NUTAN MAHARASHTRA VIDYA PRASARAK MANDAL'S

NUTAN MAHARASHTRA INSTITUTE OF ENGINEERING AND TECHNOLOGY

AN AUTONOMOUS INSTITUTE | UNDER ADMINISTRATIVE SUPPORT OF PCET

Curriculum Structure and Syllabus of Second Year B.Tech Electronics and Computer Engineering (2025 Pattern)

VISION OF THE INSTITUTE

To be a notable institution for providing quality technical education and ensuring ethical, moral and holistic development of students.

MISSION OF THE INSTITUTE

To nurture engineering graduates with state of the art competence, professionalism and problem solving skills to serve needs of industry as well as society.

VISION OF ELECTRONICS AND COMPUTER ENGINEERING

To create globally recognized Electronics and Computer Engineering graduates through industry-driven education, innovation, research, and entrepreneurial skills.

MISSION OF ELECTRONICS AND COMPUTER ENGINEERING

- To promote industry-driven learning, hands-on training, and emerging technologies to develop industry-ready professionals.
- To foster innovation, research culture, and problem-solving skills for technological advancement.
- To encourage entrepreneurship and leadership while developing socially responsible engineers capable of addressing industry and societal challenges.

INDEX

COURSE-WISE CREDIT DISTRIBUTION

Sl. No.	Type of Course	No. of Courses	Total Credits	
			No.	%
1	Basic Science Course (BSC)	8	14	8.14
2	Engineering Core Course (ECC)	10	15	8.72
3	Programme Core Course (PCC)	28	54	31.40
4	Programme Elective Course (PEC)	9	20	11.63
5	Multidisciplinary Minor (MDM)	7	13	7.56
6	Open Elective Course (OEC)	3	8	4.65
7	Vocational and Skill Enhancement Course (VSEC)	4	8	4.65
8	Ability Enhancement Course (AEC)	2	4	2.33
9	Entrepreneurship / Management Course(EMC)	2	4	2.33
10	Value Education Course (VEC)	2	4	2.33
11	Experiential Learning Courses	8	22	12.79
12	Indian Knowledge System	1	2	1.16
13	Co-curricular Courses	2	4	2.33
TOTAL		**86**	**172**	**100**

SEMESTER-WISE COURSE DISTRIBUTION

Course Distribution: Semester Wise										
Sl. No.	**Type Of Course**	**No. of Courses / Semester**								**Total**
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	
1	Basic Science Course (BSC)	4	4	-	-	-	-	-	-	8
2	Engineering Science Course (ESC)	6	4	-	-	-	-	-	-	10
3	Programme Core Course (PCC)	-	2	5	5	5	5	4	2	28
4	Programme Elective Course (PEC)	-	2	-	-	2	3	2	2	11
5	Multidisciplinary Minor (MDM)	-	-	1	1	2	1	-	2	7
6	Open Elective Course (OEC)	-	-	1	1	1	-	-	-	3
7	Vocational and Skill Enhancement Course (VSEC)	1	1	1	1	-	-	-	-	4
8	Ability Enhancement Course (AEC)	1		-	1	-	-	-	-	3
9	Entrepreneurship / Management Course(EMC)	-	-	1	1	-	-	-	-	2
10	Value Education Course (VEC)	-	-	1	1	-	-	-	-	2
11	Experiential Learning Courses	-	-	-	1	1	1	1	1	5
12	Indian Knowledge System	-	1	-	-	-	-	-	-	1
13	Co-curricular Courses	1	1	-	-	-	-	-	-	2
Total		**13**	**16**	**10**	**12**	**11**	**10**	**07**	**07**	**86**

SEMESTER-WISE CREDIT DISTRIBUTION

Course Distribution: Semester Wise										
1 Lecture hour = 1 Credit, 2 Lab Hours = 1 Credit, 1 Tutorial Hour = 1 Credit										
Sl. No.	**Type of Course**	**No. of Courses / Semester**								**Total**
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	
1	Basic Science Course (BSC)	7	7	-	-	-	-	-	-	14
2	Engineering Science Course (ESC)	9	6	-	-	-	-	-	-	15
3	Programme Core Course (PCC)	-	3	10	10	10	8	8	4	53
4	Programme Elective Course (PEC)	-	-	-	-	4	8	4	4	20
5	Multidisciplinary Minor (MDM)	-	-	2	2	4	2	-	4	14
6	Open Elective Course (OEC)	-	-	4	2	2	-	-	-	8
7	Vocational and Skill Enhancement Course (VSEC)	2	2	2	2	-	2	-	-	10
8	Ability Enhancement Course (AEC)	2	-	-	2	-	-	-	-	4
9	Entrepreneurship / Management Course(EMC)	-	-	2	2	-	-	-	-	4
10	Value Education Course (VEC)	-	-	2	-	-	-	-	-	2
11	Experiential Learning Courses	-	-	-	2	2	2	8	8	22
12	Indian Knowledge System	-	2	-	-	-	-	-	-	2
13	Co-curricular Courses	2	2	-	-	-	-	-	-	4
Total		**22**	**22**	**22**	**22**	**22**	**22**	**20**	**20**	**172**

CURRICULUM STRUCTURE
Second Year B.Tech.
Electronics and Computer Engineering
Semester – III

Level 5.0																		
Second Year B. Tech. Electronics and Computer Engineering																		
Semester III																		
Sl. No.	**Course Code**	**Course Type**	**Course Name**	**Credit Scheme**			**Teaching Scheme (Hours/Week)**			**Examination Scheme and Marks**								
										CCE		**ESE**						
				TH	**TUT**	**PR**	**L**	**T**	**P**	**UT**	**FA**	**SA**	**PR**	**OR**	**TW**	**TOTAL**		
										25	**25**	**50**						
1	ECE25PCC-201	Programme Core Course	Signals and Systems	2			2			25	25	50				100		
2	ECE25PCC-202	Programme Core Course	Data Structures and Algorithms	2			2			25	25	50				100		
3	ECE25PCC-203	Programme Core Course	Data Structures and Algorithms Laboratory			2			4				50		25	75		
4	ECE25PCC-204	Programme Core Course	Semiconductor Devices and Circuits	2			2			25	25	50				100		
5	ECE25PCC-205	Programme Core Course	Semiconductor Devices and Circuits Laboratory			2			4				50		25	75		
6	ECE25MDM-206	Multi-disciplinary Minor Course	Fundamental of Data Science	2			2			25	25	50				100		
7	-	Open Elective Course	Open Elective Course-I	3	1		3	1		25	25	50				100		
8	-	Value Education Course	Value Education Course-I		1	1		1	2						25	25		
9	ECE25VSEC-209	Vocational and Skill Enhancement Course	Vocational and Skill Enhancement Course- I			2			4					25	25	50		
10	IL25EMC-210	Entrepreneurship / Management Course	Principles of Management and Entrepreneurship		1	1		1	2						25	25		
TOTAL				**11**	**3**	**8**	**11**	**3**	**16**	**125**	**125**	**250**	**100**	**25**	**125**	**750**		
				22			**30**											

CCE-Comprehensive Continuous Evaluation**, ESE**-End Semester Evaluation**, TW**-Term Work, **OR**-Oral, **PR**-Practical, **L**-Lecture, **P**-Practical, **T**-Tutorial, **FA**–Formative Assessment, **SA**-Summative Assessment

Basket: List of Open Elective Course - I

Course Code	Course Name	
CE25OEC-207	Computational Mathematics	Choose Any One
CAI25OEC-207	Probability Theory and Statistical Methods	
AIDS25OEC-207	Probability and Statistics	
IT25OEC-207	Numerical Statistical Analysis	
ETC25OEC-207	Vectors and Transforms	
ME25OEC-207	Applied Mathematics	

Basket: List of Value Education Course - I

Course Code	Course Name	
CSE25VEC-208	Universal Human Values	Choose Any One
ETC25VEC-208A	Professional Ethics for Engineers	
ETC25VEC-208B	Social Connect and Responsibility	

Basket: List of Vocational and Skill Enhancement Course - I

Course Code	Course Name	
ECE25VSEC-209A	Python Programming for Data Science	Choose Any One
ECE25VSEC-209B	PCB Design and Fabrication Techniques	
ECE25VSEC-209C	Cloud Computing	

CURRICULUM STRUCTURE

Second Year B.Tech.

Electronics and Computer Engineering

Semester – IV

Level 5.0																	
Second Year B. Tech. Electronics and Computer Engineering																	
Semester IV																	
Sl. No.	**Course Code**	**Course Type**	**Course Name**	**Credit Scheme**			**Teaching Scheme (Hours/Week)**			**Examination Scheme and Marks**							
										CCE		**ESE**					
				TH	**TUT**	**PR**	**L**	**T**	**P**	**UT**	**FA**	**SA**	**PR**	**OR**	**TW**	**TOTAL**	
										25	**25**	**50**					
1	ECE25PCC-251	Programme Core Course	Design and Analysis of Algorithms	2			2			25	25	50				100	
2	ECE25PCC-252	Programme Core Course	Object-Oriented Programming Using JAVA	2			2			25	25	50				100	
3	ECE25PCC-253	Programme Core Course	Object-Oriented Programming Using JAVA Laboratory			2			4				50		25	75	
4	ECE25PCC-254	Programme Core Course	Digital Electronics and Microcontrollers	2			2			25	25	50				100	
5	ECE25PCC-255	Programme Core Course	Digital Electronics and Microcontrollers Laboratory			2			4				25		25	50	
6	ECE25MDM-256	Multi-disciplinary Minor Course	Fundamentals of Artificial Intelligence	2			2			25	25	50				100	
7	-	Open Elective Course	Open Elective Course-II	2			2			25	25	50				100	
8	-	Value Education Course	Value Education Course-II	1	1		1	1							25	25	
9	ECE25ELC-259	Experiential Learning Course	Community Engagement Project			2			4					50		50	
10	IL25EMC-260	Entrepreneurship / Management Course	Entrepreneurship Skills Development		1	1		1	2						25	25	
11	IL25AEC-261	Ability Enhancement Course	Modern Indian Languages (Marathi)	1		1	1		2						25	25	
TOTAL				12	2	8	12	2	16	**125**	**125**	**250**	**75**	**50**	**125**	**750**	
				22			**30**										

CCE-Comprehensive Continuous Evaluation**, ESE**-End Semester Evaluation**, TW**-Term Work, **OR**-Oral, **PR**-Practical, **L**-Lecture, **P**-Practical, **T**-Tutorial, **FA**–Formative Assessment, **SA**-Summative Assessment

Basket: List of Open Elective Course - II

Course Code	Course Name	
CE25OEC-257	Digital Marketing	Choose Any One
ETC25OEC-257	Engineering Economics	
ME25OEC-257	Digital Finance	

Basket: List of Value Education Course - II

Course Code	Course Name	
CE25VEC-258	Indian Constitution	Choose Any One
AIDS25VEC-258	Environmental Science	

Course Syllabus

Semester-III

Program	B.Tech. (Electronics and Computer Engineering)			Semester : III			
Course	Signals and Systems			Code:		ECE25PCC-201	
Credits	Teaching Scheme (Hrs./Week)			Examination Scheme and Marks			
	Lecture	Practical	Tutorial	UT	FA	SA	Total
2	2	-	-	25	25	50	100

Pre-requisites: Nil.

Course Objectives

1. To explain fundamentals of continuous-time and discrete-time signals, systems and LTI systems.
2. To apply Fourier series and Fourier transform for frequency-domain analysis of signals.
3. To apply Laplace transforms for analysis of continuous-time LTI systems.
4. To analyze continuous-time and discrete-time signals and systems in time and frequency domain.

Course Outcomes

After learning the course, the students will be able to

CO1: Understand classification, properties and mathematical representation of continuous-time and discrete-time signals and systems.

CO2: Analyze signals and systems using mathematical tools such as convolution, differential equations and system properties (linearity, causality, and stability).

CO3: Apply time-domain analysis techniques including impulse response, convolution and system modeling.

