40 Marks

Recommended Books:

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

Web Resources:

1. https://sdgs.un.org/goals
2. https://sdgs.un.org/tfm