CO4: Apply frequency-domain analysis using Fourier series, Fourier transform and Laplace transform for LTI systems.

Course Contents

Unit	Description	Duration [Hrs]
I	**Signals, Systems and Linear Time – Invariant System** Size of a signal, classification of signals, elementary signals, signal operations, signal models, even and odd functions, systems, classification of systems, properties of systems, system model. Properties of linear time – invariant systems, convolution, interconnection of LTI systems, zero- input response, zero state response, impulse response, and stability, systems represented by differential and difference equations.	8
II	**Fourier Representations of Continuous – Time Signals** Signals and vectors, correlation, orthogonal set, continuous – time Fourier series, trigonometric and exponential Fourier series, continuous – time Fourier transform, properties, Parseval relationships, Fourier transform properties.	8

III	**Fourier Representations of Discrete – Time Signals** Sampling, discrete – time signals, models, operations, discrete – time systems, zero input response, zero state response, stability, discrete – time Fourier series, discrete – time Fourier transform, reconstruction of continuous – time signals from samples, interpolation.	**8**
IV	**Laplace Transform** Properties, solution of differential and integro-differential equations, bilateral Laplace transform, transfer function, causality and stability, continuous – time second order systems, poles and zeros, connection between the Laplace and Z-transform	**6**
	Total	**30**

Text Books:

1. Lathi B.P., "Principles of Signal processing and Linear Systems", Oxford International Version - 2009.
2. Hsu H.P., "Schaum's Outline of Signals and Systems", 3rd edition, McGraw Hill Education.

Reference Books:

1. Oppenheim A.V., Willsky A.S., Nawab S.H., "Signals and Systems", 2nd edition-2015, Prentice Hall.
2. Lee E.A., Varaiya P., "Structure and Interpretation of Signals and Systems", 2nd edition-2011, Addison-Wesley.
3. Haykin S., Veen B.V., "Signals and Systems", 2nd edition - 2007, John Wiley.

e-sources:

- NPTEL: Principles of Signals and Systems – Prof. Aditya Jagannatham (IIT Mandi) https://nptel.ac.in/courses/108104100
- NPTEL: Introduction to Signals and Systems – Prof. Hitesh Sharmali (IIT Kharagpur) and Prof. Kushal Shah (ISHER, Bhopal) https://onlinecourses.nptel.ac.in/noc26_ee79/preview

Program	B.Tech. (Electronics and Computer Engineering)			Semester : III			
Course	Data Structures and Algorithm			Code:		ECE25PCC-202	
Credits	Teaching Scheme (Hrs./Week)			Examination Scheme and Marks			
	Lecture	Practical	Tutorial	UT	FA	SA	Total
2	2	-	-	25	25	50	100

Pre-requisites: Basic knowledge of programming (C/C++/Python),) and problem-solving skills.

Course Objectives:

1. To develop fundamental understanding of data structures and their role in efficient computation.
2. To design and analyze algorithms using appropriate data structures.
3. To explain linear and non-linear data structures and their applications in engineering problems.
4. To evaluate algorithm efficiency using asymptotic analysis and apply suitable techniques for real-world problem solving.

Course Outcomes:

After learning the course, the students will be able to:

CO1: Apply asymptotic notations to analyze time and space complexity of algorithms.

CO2: Implement linear data structures such as arrays, stacks, queues, and linked lists for problem solving.

CO3: Apply non-linear data structures such as trees and graphs for problem solving.

CO4: Develop efficient solutions using searching, sorting, hashing, and graph algorithms for engineering applications.

Course Contents

Unit	Description	Duration [Hrs]
I	**Algorithm Analysis and Design: Searching and Sorting** Introduction to data structures and algorithms; abstract data types (ADT); review of arrays and basic operations; algorithm design principles. Asymptotic analysis: Big-O, Omega, Theta notations; time and space complexity. Searching: Linear and Binary Search. Sorting: Bubble, Insertion, Selection, Merge, Quick, Heap sort, stability and in-place sorting, comparison of algorithms. Introduction to hashing and collision resolution techniques.	8
II	**Stacks and Queues** Stack ADT: Array and linked implementation, operations, applications (expression evaluation, recursion handling). Recursion and its relation to stack.	7

	Queue ADT: Array and linked implementation, circular queues, deque, priority queues. Applications: CPU scheduling, buffering, and real-time systems.	
III	**Linked Lists and Applications** Singly, doubly, and circular linked lists; operations (insertion, deletion, traversal, searching). Memory representation and dynamic allocation. Implementation of stacks and queues using linked lists. Applications in polynomial manipulation and sparse matrices.	**7**
IV	**Trees and Graphs** Trees: Terminology, binary trees, binary search trees (BST), AVL trees (introductory concept), tree traversals (recursive & iterative), heap and priority queue. Graphs: Representation (adjacency matrix/list), BFS and DFS, shortest path algorithms (Dijkstra's), minimum spanning trees (Prim's, Kruskal's). Applications in communication networks (routing, shortest paths), circuit and system modeling (signal flow graphs), and real-world networked systems.	**8**
	Total	**30**

Text Books:

1. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C", Pearson Education, 2nd Edition, ISBN: 978-8131720479.
2. Ellis Horowitz, Sartaj Sahni, Susan Anderson-Freed, "Fundamentals of Data Structures in C", Universities Press, 2nd Edition, ISBN: 978-8173716065.
3. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, "Introduction to Algorithms", MIT Press, 3rd Edition, ISBN: 978-0262033848.

Reference Books:

1. Narasimha Karumanchi, "Data Structures and Algorithms Made Easy", CareerMonk Publications, 5th Edition, ISBN: 978-8192107554.
2. Robert Sedgewick, "Algorithms in C", Addison Wesley, 3rd Edition, ISBN: 978-0201514254.
3. Michael T. Goodrich, Roberto Tamassia, Michael H. Goldwasser, "Data Structures and Algorithms in Python", Wiley, 1st Edition, ISBN: 978-1118290279.

e-sources:

- NPTEL: Introduction to Data Structures and Algorithms – Prof. Naveen Garg (IIT, Delhi) https://nptel.ac.in/courses/106102064
- COURSERA: Data Structures and Algorithms Specialization – Prof. Michael Levin et al (University of California San Diego) https://www.coursera.org/specializations/data-structures-algorithms

Program	B.Tech. (Electronics and Computer Engineering)				Semester : III		
Course	Data Structures and Algorithm Laboratory				Code	ECE25PCC-203	
Credits	Teaching Scheme (Hrs./Week)			Examination Scheme and Marks			
	Lecture	Practical	Tutorial	TW	OR	PR	Total
2	-	4	-	25	-	50	75

Pre-requisites: Basic knowledge of programming (C/C++/Python),) and problem-solving skills.

Course Objectives:

1. To implement fundamental data structures and algorithms for efficient problem-solving.
2. To analyze algorithms using asymptotic measures of time and space complexity.
3. To apply linear and non-linear data structures such as stacks, queues, linked lists, trees, heaps, hash tables, and graphs in programming.
4. To develop programming skills through implementation of searching, sorting, recursion, and graph algorithms.

Course Outcomes:

After learning the course, the students will be able to:

CO1: Implement and analyze searching and sorting algorithms using appropriate performance metrics.

CO2: Apply stack and queue data structures to solve computational problems.

CO3: Develop programs using linked lists and hashing techniques for efficient data management.

CO4: Implement tree and graph algorithms including traversal, shortest path, and minimum spanning tree.

Course Contents

Guidelines for Laboratory Conduction

The instructor is expected to conduct **minimum 12 experiments/assignments.** The instructor may set multiple sets of assignments and distribute them among batches of students.

Suggested List of Experiments/Assignments

Sl. No	Problem Statement
1	Implementation and Analysis of Linear Search and Binary Search with comparison count for best, average, and worst cases
2	Implementation and Performance Comparison of Bubble Sort, Selection Sort, and In different input sizes

3	Implementation and Time Complexity Analysis of Quick Sort and Merge Sort
4	Implementation of Heap Sort and Basic Heap Operations (Insert, Delete, Heapify)
5	Implementation and Time Complexity Analysis of Fibonacci Series using Recursion and Iteration
6	Implementation of Stack ADT using Array and Linked List with Applications (Undo/Redo, Function Calls)
7	Implementation of Stack Application for Infix to Postfix Conversion and Postfix Expression Evaluation
8	Implementation of Queue ADT using Array with Application in Task Scheduling
9	Implementation of Circular Queue and Deque with Applications in Buffer Management
10	Implementation of Singly Linked List with Insertion, Deletion, Searching, and Traversal Operations
11	Implementation of Doubly Linked List and Circular Linked List with Applications
12	Implementation of Binary Tree with Recursive Traversals (Preorder, Inorder, Postorder)
13	Implementation of Binary Search Tree (BST) with Insertion, Searching, and Deletion Operations
14	Implementation of Hash Table with Collision Resolution Techniques (Chaining and Linear Probing)
15	Implementation of Graph Representation using Adjacency List with BFS and DFS Traversal
16	Implementation of Dijkstra's Shortest Path Algorithm and Minimum Spanning Tree using Prim's or Kruskal's Algorithm with Real-World Applications

Text Books:

4. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C", Pearson Education, 2nd Edition, ISBN: 978-8131720479.
5. Ellis Horowitz, Sartaj Sahni, Susan Anderson-Freed, "Fundamentals of Data Structures in C", Universities Press, 2nd Edition, ISBN: 978-8173716065.
6. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, "Introduction to Algorithms", MIT Press, 3rd Edition, ISBN: 978-0262033848.

Reference Books:

4. Narasimha Karumanchi, "Data Structures and Algorithms Made Easy", CareerMonk Publications, 5th Edition, ISBN: 978-8192107554.
5. Robert Sedgewick, "Algorithms in C", Addison Wesley, 3rd Edition, ISBN: 978-0201514254.
6. Michael T. Goodrich, Roberto Tamassia, Michael H. Goldwasser, "Data Structures and Algorithms in Python", Wiley, 1st Edition, ISBN: 978-1118290279.

e-sources:

- NPTEL: Introduction to Data Structures and Algorithms – Prof. Naveen Garg (IIT, Delhi) https://nptel.ac.in/courses/106102064
- COURSERA: Data Structures and Algorithms Specialization – Prof. Michael Levin et al (University of California San Diego)
  https://www.coursera.org/specializations/data-structures-algorithms

Program	S.Y. B.Tech. (Electronics and Computer Engineering)			Semester : IV			
Course	Semiconductor Devices and Circuits			Code:		ECE25PCC-204	
Credits	Teaching Scheme (Hrs./Week)			Examination Scheme and Marks			
	Lecture	Practical	Tutorial	UT	FA	SA	Total
2	2	-	-	25	25	50	100

Pre-requisites: Prior knowledge of PN junction diode, BJT, MOSFET, energy band theory and basic electrical circuit concepts.

Course Objectives:

1. To develop understanding of semiconductor materials, energy band theory and carrier transport mechanisms.
2. To explain electrostatics and carrier behavior in PN junction devices.
3. To analyze operational behavior and performance influencing factors of Bipolar and MOS transistors.
4. To introduce semiconductor fabrication processes and fundamentals of integrated circuit technology.

Course Outcomes:

After learning the course, the students will be able to:

CO1: Explain semiconductor materials, energy band structure and carrier transport mechanisms.

CO2: Apply electrostatic principles to interpret behavior of PN junction devices under different operating conditions.

CO3: Apply concepts of Bipolar and MOS transistors to analyze device behavior and performance influencing factors.

CO4: Explain semiconductor fabrication processes and basic concepts of integrated circuit technology.

Course Contents

Unit	Description	Duration [Hrs]
I	**Semiconductor Materials and Carrier Transport** Crystal structure of semiconductor materials, Energy band theory of solids, Classification of materials - conductors, semiconductors and insulators, Direct and indirect band gap semiconductors, Intrinsic and extrinsic semiconductors, Carrier concentration and Fermi level (conceptual idea), Carrier transport mechanisms: drift current, diffusion current, Mobility and conductivity, Effect of temperature and doping on carrier concentration and mobility, Hall effect and engineering applications, Einstein relation (concept) Numerical on carrier concentration, mobility, conductivity, drift current density, Hall coefficient.	8

II	**PN Junction Electrostatics and Carrier Dynamics** Energy band diagram of PN junction, Built-in potential and depletion region, Carrier drift and diffusion mechanism in PN junction, Junction capacitances - transition capacitance, diffusion capacitance, Breakdown mechanisms - Zener breakdown, avalanche breakdown Temperature dependence of junction characteristics, Non-ideal diode behavior (qualitative), Switching characteristics of diode (concept of reverse recovery time). Numerical on built-in potential (basic), junction capacitance concept.	**7**
III	**Bipolar and MOS Transistors** BJT internal carrier transport mechanism, Base width modulation (Early effect), Breakdown mechanisms in transistors, Charge storage effects and switching limitations, Frequency limitations of transistor (concept only),MOS capacitor physics - energy band diagram, accumulation, depletion and inversion, Threshold voltage influencing factors, MOSFET channel formation physics, Channel length modulation (concept), Introduction to short channel effects (qualitative), Conceptual comparison of BJT and MOSFET device behavior. Numerical on threshold voltage concept, basic current relations, identification of operating regions.	**8**
IV	**Semiconductor Fabrication Technology and Integrated Circuits** Introduction to semiconductor fabrication process, Thermal oxidation, Diffusion process, Ion implantation, Chemical Vapour Deposition (CVD), Photolithography, Etching techniques, Metallization, Basic CMOS fabrication flow, Introduction to Integrated Circuits: SSI, MSI, LSI, VLSI concepts, Scaling concept and its impact on device performance, Overview of modern trends in semiconductor technology	**7**
	Total	**30**

Text Books:

1. Streetman B.G., Banerjee S., Solid State Electronic Devices, Pearson Education, 7th Edition, ISBN: 9780133356038.
2. Neamen D.A., Semiconductor Physics and Devices: Basic Principles, McGraw Hill Education, 4th Edition, ISBN: 9780071089029.
3. Pierret R.F., Semiconductor Device Fundamentals, Pearson Education, 1st Edition, ISBN: 9788177589771.

Reference Books:

1. Sze S.M., Ng K.K., Physics of Semiconductor Devices, Wiley India, 3rd Edition, ISBN: 9780471143239.

2. Tyagi M.S., Introduction to Semiconductor Materials and Devices, Wiley India, 1st Edition, ISBN: 9780470874110.
3. Sedra A.S., Smith K.C., Microelectronic Circuits, Oxford University Press, 7th Edition, ISBN: 9780199339136.

e-sources:

- NPTEL: Semiconductor Devices and Circuits – Prof. Sanjiv Sambhandhan (IISc) https://onlinecourses.nptel.ac.in/noc21_ee80/preview
- NPTEL: Introduction to Semiconductor Devices – Prof. Naresh Kumar Emani (IIT Hyderabad)
  https://nptel.ac.in/courses/108106181

Program	S.Y. B.Tech. (Electronics and Computer Engineering)				Semester : IV		
Course	Semiconductor Devices and Circuits Laboratory				Code	ECE25PCC-205	
Credits	Teaching Scheme (Hrs./Week)			Examination Scheme and Marks			
	Lecture	Practical	Tutorial	TW	OR	PR	Total
2	-	4	-	25	-	50	75

Pre-requisites: Prior knowledge of semiconductor devices, PN junction diode, BJT, MOSFET fundamentals, energy band concepts and basic electrical measurements.

Course Objectives:

1. To provide understanding of semiconductor material properties and carrier transport mechanisms through experimental measurement techniques.
2. To demonstrate characteristics and behavior of semiconductor devices such as PN junction and MOS structures using hardware and simulation tools.
3. To develop ability to analyze performance parameters of Bipolar and MOS transistors using simulation and modelling tools such as SPICE.
4. To introduce basic semiconductor fabrication processes and integrated circuit technology through virtual laboratory exposure.

Course Outcomes:

After learning the course, the students will be able to:

CO1: Apply experimental methods to determine semiconductor material properties such as carrier concentration, mobility and resistivity using standard measurement techniques.

CO2: Apply principles of semiconductor devices to analyze characteristics of PN junction and MOS structures using hardware and simulation tools.

CO3: Analyze performance parameters of Bipolar and MOS transistors using simulation tools and interpret their behavior under varying operating conditions.

CO4: Explain semiconductor fabrication process steps and their role in development of integrated circuits using virtual laboratory tools.

Course Contents

Guidelines for Laboratory Conduction

- The instructor is expected to conduct **all Assignment/Experiments**.
- The instructor may set multiple sets of assignments and distribute them among batches of students.

Sl. No.	Suggested List of Assignment/Experiments
1	Hall Effect Measurement for Determination of Carrier Concentration

2	Study of Temperature Dependence of Semiconductor Resistivity
3	Study of PN Junction Characteristics
4	Study of Bipolar Junction Transistor Characteristics
5	Simulation of Energy Band Structure of Semiconductor Materials
6	Simulation of Carrier Transport Mechanisms in Semiconductor
7	Simulation of Electrostatic Characteristics of PN Junction
8	Simulation of MOS Capacitor Capacitance–Voltage Characteristics
9	Simulation of MOSFET Characteristics using SPICE.
10	Device Modelling using SPICE Simulation Tool
11	Study of Semiconductor Fabrication Process Steps
12	Study of CMOS Fabrication Process Flow

Text Books:

1. Streetman B.G., Banerjee S., Solid State Electronic Devices, Pearson Education, 7th Edition, ISBN: 9780133356038.
2. Neamen D.A., Semiconductor Physics and Devices: Basic Principles, McGraw Hill Education, 4th Edition, ISBN: 9780071089029.
3. Pierret R.F., Semiconductor Device Fundamentals, Pearson Education, 1st Edition, ISBN: 9788177589771.

Reference Books:

1. Sze S.M., Ng K.K., Physics of Semiconductor Devices, Wiley India, 3rd Edition, ISBN: 9780471143239.
2. Tyagi M.S., Introduction to Semiconductor Materials and Devices, Wiley India, 1st Edition, ISBN: 9780470874110.
3. Sedra A.S., Smith K.C., Microelectronic Circuits, Oxford University Press, 7th Edition, ISBN: 9780199339136.

e-sources:

- NPTEL: Semiconductor Devices and Circuits – Prof. Sanjiv Sambhandhan (IISc) https://onlinecourses.nptel.ac.in/noc21_ee80/preview
- NPTEL: Introduction to Semiconductor Devices – Prof. Naresh Kumar Emani (IIT Hyderabad) https://nptel.ac.in/courses/108106181
- NPTEL: Fundamentals of Electronic Device Fabrication – Prof. Parasuraman Swaminathan (IIT Madras) https://onlinecourses.nptel.ac.in/noc21_mm26/preview

Program	B.Tech. (Electronics and Computer Engineering)			Semester : III			
Course	Fundamentals of Data Science			Code:		ECE25MDM-206	
Credits	Teaching Scheme (Hrs./Week)			Examination Scheme and Marks			
	Lecture	Practical	Tutorial	UT	FA	SA	Total
2	2	-	-	25	25	50	100

Pre-requisites: Prior knowledge of fundamentals of python and C programming, Familiar with data representation (tables, charts and graphs).

Course Objectives:

1. To introduce fundamental concepts of data science and its real-world applications.
2. To develop understanding of data collection, preprocessing, and management using basic tools.
3. To apply statistical methods and programming tools for data analysis and preparation.
4. To visualize data and apply basic machine learning techniques for solving real-world problems.

Course Outcomes:

After learning the course, the students will be able to:

CO1: Describe the significance of data science and understand the data science process and basic concepts.

CO2: Explain data collection, storage, management, and preprocessing techniques used in data science.

CO3: Apply statistical methods and data preparation techniques using Python tools for data analysis.

CO4: Analyze and visualize data and apply basic machine learning techniques to solve real-world problems.

Course Contents

Unit	Description	Duration [Hrs]
I	**Introduction To Data Science** Definition, Big Data and Data Science Hype, Datafication, Data Science Profile, Meta-Definition, Data Scientist, Statistical Inference (basic idea),Populations and Samples, Populations and Samples of Big Data, Big Data and Assumptions, Modeling (introduction), Philosophy of Exploratory Data Analysis, The Data Science Process, A Data Scientist's Role in this Process	8
II	**Data Munging and Tools** Mathematical Preliminaries: Basic Probability, Descriptive Statistics (mean, median, mode, variance), Correlation Analysis (introduction). Data Munging and Tools: Properties of Data, Introduction to Python for Data Science, Libraries: NumPy and Pandas (basic operations), Collecting Data,	8

	Cleaning Data, Data Transformation, Crowdsourcing.	
III	**Scores , Rankings and Statistical Analysis** Scores and Rankings: Developing Scoring Systems, Z-scores and Normalization, Basic Ranking Techniques Statistical Analysis: Sampling from Distributions, Introduction to Statistical Distributions, Concept of Statistical Significance (intuitive), P-values (basic idea), Permutation Tests (overview).	**6**
IV	**Visualizing Data and Introduction of Machine Learning** Visualizing Data: Exploratory Data Analysis, Developing a Visualization Aesthetic, Chart Types (bar, line, pie, histogram, and scatter), Tools: Matplotlib/Seaborn (basic), Principles of Good Visualization. Mathematical Models and Introduction to Machine Learning: Philosophies of Modeling, A Taxonomy of Models, Baseline Models, Introduction to Machine Learning: Regression and Classification (basic concepts),Evaluating Models (accuracy, basic metrics), Evaluation Environment (simple scenarios).	**8**
	Total	**30**

Text Books:

1. Steven S. Skiena, "The Data Science Design Manual", Springer 2017.
2. Rachel Schutt & O'neil, "Doing Data Science", Straight Talk from The Frontline O'REILLY, ISBN:978-1-449-35865-5, 1st edition, October 2013.

Reference Books:

1. Joel Grus," Data Science from Scratch" First Edition, April 2015
2. Gareth James, Daniela Witten, Trevor Hatie, RoberstTibhirani , "An Introduction to Statistical Learning-with Applications in R", 2013
3. Jure Leskovek, Anand Rajaraman and Jeffrey Ullman. Mining of Massive Datasets. v2.1, Cambridge University Press. 2 edition (30 September 2014)
4. R Programming for Data Science, Roger D. Peng, LeanPub, 2015

e-sources:

- NPTEL: Foundation of Data Science – Prof. Dinesh Kumar (IIM, Bangalore) https://onlinecourses.swayam2.ac.in/e-learning/preview/imb23_mg64
- NPTEL: Python for Data Science – Prof. Ragunathan Rengasamy (IIT, Madras) https://onlinecourses.nptel.ac.in/noc22_cs32/preview

Program	S.Y. B.Tech. (Open Elective Course-I)			Semester: III			
Course	Computational Mathematics			Code:			CE25OEC-207
Credits	Teaching Scheme (Hrs./Week)			Examination Scheme and Marks			
	Lecture	Practical		Lecture	Practical		Lecture
4	3	-	1	25	25	50	100

Pre-requisites: Prior knowledge of algebra, trigonometry, and calculus from First-Year Engineering Mathematics.

Course Objectives:

1. To develop foundational knowledge of logic, sets, functions, relations, and combinatory.
2. To model and analyze computational problems using discrete mathematical structures.
3. To understand conceptual clarity and knowledge of Statistical methods and probability.
4. To understand Numerical techniques to approximate solutions for interpolation, integration, and ordinary differential equations.
5. To understand different transform methods like Fourier/Z transforms.

Course Outcomes: After completion of the course, the students will be able to:

CO1: Apply propositional/predicate logic and proof techniques for problem solving.

CO2: Solve counting problems using combinatory and recurrence relations.

CO3: Apply correlation and regression methods to analyze experimental data in reliability, probability, testing, and quality control.

CO4: Apply numerical methods for interpolation, differentiation, integration, and solving differential equations using single-step and multi-step methods.

CO5: Apply transforms to engineering systems related to signals, circuits, and control applications.

Course Contents

Unit	Description	Duration [Hrs]
I	**Logic, Proof Techniques & Sets** Propositional logic, truth tables, Predicate logic, quantifiers Logical implications, inference rules Proof techniques: direct, contradiction, contrapositive, Mathematical induction. Sets: Set operations, algebra of sets Functions: injective, surjective, bijective.	9
II	**Relations, Recurrence & Combinatory** Recurrence relations (basic introduction), Relations: definition, properties, equivalence relations, partial orders Combinatory: Permutations & combinations, Pigeonhole principle Inclusion–exclusion principle.	9
III	**Statistics & Probability** Introduction to Data Science, Measures of central tendency, Measures of	9

	dispersion, Coefficient of variation, Moments, Skewness and Kurtosis, Correlation: Karl Pearson's correlation, Spearman's rank correlation, Regression analysis, and Reliability of regression estimates. Probability, Probability density function, and Central limit theorem, Probability distributions: Binomial, Poisson, Normal, and Test of hypothesis: Chi-square test.	
IV	**Numerical Methods** Interpolation: Finite Differences, Newton's and Lagrange's interpolation formulae, Numerical differentiation. Numerical Integration: Trapezoidal and Simpson's rules, Bound of truncation error. Solution of ordinary differential equations: Euler's method, Modified Euler's method, Runge-Kutta 4th order method, introduction to Predictor-Corrector methods.	**9**
V	**Fourier and Z-Transforms** Fourier Transform: Introduction to time-domain and frequency-domain representation of signals. Complex exponential form of Fourier series. Fourier integral representation. Fourier Transform and inverse Fourier Transform. Properties of Fourier Transform such as linearity, time shifting, frequency shifting, and scaling. Fourier sine and cosine transforms with inverses. Z-Transform: Discrete-time signals and systems. Definition of Z-transform and region of convergence (ROC). Z-transform of basic sequences. Properties of Z-transform. Inverse Z-transform using standard pairs and partial fraction method. Applications of Z-Transform: Application of Z-transform in solving linear difference equations, analysis of discrete-time systems, stability analysis, and modeling of simple digital filters, Fourier sine and cosine transforms and their inverses.	**9**
	Total	**45**

Text Books:

1. Rosen, K. H., Discrete Mathematics and Its Applications, 8th Edition, McGraw-Hill Education, 2019. ISBN: 978-1-259-67651-2.
2. Kolman, B., Busby, R. C., & Ross, S., Discrete Mathematical Structures, 6th Edition, Pearson/Prentice Hall, 2009/2010. ISBN: 978-0-13-229751-6.
3. Lipschutz, S., & Lipson, M., Schaum's Outline of Discrete Mathematics, Revised 3rd Edition,

McGraw-Hill Education, 2009. ISBN: 978-0-07-161586-0.
4. Grimaldi, R. P., Discrete and Combinatorial Mathematics: An Applied Introduction, 5th Edition, Pearson/Addison-Wesley, 2004 (reprints 2013). ISBN: 978-0-321-21103-3.
5. Ramana, B. V., Higher Engineering Mathematics, Tata McGraw-Hill, 2006. ISBN: 978-0-07-063419-0.

Reference Books:

1. Kenney, J. F. and Rosen, K. H., Discrete Mathematics, 1st Edition, McGraw-Hill Education, 2012. ISBN: 978-0-07-338309-5.
2. Biggs, N. L., Discrete Mathematics, 2nd Edition, Oxford University Press, 2003.ISBN: 978-0-19-850717-8.
3. Graham, R. L., Knuth, D. E. and Patashnik, O., Concrete Mathematics: A Foundation for Computer Science, 2nd Edition, Addison-Wesley, 1994. ISBN: 978-0-201-55802-9.
4. Deo, N., Graph Theory with Applications to Engineering and Computer Science, Prentice-Hall of India, 1974. ISBN: 978-0-13-363473-0.
5. Epp, S. S., Discrete Mathematics with Applications, 4th Edition, Cengage Learning, 2011. ISBN: 978-0-495-39132-6.
6. Kreyszig, E., Advanced Engineering Mathematics, Wiley Eastern Ltd., New Delhi (Indian Edition), 1999 (Reprinted). ISBN: 978-81-224-0883-6.
7. Jain, M. K., Iyengar, S. R. K. and Jain, R. K., Numerical Methods for Scientific and Engineering Computation, 7th Edition, Khanna Publishers, 2013. ISBN: 978-81-7409-205-9.

e-sources:

- https://onlinecourses.nptel.ac.in/noc20_cs82/preview
- https://onlinecourses.nptel.ac.in/noc25_cs27/preview

Program	S.Y. B.Tech. (Open Elective Course-I)			Semester: III			
Course	Probability Theory and Statistical Methods			Code:		CAI25OEC-207	
Credits	Teaching Scheme (Hrs./Week)			Examination Scheme and Marks			
	Lecture	Practical	Tutorial	UT	FA	SA	Total
4	3	-	1	25	25	50	100

Pre-requisites: Prior knowledge of basic understanding of algebra and arithmetic operations is essential.

Course Objectives:

1. To introduce the fundamental concepts of probability, random variables, and distributions required to model real-world uncertainty.
2. To develop the ability to analyze discrete and continuous probability models and interpret their applications.
3. To provide understanding of statistical measures, sampling techniques, and the behaviour of sample data.
4. To explain estimation methods, hypothesis testing, and inference techniques used for data-driven decision making.
5. To enable students to apply probability and statistical tools for solving practical engineering and computational problems.

Course Outcomes:

After completing this course, students will be able to:

CO1: Explain random variables, probability distributions, and their properties.

CO2: Apply standard discrete and continuous distributions to solve problems.

CO3: Analyze statistical measures and perform hypothesis testing for decision-making.

CO4: Apply point estimates, interval estimates, and MLE for parameter estimation.

CO5: Evaluate stochastic processes and Markov chain behaviors in AI-related scenarios.

Course Contents

Unit	Description	Duration [Hrs]
I	**Fundamentals of Probability & Random Variables** Sets, events, sample space, mutually exclusive events, independent events, conditional probability, Bayes' theorem, random variables (discrete and continuous), PMF, PDF, CDF, expectation, variance, moments, joint distributions, marginal distributions, conditional distributions, independence of random variables, Markov's inequality, Chebyshev's inequality, Chernoff bounds, Weak Law of Large Numbers, Strong Law of Large Numbers, Central Limit Theorem.	10

	Case Studies (Select any one): Spam classification using Bayes' theorem, weather prediction using conditional probability, joint probability in manufacturing defect analysis, network traffic modelling using Central Limit Theorem.	
II	**Probability Distributions** Bernoulli distribution, Binomial distribution, Geometric distribution, Poisson distribution, Poisson process, Uniform distribution, Exponential distribution, Normal distribution, mean and variance of distributions, Introduction of moment generation, applications in AI/ML and queuing systems. **Case Studies (Select any one):** Call center arrival modelling using Poisson distribution, defect detection in manufacturing using binomial distribution, waiting time analysis using exponential distribution, sensor reading variations modeled using normal distribution.	**8**
III	**Hypothesis Testing** Parameter and statistic, null hypothesis, alternative hypothesis, Type I error, Type II error, significance level, p-value, power of a test, large sample tests (mean, difference of means, proportion, difference of proportions), small sample tests (t-test for mean, t-test for difference of means), chi-square test, F-test for variances, hypothesis testing for real-world decision making. **Case Studies (Select any one):** A/B testing for e-commerce click-through rate improvement, medical data testing for treatment effectiveness, comparison of accuracy between two ML models, evaluating impact of teaching method using student score data.	**10**
IV	**Estimation – Point, Interval & MLE** Point estimation, interval estimation, confidence intervals for mean, confidence intervals for proportion, confidence intervals for binomial, Poisson and normal parameters, properties of estimators (unbiasedness, consistency, efficiency), Maximum Likelihood Estimation, MLE for binomial parameters, MLE for Poisson parameters, MLE for exponential distribution, MLE for normal distribution parameters. **Case Studies (Select any one):** MLE-based click-through rate estimation, estimation of failure rate of electronic components using exponential distribution, estimation of customer arrival rate in retail using Poisson distribution, confidence interval estimation for OTT movie rating averages.	**9**

V	**Stochastic Processes & Markov Chains** Introduction to stochastic processes, branching processes, Markov chains, transition probability matrix, state classification, recurrent states, transient states, absorbing states, stationary distributions, applications of Markov chains in AI, introduction to martingales and stopping times. **Case Studies (Select any one):** Google PageRank using Markov chains, customer loyalty state transition modelling, weather forecasting using Markov model, reinforcement learning grid-world transition modelling.	**8**
	Total	**45**

Text Books:

1. R. A. Johnson, Miller and Freund's "Probability and Statistics for Engineers", Pearson Publishers, 9 th Edition, 2017.
2. John E. Freund, Benjamin M. Perles, "Modern Elementary Statistics", 12th Edition, Pearson, 2013. 3. Hamdy A. Taha, "Operations Research: An Introduction", Pearson, 2017, Tenth Edition.
3. S.C.Gupta and V.K.Kapoor, "Fundamentals of Mathematical Statistics", 12th Edition, S.Chand & Co, 2020.
4. Kanti Swarup, P. K. Gupta, and Man Mohan, "Operations Research", 20th Revised Edition, Sultan Chand & Sons, 2022, ISBN-13: 978-93-5161-183-7.

Reference Books*:*

1. Sheldon M. Ross, "Introduction to Probability and Statistics for Engineers and Scientists", 6th Edition, Academic Press (Elsevier), 2021, ISBN-13: 978-0128243466.
2. A. Papoulis and S. U. Pillai, "Probability, Random Variables, and Stochastic Processes", 4th Edition, McGraw-Hill Education, 2002, ISBN-13: 978-0073660113.
3. J. S. Milton and J. C. Arnold, "Probability and Statistics in the Engineering and Computer Sciences", 4th Edition, McGraw-Hill Education, 2003, ISBN-13: 978-0071238123.

e-sources:

- **NPTEL –** Stochastic Processes (IIT Bombay)
  https://nptel.ac.in/courses/111102014
- **University of Cambridge –** Stochastic Processes Notes
  https://www.statslab.cam.ac.uk/~rrw1/markov/M.pdf

Program	S.Y. B.Tech. (Open Elective Course-I)			Semester: III			
Course	Probability and Statistics			Code:		AIDS25OEC-207	
Credits	Teaching Scheme (Hrs./Week)			Examination Scheme and Marks			
	Lecture	Practical	Tutorial	UT	FA	SA	Total
4	3	-	1	25	25	50	100

Pre-requisites: Prior knowledge of basic understanding of algebra and arithmetic operations, Fundamental concepts of probability (events, sample space, basic rules) is essential.

Course Objectives:

1. To introduce the basic concepts of random variables and probability distributions.
2. To develop the ability to apply standard discrete and continuous distributions to real-world problems.
3. To analyze fundamental statistical measures and distribution properties.
4. To provide knowledge of hypothesis testing methods for decision-making.
5. To enable students to analyze real-life situations using statistical reasoning and case studies.

Course Outcomes:

After completing this course, students will be able to:

CO1: Demonstrate understanding of Set Theory concepts and their relevance to probability.

CO2: Interpret random variables, probability distribution functions, and basic probability concepts.

CO3: Apply standard discrete and continuous probability distributions (Binomial, Poisson, Uniform, Exponential, and Normal) to solve simple engineering problems.

CO4: Analyze statistical measures such as mean, quantiles, and inequalities (Markov and Chebyshev) to study distribution properties.

CO5: Evaluate hypotheses for population parameters and interpret results using real-life case studies.

Course Contents

Unit	Description	Duration [Hrs]
I	**Introduction to Set Theory** Basics of set Theory: Introduction to sets and algebra of sets, Random Experiment, Sample Space, Events, Complementary Events, Union and Intersection of Two Events, Difference Events, Exhaustive Events, Mutually Exclusive Events, Equally Likely Events, Independent Events.	8
II	**Introduction to Probability** Probability Theory: Mathematical & Statistical definition of Probability, Need of probability theory in Data science, Axiomatic definition of probability, Addition Theorem, Multiplication Theorem, Theorems of	7

	Probability, Conditional Probability, Inverse Probability, Joint Probability, Total Probability and Bayes Theorem. **Case Study**: Use of probability in real-life situations, like weather forecasting, sports betting, sales forecasting etc.	
III	**Introduction to Statistics** Introduction, Origin and Development and scope of Statistics, Population and Sample, Sampling –Introduction, Types of Sampling, Purposive Sampling, Random Sampling, Simple Sampling, Stratified Sampling, Parameter and Statistic, Sampling Distribution 54 Sampling with and Without Replacement, Population Parameters, Sample Statistics. Introduction, Arithmetic Mean, Simple and weighted mean for raw data, Discrete frequency distribution, Continuous frequency distribution, Properties of A. M. Merits & Demerits of A.M. Median, Mode for raw data, Merits and demerits of Median and Mode. **Case Study**: Create measures of central tendency for a real-life example dataset, such as the payroll dataset or titanic dataset. Case study of sampling for any real-world problem like exit poll statistics	**10**
IV	**Descriptive Statistics** Measures of Dispersion, Skewness and Kurtosis: Dispersion, Characteristics for an Ideal Measure of Dispersion, Measures of Dispersion, Range, Quartile Deviation, Mean Deviation, Standard Deviation and Root Mean Square Deviation, Coefficient of Dispersion, Coefficient of Variation, Skewness, Kurtosis. Correlation and Regression: Bivariate Distribution, Scatter diagrams, Correlation, Karl Pearson's coefficient of correlation, Rank correlation, Regression, Regression Coefficients, Lines of Regression. **Case study**: Create measures of dispersion for a real-life example dataset like students dataset, iris detection etc.	**10**
V	**Probability Distributions & Hypothesis Testing** Random Variables: Distribution function, PMF, PDF, basic properties; mean, median, quantiles, Markov and Chebyshev inequalities. Standard Distributions: Bernoulli, Binomial, Poisson, Uniform, Exponential, Normal – definitions and simple applications. Moment concepts (introduction) and basic characteristics of the above distributions. Hypothesis Testing: Statistical hypothesis, null and alternative hypotheses, level of significance,	**10**

	Type I & II errors, tests for mean and proportion. **Case Study**: Case studies based on binomial distribution and hypothesis testing for real-life decision problems.	
	Total	**45**

Text Books:

1. A. M. Mood, F. A. Graybill, D. C. Boes, Introduction to the Theory of Statistics, McGraw-Hill. 3rd Edition
2. Robert V. Hogg, Joseph McKean, Allen T. Craig, Introduction to Mathematical Statistics, Pearson, 8th Edition
3. S. C. Gupta and V. K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand & Sons. 11th Edition

Reference Books*:*

1. Sheldon Ross, A First Course in Probability, Pearson, 9th Edition
2. William Mendenhall, Statistics for Engineering and the Sciences, CRC Press, 13th Edition
3. J.E. Freund, Mathematical Statistics, Pearson, 7th Edition

e-sources:

1. NPTEL Courses (IIT Bombay / IIT Kanpur)
   https://nptel.ac.in/courses/111105090
2. Probability and Statistics for Engineers
   https://nptel.ac.in/courses/111102160

Program	S.Y. B.Tech. (Open Elective Course-I)			Semester: III			
Course	Numerical Statistical Analysis			Code:	IT25OEC-207		
Credits	Teaching Scheme (Hrs./Week)			Examination Scheme and Marks			
	Lecture	Practical	Tutorial	UT	FA	SA	Total
4	3	-	1	25	25	50	100

Pre-requisites: Prior knowledge of Engineering Mathematics, Algebra, Calculus, and Programming Concepts is essential.

Course Objectives:

1. To solve algebraic and transcendental equations using numerical methods.
2. To apply interpolation, curve fitting, numerical differentiation, and numerical integration techniques.
3. To analyze probability theory, random variables, and standard probability distributions.
4. To utilize statistical tools for sampling, correlation, regression, and hypothesis testing.
5. To develop analytical skills for engineering problems using numerical and statistical techniques.

Course Outcomes:

After completion of the course, the students will be able to:

CO1: Apply numerical techniques to solve algebraic and transcendental equations with convergence analysis.

CO2: Use interpolation, curve fitting, numerical differentiation, and numerical integration effectively.

CO3: Apply probability concepts and apply standard probability distributions to engineering problems.

CO4: Perform sampling, regression analysis, correlation and statistical data interpretation.

CO5: Conduct hypothesis testing such as t-test, z-test, chi-square, ANOVA & construct confidence Intervals.

Course Contents

Unit	Description	Duration [Hrs]
I	**Numerical Solution of Equations** Types of Errors: Absolute, Relative, Percentage error Roots of algebraic & transcendental equations, Bisection Method, Regula Falsi Method, Newton–Raphson Method, Secant Method and Convergence of iterative methods.	9
II	**Interpolation & Curve Fitting** Finite differences**,** Interpolation: Newton Forward & Backward Interpolation, Lagrange's Interpolation**,** Newton's Divided Difference Formula, Curve fitting: Least Squares Method, Fitting Straight Line, Parabola, and Exponential Curves.	9

III	**Numerical Differentiation & Integration** Numerical differentiation using Newton's formulas, Maxima & minima using numerical differentiation, Numerical Integration: Trapezoidal Rule, Simpson's 1/3 Rule, Simpson's 3/8 Rule, Error analysis for numerical differentiation & integration.	**9**
IV	**Probability & Statistical Distributions** Basic Probability Theory, Bayes' Theorem, Random Variables, Discrete & Continuous Probability Distributions: Binomial Distribution, Poisson Distribution, Normal Distribution, Moments, Skewness & Kurtosis.	**9**
V	**Sampling, Regression & Hypothesis Testing** Sampling Techniques & Sampling Distribution, Correlation: Karl Pearson coefficient, Regression Analysis: Linear regression & multiple regression, Hypothesis Testing: t-test, z-test, Chi-square test, ANOVA (One-way) and Confidence intervals.	**9**
	Total	**45**

Text Books:

1. S.S. Sastry – Introductory Methods of Numerical Analysis, PHI, 5th edition
2. Erwin Kreyszig – Advanced Engineering Mathematics, Wiley, 10th edition
3. Gupta & Kapoor – Fundamentals of Mathematical Statistics, Sultan Chand, , 11th edition

Reference Books:

1. Jain, Iyengar, Jain – Numerical Methods for Scientific and Engineering Computation, New Age, 6th edition
2. William Navidi – Engineering Statistics, McGraw Hill, 2nd edition
3. Richard Johnson – Statistics & Data Analysis, Pearson, 6th edition

e-sources:

1. NPTEL: Numerical Methods (IIT Bombay / IIT Kharagpur)
   https://nptel.ac.in/courses/111/102/111102128/

e-Books:

1. https://www.aerostudents.com/courses/applied-numerical analysis/IntroductoryMethodsOfNumericalAnalysis.pdf

Program	S.Y. B.Tech. (Open Elective Course-I)				Semester : III		
Course	Vectors and Transforms				Code:	ETC25OEC-207	
Credits	Teaching Scheme (Hrs./Week)			Examination Scheme and Marks			
	Lecture	Practical	Tutorial	UT	FA	SA	Total
4	3	-	1	25	25	50	100

Pre-requisites: Prior knowledge of Univariate Calculus, Multivariate Calculus is essential.

Course Objectives:

1. To develop a strong foundational understanding of transform techniques to analyze and solve engineering and communication-related problems.
2. To provide conceptual clarity in formulating and solving differential equations arising in various engineering applications.
3. To equip students with numerical methods for interpolation, numerical integration, and solving ordinary differential equations with practical computational approaches.
4. To enable students to understand, differentiate, and integrate vector fields, and apply these concepts to engineering and physical systems.

Course Outcomes:

After successful completion of the course, learner will be able to:

CO1: Apply transforms such as Laplace transform, to solve problems related to signal processing and control systems.

CO2: Apply Integral transforms such as, Fourier transform to solve problems related to signal processing and control systems.

CO3: Apply transforms such as Z-Transform to solve problems related to signal processing and control systems.

CO4: Obtain Interpolating polynomials, numerically differentiate and integrate functions, numerical solutions of differential equations using single step and multi-step iterative methods used in modern scientific computing.

CO5: Perform vector differentiation and integration, analyze the vector fields and apply to electromagnetic fields.

Course Contents

Unit	Description	Duration [Hrs]
I	**Laplace Transform** Definition – conditions for existence; Transforms of elementary functions; Properties of Laplace transforms - Linearity property, first shifting property, second shifting property, transforms of functions multiplied by t^n , scale change property, transforms of	9

	functions divided by t, transforms of integral of functions, transforms of derivatives; Evaluation of integrals by using Laplace transform; Transforms of some special functions- periodic function, Heaviside unit step function, Dirac delta function.	
II	**Inverse Laplace Transform** Introductory remarks; Inverse transforms of some elementary functions; General methods of finding inverse transforms; Partial fraction method and Convolution Theorem for finding inverse Laplace transforms; Applications to find the solutions of linear differential equations.	**9**
III	**Fourier and Z-Transforms** Fourier Transform (FT): Complex exponential form of Fourier series, Fourier integral representation, Fourier sine and cosine integrals, Fourier transform, Fourier sine and cosine transforms and their inverses. Z-Transform (ZT): Introduction, Definition, Standard properties, ZT of standard sequences and their inverses, Solution of difference equations.	**9**
IV	**Numerical Methods** Interpolation: Finite Differences, Newton's and Lagrange's interpolation formulae, Numerical differentiation. Numerical Integration: Trapezoidal and Simpson's rules, Bound of truncation error. Solution of ordinary differential equations: Euler's method, Modified Euler's method, Runge-Kutta 4th order method, introduction to Predictor-Corrector methods.	**9**
V	**Vector Differential and Integral Calculus** Physical interpretation of Vector differentiation, Vector differential operator, Gradient, Divergence and Curl, Directional derivative, Solenoidal, Irrotational and Conservative fields, Scalar potential, Vector identities. Line, Surface and Volume integrals, Work-done, Green's Lemma, Gauss's Divergence theorem, Stoke's theorem. Applications to problems in Electro-magnetic fields.	**9**
	Total	**45**

Text Books:

1. Higher Engineering Mathematics by B. V. Ramana (Tata McGraw Hill), 1st Edition.
2. Advanced Engineering Mathematics by Peter V. O'Neil (Thomson Learning), 2nd Edition.

Reference Books:

1. Advanced Engineering Mathematics by Erwin Kreyszig (Wiley Eastern Ltd.), 1st Edition.
2. Higher Engineering Mathematics by B. S. Grewal (Khanna Publication), 2nd Edition.
3. Integral Transforms by I. N. Sneddon, Tata McGraw-Hill, New York, 2nd Edition.
4. Steven C. Chapra, Raymond P. Canale, Numerical Methods for Engineers, 4/e, Tata McGraw

Hill Editions, 2002, ISBN 0-07-047437-0

5. Dr. B. S. Garewal, Numerical Methods in Engineering and Science, 7/e, Khanna Publishers, ISBN 81-74009-205-6
6. Thomas' Calculus by George B. Thomas (Addison-Wesley, Pearson), 1st Edition.

e-sources:

- https://onlinecourses.nptel.ac.in/noc23_ma54/
- https://nptel.ac.in/courses/111106111

Program	S.Y. B.Tech. (Open Elective Course-I)				Semester: III		
Course	Applied Mathematics				Code	ME25OEC-207	
Credits	Teaching Scheme (Hrs./Week)			Examination Scheme and Marks			
	Lecture	Practical	Tutorial	UT	FA	SA	Total
4	3	-	1	25	25	50	100

Pre-requisites: Prior Knowledge of Univariate Calculus**,** Multivariate Calculus**,** Fourier series, Collection, classification, and representation of data is essential.

Course Objectives:

1. To develop conceptual understanding of Laplace Transform techniques and their applications in engineering problems.
2. To impart knowledge of Inverse Laplace Transform methods for solving differential equations and system analysis problems.
3. To introduce Fourier Transform techniques for analysis of signals and systems in the frequency domain.
4. To familiarize students with statistical methods and probability theory for modeling and analysis of engineering data.
5. To provide foundations of vector calculus, including vector fields and their differentiation and integration, for engineering applications.

Course Outcomes: After learning the course, the students will be able to:

CO1: Apply transforms such as the Laplace transform to solve problems related to mechanical systems.

CO2: Apply transforms such as the Inverse Laplace transform to solve problems related to mechanical systems, such as Differential Equations, mass, and spring systems.

CO3: Apply Integral transforms, such as the Fourier transform to solve problems related to mechanical systems

CO4: Apply Statistical methods like correlation and regression in analyzing and interpreting experimental data applicable to reliability engineering and probability theory in testing and quality control.

CO5: Perform vector differentiation and integration, analyze the vector fields and apply to magnetic fields

Course Contents

Unit	Description	Duration [Hrs.]
I	**Laplace Transform** Definition – conditions for existence; Transforms of elementary functions; Properties of Laplace transforms - Linearity property, first shifting property, second shifting property, transforms of functions multiplied by t^n, scale change property, transforms	9

	of functions divided by t, transforms of integral of functions, transforms of derivatives; Evaluation of integrals by using Laplace transform; Transforms of some special functions- periodic function, Heaviside unit step function, Dirac delta function.	
II	**Inverse Laplace Transform** Introductory remarks; Inverse transforms of some elementary functions; General methods of finding inverse transforms; Partial fraction method and Convolution Theorem for finding inverse Laplace transforms; Applications to find the solutions of linear differential equations.	**9**
III	**Fourier Transforms** Fourier Transform (FT): Complex exponential form of Fourier series, Fourier integral representation, Fourier sine and cosine integrals, Fourier transform, Fourier sine and cosine transforms, and their inverse Fourier transform, inverse Fourier sine transform, inverse Fourier cosine transform.	**9**
IV	**Statistics & Probability** Introduction to Data Science, Measures of central tendency, Measures of dispersion, Coefficient of variation, Moments, Skewness and Kurtosis, Correlation: Karl Pearson's correlation, Spearman's rank correlation, Regression analysis, and Reliability of regression estimates. Probability, Probability density function, and Central limit theorem, Probability distributions: Binomial, Poisson, Normal, and Test of hypothesis: Chi-square test and t- test.	**9**
V	**Vector Differential and Integral Calculus** Physical interpretation of Vector differentiation, Vector differential operator, Gradient, Divergence and Curl, Directional derivative, Solenoidal, Irrotational and Conservative fields, Scalar potential, Vector identities. Line, Surface and Volume integrals, Work-done, Green's Lemma, Gauss's Divergence theorem, Stokes' theorem. Applications to problems in Electro-magnetic fields.	**9**
	Total	**45**

Text Books:

1. Higher Engineering Mathematics by B. V. Ramana (Tata McGraw Hill),1st Edition.
2. Advanced Engineering Mathematics by Peter V. O'Neil (Thomson Learning), 2nd edition.

Reference Books:

1. Advanced Engineering Mathematics by Erwin Kreyszig (Wiley Eastern Ltd.), 1st Edition.
2. Higher Engineering Mathematics by B. S. Grewal (Khanna Publication), 1st Edition.

3. Integral Transforms by I. N. Sneddon, Tata McGraw-Hill , New York, 2nd edition.
4. Thomas' Calculus by George B. Thomas (Addison-Wesley, Pearson), 1st Edition.
5. Introduction to Probability and Statistics for Engineers and Scientists, 5e, by Sheldon M. Ross.
6. Jason Brownlee, 'Statistical Methods for Machine Learning', Machine learning Mastery, 1st Edition.

e-sources:

- https://nptel.ac.in/courses/111107098
- https://nptel.ac.in/courses/111105041

Program	S.Y. B.Tech. (Value Education Course-I)			Semester : III			
Course	Universal Human Values			Code		CSE25VEC-208	
Credits	Teaching Scheme (Hrs./Week)			Examination Scheme and Marks			
	Lecture	Practical	Tutorial	UT	FA	SA	Total
2	-	2	1			25	25

Pre-requisites: Basic knowledge of Social Values, Communication is essential.

Course Objectives:

1. To help the students develop a holistic, humane world-vision, and appreciate the essential complementarity between values and skills to ensure mutual happiness and prosperity.
2. To elaborate on 'Self-exploration' as the process for Value Education.
3. To facilitate the understanding of harmony at various levels starting from self and going towards family and society.
4. To elaborate on the salient aspects of harmony in nature and the entire existence.

Course Outcomes:

After successful completion of the course, learner will be able to:

CO1. Recognize the concept of self-exploration as the process of value education and see they have the potential to explore on their own right.

CO2. Explore the human being as the coexistence of self and body to see their real needs / basic aspirations clearly.

CO3. Explain relationship between one self and the other self as the essential part of relationship and harmony in the family.

CO4. Interpret the interconnectedness, harmony and mutual fulfillment inherent in the nature and the entire existence and draw ethical conclusions in the light of Right understanding.

Course Contents

Unit	Description	Duration [Hrs]
I	**Introduction to Value Education** Understanding Value Education, Self-exploration as the Process for Value Education, Continuous Happiness and Prosperity - the Basic Human Aspirations and their Fulfilment, Right Understanding, Relationship and Physical Facility, Happiness and Prosperity - Current Scenario, Method to Fulfil the Basic Human Aspirations.	4

II	**Harmony in the Human Being** Understanding Human being as the Co-existence of the Self and the Body, Distinguishing between the Needs of the Self and the Body, The Body as an Instrument of the Self, Understanding Harmony in the Self, Harmony of the Self with the Body, Programme to Ensure self-regulation and Health.	**4**
III	**Harmony in the Family and Society** Harmony in the Family - the Basic Unit of Human Interaction "Trust' - the Foundational Value in Relationship, 'Respect' - as the Right Evaluation, Values in Human-to-Human Relationship, Understanding Harmony in the Society, Vision for the Universal Human Order.	**4**
IV	**Harmony in the Nature (Existence)** Understanding Harmony in the Nature, Interconnectedness, self-regulation and Mutual Fulfilment among the Four Orders of Nature, Realizing Existence as Co-existence at All Levels, The Holistic Perception of Harmony in Existence, Professional Ethics in the light of Right Understanding, Strategies for Transition towards Value-based Life and Profession.	**3**
	Total	**15**

The subject instructor supposed conduct the activities based on the topic covered during the tutorial sessions. The few activities should be individual or in group. The students supposed to submit the properly written documents.

Suggested list of Experiments/Assignments

Sl. No.	**Experiments/Assignments**
1	Introduce yourself in detail. What are your life goals? How do you make goals for your life? How do you distinguish between right and wrong? What are your major accomplishments and faults in life? Observe and study them.
2	Man-made issues such as energy and material resource depletion, pollution, global warming, ozone depletion, deforestation, and soil degradation pose a threat to the survival of life on Earth. What is the source of these ailments and what is the solution, in your opinion?
3	There is rapidly growing danger due to nuclear proliferation, arms race, terrorism, breakdown of relationships, generation gap, depression, and suicidal attempts. What do you think is the root cause of these threats to human happiness and peace? What is the solution in your opinion?
4	Our "Natural Acceptance" ability allows us to choose what is right or wrong for ourselves. We

	are not educated to listen to our "Natural Acceptance," which can be confused by perceptual biases and sensory stimuli. Explore the following: (i) What is your natural level of respect for yourself and others? (ii) What is "naturally acceptable" to you: nurturing or exploiting others? Is your lifestyle consistent with your natural acceptance or divergent from it?
5	Share a personal experience when you demonstrated deliberate devotion to values in a challenging scenario.
6	Identify any two major problems confronting society now and investigate the underlying causes. Can these be handled based on natural acceptance of human values? If so, how should one move in this approach given the current situation?
7	Having awareness about nature, its four orders and their mutual fulfilment. Activities to be performed- written assignment, chart making.
8	List down all your desires, Observe whether the desire is related to Self (I) or Body. If it appears to be related to both, see which part of it is related to Self (I) and which part is related to Body.
9	Form small groups in the class and in that group initiate dialogue and ask the eight questions related to trust. The eight questions are: 1a. Do I want to make myself happy? 2a. Do I want to make the other happy? 3a. Is the other want to make him happy? 4a. Is the other want to make me happy? Intention (Natural Acceptance) 1b. Am I able to make myself always happy? 2b. Am I able to make the other always happy? 3b. Is the other able to make him always happy? 4b. Is the other able to make me always happy? What is the answer?

	Competence Let each student answer the questions for himself and everyone else. Discuss the difference between intention and competence. Observe whether you evaluate your intention & competence as well as the others' intention & competence.
10	1. Observe on how many occasions you are respecting your related ones (by doing the right evaluation) and on how many occasions you are disrespecting by way of under- evaluation, over-evaluation or otherwise evaluation. 2. Also observe whether your feeling of respect is based on treating the other as yourself or on differentiations based on body, physical facilities or beliefs.
11	Write a note in the form of story, poem, skit, essay, narration, dialogue to educate a child. Evaluate it in a group. Develop three chapters to introduce social science-its need, scope and content in the primary education of children.
12	List down units (things) around you. Classify them in four orders. Observe and explain the mutual fulfilment of each unit with other orders. List what do you take from nature; and what do you give back to nature? Are you a source of harmony in Nature?

Text Books:

1. A Foundation Course in Human Values and Professional Ethics, RR Gaur, R Asthana, GP Bagaria, 3rd revised edition, UHV Publications, 2023, ISBN: 978-81-957703-7-3 (Printed Copy), 978-81- 957703-6-6 (e-book)
2. Teachers' Manual for A Foundation Course in Human Values and Professional Ethics, RR Gaur, R Asthana, GP Bagaria, 3rd revised edition, UHV Publications, 2023, ISBN: 978-81-957703-5-9 (Printed Copy), 978-81-957703-0-4 (e-Book)

Reference Books:

1. Nagaraj, 1999, Jeevan Vidya: Ek Parichaya, Jeevan Vidya Prakashan, Amarkantak
2. P. Banerjee, 2005, Foundations of Ethics and Management, Excel Books.
3. N. Tripathy, 2003, Human Values, New Age International Publishers.
4. E. G. Seebauer & Robert L. Berry, 2000, Fundamentals of Ethics for Scientists & Engineers , Oxford University Press

e-Sources:

- Jeevan Vidya: Ek Parichaya — A. Nagaraj (1999)
  https://uhvparivar.org/publications/otherbooks/Jeevan-Vidya-ek-Parichay.pdf

E-Books:

1. A Foundation Course in Human Values and Professional Ethics.
   https://uhvparivar.org/publications/uhvbooks/UHV-FCV-3E-Textbook.pdf

MOOC / NPTEL/YouTube Links:

1. Swayam Course on "Understanding Human Being Nature and Existence Comprehensively" by Dr. Kumar Sambhav
   Link- https://onlinecourses.swayam2.ac.in/aic22_ge23/preview
2. NPTEL Course on "Exploring Human Values: Visions of Happiness and Perfect Society" by Prof. A. K. Sharma IIT Kanpur
   Link- https://nptel.ac.in/courses/109104068
3. UHV Lecture Series – Prof. R. R. Gaur
   Link- https://www.youtube.com/playlist?list=PLz0n_SjOttT0LlwM1zVfPVTz3wGM5seXm

Program	S.Y. B.Tech. (Value Education Course-I)			Semester : III			
Course	Professional Ethics for Engineers			Code		ETC25VEC-208A	
Credits	Teaching Scheme (Hrs./Week)			Examination Scheme and Marks			
	Lecture	Practical	Tutorial	UT	FA	SA	Total
1	-	2	1			25	25

Pre-requisites: Prior knowledge of business management is essential

Course Objectives:

1. To provide the students an understanding of the meaning of ethics in engineering profession.
2. To introduce an awareness of ethical duties and responsibilities of engineers in the practice of them Careers.
3. To provide a sociological understanding of the social impact of technology and engineering.
4. To examine some of the classical cases as well as contemporary ethical issues in engineering Profession.

Course Outcomes:

After successful completion of the course, learner will be able to:

CO1: Practice the moral values that ought to guide the Engineering profession.

CO2: Discover of the set of justified moral principles of obligation, ideals that ought to be endorsed by the engineers and apply them to concrete situations.

CO3: Know the definitions of risk and safety also discover different factors that affect the perception of risk.

CO4: Appreciate the Ethical issues and Know the code of ethics adopted in various professional bodies and industries.

Course Contents

Unit	Description	Duration [Hrs]
I	**Ethics in Engineering** Understanding basic concepts Ethics- Engineering Ethics- Engineering as Profession – Difference between occupation and professions- Professional Ethics - Codes of Ethics in Engineering profession- Moral dilemmas and moral autonomy in Engineering profession.	4
II	**Engineering as Social Experimentation** Engineering as Experimentation-Engineers as responsible Experimenters-A balanced outlook on law.	3
III	**Social Impact of Technology and Engineering**	4

	Ethics of science and engineering- Ethical leadership in engineering and society, social responsibility of scientist/ researchers, Intellectual property and society, Cross cultural issues in engineering research.	
IV	**Major Issues in Engineering Ethics and Environment** Ethics and sustainable engineering- Computer ethics- Analyzing ethical problems in research- Ethics in collaborative research- Engineers as expert consultants and advisors- Corporate Social Responsibility (CSR).	**4**
	Total	**15**

Course Contents

Sl. No.	**Suggested List of Experiments/Assignments**
1	Study of basic ethical concepts including values, morals, rights, duties, and ethical reasoning frameworks relevant to engineering practice.
2	Study of engineering as a profession with emphasis on professional roles, responsibilities, accountability, and distinction between occupation and profession.
3	Study of professional ethics and codes of ethics as prescribed by recognized professional engineering bodies, highlighting ethical conduct and compliance.
4	Study of moral dilemmas in engineering practice through case studies to develop ethical reasoning and decision-making skills.
5	Study of engineering as social experimentation focusing on risk, safety, uncertainty, and the responsibility of engineers as responsible experimenters.
6	Study of law and ethics in engineering practice to understand regulatory compliance and the need for a balanced ethical and legal outlook.
7	Study of social, environmental, and sustainability impacts of technology and engineering in the context of societal well-being..
8	Study of research ethics and intellectual property rights including issues related to plagiarism, authorship, innovation, and societal benefit.
9	Study of computer ethics and ethics in collaborative engineering work covering data privacy, cybersecurity, and professional integrity.
10	Study of corporate social responsibility (CSR), ethical leadership, and sustainable practices in engineering organizations.

Text Books:

1. Naagarazan, R.S. , “Professional Ethics and Human Values “ New age International, 3rd Edition.
2. Charles D. Fleddermann, "Engineering Ethics", Pearson Education / Prentice Hall 4th edition.

Reference Books:

1. Govindarajan M, Natarajan S, Senthil Kumar V. S, “Engineering Ethics”, Prentice all of India, New Delhi, 2004, 1st Edition.
2. Charles E Harris, Michael S. Protchard and Michael J Rabins, "Engineering Ethics - Concepts and Cases", Wadsworth Thompson Learning, United States, 2000, 2nd Edition.
3. John R Boatright, "Ethics and the Conduct of Business", Pearson Education, New Delhi, 2003, 4th Edition.

e-Sources:

1. https://youtu.be/ag1fHF7aL0A?si=vlNPA0Ea7ZjKAT3S
2. https://youtu.be/ag1fHF7aL0A?si=_T2VV3q_iYG4rj8L

Program	S.Y. B.Tech. (Value Education Course-I)				Semester : III		
Course	Social Connect and Responsibility				Code:	ETC25VEC-208B	
Credits	Teaching Scheme (Hrs./Week)			Examination Scheme and Marks			
	Lecture	Practical	Tutorial	TW	OR	PR	Total
2	-	2	1	25	-	-	25

Pre-requisites: Prior knowledge of basic awareness of societal issues and community needs

Course Objectives:

1. To enable the student to do a deep drive into societal challenges being addressed by NGO(s), social enterprises & The government and build solutions to alleviate these complex social problems through immersion, design & technology.
2. To provide a formal platform for students to communicate and connect with their surroundings.
3. To enable to create of a responsible connection with society.

Course Outcomes: After successful completion of the course, learner will be able to:

CO1: Perform tree plantation, adoption activities, document plant characteristics, relevance and cultural significance.

CO2: Demonstrate understanding of local heritage and crafts through field visits and digital documentation.

CO3: Explain principles of organic farming and wet waste management and relate them to sustainable campus practices.

CO4: Analyze water conservation practices in community settings and prepare evidence-based documentation.

CO5: Explore and document local culinary heritage, indigenous materials, and food lore through field-based interactions.

Course Contents:

The course is mainly activity-based that will offer a set of activities for the student that enables them to connect with fellow human beings, nature, society, and the world at large. The course will engage student's interactive sessions, open mic, reading groups, storytelling sessions, and semester-long activities conducted by faculty mentors.

Unit	Description	Duration [Hrs]
I	**Plantation and adoption of a tree** Plantation of a tree that will be adopted for four years by a group of B. Tech. students. They will also make an excerpt either as a documentary or a photo blog describing the plant's origin, its usage in daily life, and its appearance in folklore and literature carried out by the project groups.	3

II	**Heritage walk and crafts corner** Heritage tour, knowing the history and culture of the city, connecting to people around through their history, knowing the city and its craftsman, photo blog and documentary on evolution and practice of various craft forms.	**3**
III	**Organic farming and waste management** Usefulness of organic farming, wet waste management in neighboring villages, and implementation in the campus.	**3**
IV	**Water Conservation** Knowing the present practices in the surrounding villages and implementation in the campus, documentary or photo blog presenting the current practices.	**3**
V	**Food Walk** City's culinary practices, food lore, and indigenous materials of the region used in cooking.	**3**
	Total	**15**

Course Contents	
Sl. No.	**Suggested List of Assignment/Experiments**
1	**Tree Plantation & Adoption Activity** Students will plant a sapling on campus or a designated location and adopt it for four years. They must record initial environmental conditions, plant type, and growth indicators.
2	**Documentary/Photo Blog on Adopted Plant** Each group will prepare a short documentary or a photo blog about the adopted tree covering: • Plant origin • Botanical features • Usage in daily life • Cultural, folklore, and literary significance
3	**Heritage Walk Documentation** Students will participate in a heritage walk within the city to study historical sites, traditional architecture, and community spaces. They will document observations with photographs and short descriptions.
4	**Crafts Corner Study & Documentation** Visit a local crafts workshop (e.g., pottery, weaving, metalwork) to interact with

	craftsmen and understand techniques, tools, and cultural relevance. Prepare a photo blog or documentary on evolution and practice of the craft.
5	**Organic Farming Exposure Visit** Students will visit an organic farm or agricultural field to learn about: • Organic farming techniques • Soil preparation • Bio fertilizers • Crop rotation • Pest control methods A reflective report will be prepared based on observations.
6	**Wet Waste & Compost Management Practical** Study wet waste collection, segregation, and composting processes in nearby villages or campus. Students will carry out small-scale composting using daily biodegradable waste.
7	**Water Conservation Practices Survey** Survey nearby villages/campus to document traditional and modern water conservation practices such as: • Rainwater harvesting • Check dams • Greywater reuse • Percolation pits Prepare a photo blog or documentary presenting current practices and recommendations.
8	**Food Walk & Culinary Culture Mapping** Conduct a food walk to explore local dishes, ingredients, indigenous cooking materials, and culinary traditions. Students will document: • History behind specific dishes • Food lore • Traditional preparation methods

Guideline for Assessment Process:

Continuous Internal Evaluation (CIE) After completion of, the social connect, the student shall prepare, with daily diary as reference, a comprehensive report in consultation with the mentor/s to indicate what he has observed and learned in the social connect period. The report should be signed by the mentor. The report shall be evaluated on the basis of the following criteria and/or other relevant criteria pertaining to the activity completed. Marks allotted for the diary are out of 50. Planning and

scheduling the social connect Information/Data collected during the social connect Analysis of the information/data and report writing.

Textbooks:

1. Agricultural Sustainability: Strategies for Organic, Climate-Smart, and Resource-Conserving Farming, Shravanthi et al., First edition, 2025.
2. Hydrological Measurements for Watershed Research – Wasi Ullah et al., First Edition.
3. Perspectives in Environmental Studies – Kaushik & Kaushik, First Edition,2018.

e-sources:

- https://www.youtube.com/watch?v=iaQjEDYyWKw
- https://onlinecourses.nptel.ac.in/noc23_hs155/preview

Program	S.Y. B.Tech. (Electronics and Computer Engineering)				Semester : III		
Course	Python Programming for Data Science				Code		ECE25VSEC-209A
Credits	Teaching Scheme (Hrs./Week)			Examination Scheme and Marks			
	Lecture	Practical	Tutorial	TW	OR	PR	Total
2	-	4	-	25	25	-	50

Pre-requisites: Prior knowledge of of Python programming constructs, and basic mathematics.

Course Objectives:

1. To introduce students to Python libraries such as NumPy and Pandas for scientific and data analysis applications.
2. To demonstrate techniques for preprocessing and transforming structured datasets.
3. To explain methods for graphical representation of data using visualization libraries.
4. To illustrate basic data science techniques for solving engineering and real-world problems using Python tools.

Course Outcomes:

After learning the course, the students will be able to:

CO1: Apply NumPy and Pandas for numerical and structured data operations.

CO2: Analyze datasets using preprocessing techniques such as cleaning, filtering, grouping, and transformation.

CO3: Develop data visualizations using Matplotlib and Seaborn to interpret data patterns.

CO4: Implement basic machine learning models using Scikit-learn for regression and classification.

CO5: Develop and evaluate a basic data science solution using real-world datasets.

Course Contents

Sl. No.	Suggested List of Assignment/Experiments
1	Perform numerical computations using NumPy arrays including indexing, slicing, reshaping, and vectorized operations.
2	Implement matrix and statistical operations using NumPy for solving engineering data problems.
3	Import datasets using Pandas and perform initial data inspection and descriptive statistical analysis.
4	Perform data preprocessing by handling missing values, removing duplicates, and modifying dataset structure using Pandas.
5	Apply filtering, sorting, and conditional selection techniques to extract meaningful information from datasets.

6	Perform grouping and aggregation operations using Pandas to summarize structured data.
7	Create line plots, bar charts, and histograms using Matplotlib for visualization of data distributions.
8	Generate scatter plots and correlation heatmaps using visualization libraries to analyze relationships among variables.
9	Perform statistical analysis including mean, median, variance, standard deviation, and correlation using Python libraries.
10	Implement simple linear regression using Scikit-learn for prediction of continuous values.
11	Implement a basic classification technique using Scikit-learn for categorical outcome prediction.
12	Develop a mini project using a real-world dataset involving data preprocessing, visualization, and implementation of a basic prediction model.

Text Books:

1. Wes McKinney, Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython, 2nd Edition, O'Reilly Media, ISBN- 978-1491957660.
2. Jake VanderPlas, Python Data Science Handbook: Essential Tools for Working with Data, 1st Edition, O'Reilly Media, ISBN- 978-1491912058
3. Fabio Nelli, Python Data Analytics: With Pandas, NumPy, and Matplotlib, 3rd Edition, Apress, 978-1484295311
4. Thareja R., Data Science and Machine Learning Using Python, 1st Edition, McGraw-Hill Education, ISBN: 978-9355322142.

Reference Books:

1. Y. Daniel Liang McGraw-Hill, ISBN: 978-1259060366, Introduction to Programming Using Python,
2. Deitel P.J., Deitel H.M., Intro to Python for Computer Science and Data Science, Pearson, ISBN: 978-9353949518
3. Kennedy Behrman, Foundational Python for Data Science, Pearson, ISBN: 978-0136624356
4. Mueller J.P., Massaron L., Python for Data Science for Dummies, Wiley, ISBN: 978-8126524938

e-sources:

- NPTEL: NOC: Python for Data Science – Prof. Raghunathan Rengasamy (IIT Madras) https://nptel.ac.in/courses/106106212

- NPTEL: NOC: Data Analytics with Python – Prof. A. Ramesh (IIT Roorkee https://nptel.ac.in/courses/106107220

Program	S.Y. B.Tech. (Electronics and Computer Engineering)			Semester : III			
Course	PCB Design and Fabrication Techniques			Code			ECE25VSEC-209B
Credits	Teaching Scheme (Hrs./Week)			Examination Scheme and Marks			
	Lecture	Practical	Tutorial	TW	OR	PR	Total
2	-	4	-	25	25	-	50

Pre-requisites: Prior basic knowledge electronic and electrical components, and Fundamental knowledge of measuring instruments such as multi-meter.

Course Objectives:

1. To introduce PCB design concepts, layout fundamentals and industry standards.
2. To design schematic diagrams and PCB layouts using EDA tools by applying standard design rules.
3. To provide hands-on experience in PCB fabrication processes such as layout transfer, etching, drilling and soldering.
4. To develop practical skills required for PCB assembly, testing and troubleshooting of electronic circuits.

Course Outcomes:

After learning the course, the students will be able to:

CO1: Explain PCB design flow, layout fundamentals, materials, and fabrication processes.

CO2: Design schematic diagrams and PCB layouts using PCB design software by applying design rules.

CO3: Perform PCB fabrication processes including layout transfer, etching, drilling, and soldering.

CO4: Develop and test a single-sided PCB for a simple electronic application.

CO5: Verify and evaluate fabricated PCB using appropriate testing instruments for functional correctness.

Course Contents

Sl. No.	Suggested List of Assignment/Experiments
1	Explain PCB types, layout basics, design flow, PCB materials (FR4), copper thickness and industry standards.
2	Design schematic diagram of a simple electronic circuit using PCB design software (KiCad / Eagle / EasyEDA/ Autodesk Eagle).
3	Design PCB layout by placing components and defining board outline using PCB design software.
4	Apply design rules such as track width, spacing, pad size and clearance using PCB

	design software.
5	Generate Gerber files and drill files from PCB design software.
6	Transfer PCB layout on copper clad board using photoresist or toner transfer technique.
7	Perform chemical etching process to remove unwanted copper from PCB.
8	Perform drilling of component holes on etched PCB using PCB drilling machine.
9	Perform component placement and soldering on fabricated PCB.
10	Test fabricated PCB using multimeter for continuity and short circuit detection.
11	Design and fabricate single sided PCB for simple application circuit (LED flasher / regulated power supply / sensor interface).
12	Develop a mini PCB project including schematic design, layout design, fabrication, soldering and testing.

Text Books:

1. Khandpur R.S., Printed Circuit Boards: Design, Fabrication, and Assembly, McGraw-Hill Education, ISBN: 9780071464208.
2. Bosshart W., Printed Circuit Boards: Design and Technology, Tata McGraw-Hill, ISBN: 9780074515495.

Reference Books:

1. Robertson C., Printed Circuit Board Designer's Reference – Basics, Pearson Education, ISBN: 9780130674814.
2. Hamilton C., A Guide to Printed Circuit Board Design, Wiley/Elsevier, ISBN: 9780408013987.

e-sources:

- NPTEL: NOC: Electronic Systems Design: Hands-on Circuits and PCB Design with CAD Software – Prof. Ankur Gupta (IIT Delhi)
  https://nptel.ac.in/courses/108102481
- NPTEL: NOC: Fundamentals of Electronic Device Fabrication – Prof. Parasuraman Swaminathan (IIT Madras)
  https://onlinecourses.nptel.ac.in/noc19_mm23/preview

Program	S.Y. B.Tech. (Electronics and Computer Engineering)				Semester : III		
Course	Cloud Computing				Code		ECE25VSEC-209C
Credits	Teaching Scheme (Hrs./Week)			Examination Scheme and Marks			
	Lecture	Practical	Tutorial	TW	OR	PR	Total
2	-	4	-	25	25	-	50

Pre-requisites: Prior Basic knowledge of programming fundamentals and internet technologies.

Course Objectives:

1. To provide fundamental knowledge of cloud computing concepts, architecture, service models and deployment models.
2. To provide practical exposure to creation and configuration of computing, storage and networking resources using cloud platforms.
3. To demonstrate distributed computing concepts using Hadoop framework, MapReduce programming model and virtualization tools.
4. To develop practical skills for building basic cloud-based applications using platform services and industry-relevant cloud tools.

Course Outcomes:

After learning the course, the students should be able to:

CO1: Apply network configuration and diagnostic tools to analyze basic networking parameters and communication.

CO2: Configure cloud computing resources such as virtual machines, storage services, and networking components.

CO3: Implement distributed computing applications using Hadoop framework, MapReduce, and HDFS.

CO4: Apply virtualization concepts using hypervisor tools for creation and management of virtual machines.

CO5: Develop a cloud-based application by integrating computing, storage, networking, and deployment services.

Course Contents

Sl. No.	Suggested List of Assignment/Experiments
1	Identify network parameters such as IP address, DNS server, gateway and connectivity using basic network configuration tools.
2	Demonstrate client–server communication using basic network utilities (ping, traceroute, nslookup).

3	Demonstrate basic cloud computing concepts by creating and configuring user accounts on public cloud platforms.
4	Explore different cloud service models (IaaS, PaaS, SaaS) by identifying real-world cloud service providers.
5	Create and configure virtual machine instance using cloud platform (AWS EC2 / Google Cloud / Azure).
6	Implement storage services on cloud platform and perform upload, download and sharing of files.
7	Analyze pricing model and cost estimation of cloud services using cloud cost calculator tools.
8	Configure networking features such as security groups, firewall rules or virtual private cloud in cloud environment.
9	Install and execute Hadoop framework in local or virtual environment.
10	Implement MapReduce program for simple data processing application.
11	Demonstrate distributed file storage using HDFS or GFS concepts.
12	Perform virtualization using hypervisor tools such as VirtualBox / VMware to create virtual machines.
13	Deploy simple web-based application on cloud platform using Platform as a Service (PaaS) environment.
14	Develop mini cloud-based solution involving virtual machine creation, storage usage and application deployment.

Text Books:

1. Kailash Jayaswal, Jagannath Kallakurchi, Donald J. Houde, Deven Shah, Cloud Computing Black Book, Wiley India, 1st Edition, ISBN: 9789351194187.
2. Thomas Erl, Eric Barceló Monroy, Cloud Computing: Concepts, Technology, Security and Architecture, Pearson, 2nd Edition, ISBN: 9780138052188.
3. Arshdeep Bahga, Vijay Madisetti, Cloud Computing: A Hands-On Approach, Universities Press (McGraw Hill Education distribution), 1st Edition, ISBN: 9788173719837.

Reference Books:

1. Kailash Jayaswal, Jagannath Kallakurchi, Donald J. Houde, Deven Shah, Cloud Computing Black Book, Wiley India, 1st Edition, ISBN: 9789351194187.
2. Rajkumar Buyya, James Broberg, Andrzej Goscinski, Cloud Computing: Principles and Paradigms, John Wiley & Sons, 1st Edition, ISBN: 9780470887998.
3. Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi, Mastering Cloud Computing: Foundations and Applications Programming, Morgan Kaufmann (Elsevier / Pearson

distribution), 1st Edition, ISBN: 9780124114548.

e-sources:

- NPTEL: NOC: Cloud Computing – Prof. Soumya Kanti Ghosh (IIT Kharagpur)
  https://nptel.ac.in/courses/106105167
- NPTEL: NOC: Google Cloud Computing Foundations – Prof. Soumya Kanti Ghosh (IIT Kharagpur)
  https://nptel.ac.in/courses/106105223

Program	S.Y. B.Tech. (Entrepreneurship Management Course)			Semester: III			
Course	Principles of Management and Entrepreneurship			Code:	IL25EMC-210		
Credits	Teaching Scheme (Hrs./Week)			Examination Scheme and Marks			
	Lecture	Practical	Tutorial	PR	OR	TW	Total
2	-	2	1	-	-	25	25

Pre-requisites: Prior knowledge of Engineering Environment, Communication Skills, Mathematical and Analytical Skills are essential.

Course Objectives:

1. To introduce the fundamental concepts, functions, and principles of management.
2. To develop the ability to plan, organize, lead, and control organizational activities.
3. To familiarize with the concept of entrepreneurship.
4. To develop skills for identifying business opportunities.
5. To create awareness about MSME policies, institutional support systems, startup ecosystem.

Course Outcomes:

CO1: Explain fundamental principles, functions of management with the role and responsibilities of manager.

CO2: Design and develop the plan, strategies, organizational structure and HR processes.

CO3: Apply motivational theories for leadership in organizational situations

CO4: Identify entrepreneurial traits and competencies

CO5: Create the opportunities to Utilize government and financial support systems through business plans.

Course Contents

Unit	Description	Duration [Hrs]
I	**Theory of Management** Meaning, Nature, Scope and Importance of Management, Functions of Management – Planning, Organizing, Staffing, Directing, Controlling, Levels of Management – Top, Middle and Lower, Roles of a Manager (Mintzberg's Managerial Roles), Evolution of Management Thought: Classical Theory (Fayol, Taylor), Behavioral Approach, Modern Approaches (System, Contingency), Social and Ethical Responsibilities of Managers.	3
II	**Planning and Techniques in Management** Planning – Nature, Process, Types of Plans, MBO (Management by Objectives), Decision Making – Types, Steps, Techniques, Organizing –	3

	Concept, Types of Organization Structures (Functional, Divisional, Matrix), Span of Control, Delegation of Authority, Centralization vs Decentralization, Staffing – Manpower Planning, Recruitment, Selection and Training.	
III	**Leadership and Control** Leadership – Meaning, Importance, Qualities of a Leader, Leadership Styles – Autocratic, Democratic, Laissez-faire, Transformational, Motivation – Meaning, Importance, Motivation Theories – Maslow, Herzberg, McGregor Theory X & Y, Communication – Process, Types, Barriers, Effective Communication Techniques, Controlling – Concept, Steps, Techniques of Control, Budgetary and Non-Budgetary Controls.	**3**
IV	**Introduction to Entrepreneurship and Business Plan** Concept and Meaning of Entrepreneurship**,** Characteristics and Competencies of Successful Entrepreneurs**,** Types of Entrepreneurs – Innovative, Imitative, Serial, Social, Women Entrepreneurs**,** Entrepreneurial Process – Idea Generation to Enterprise Launch**,** Creativity and Innovation – Techniques and Tools**,** Barriers to Entrepreneurship – Personal, Social, Situational. Micro, Small & Medium Enterprises (MSMEs) – Definition, Importance, Opportunities, Business Environment – Internal & External Factors, Market Survey, Feasibility Study & Project Identification, Business Plan Preparation & Project Report Components. & External Factors, Market Survey, Feasibility Study & Project Identification, Business Plan Preparation & Project Report Components. Institutional Support for Entrepreneurship: MSME-DI, DIC, NSIC, SIDBI, NABARD, KVIC, NIESBUD, EDII, Start-up India, Make in India, Atal Innovation Mission. Financial Support: Seed Funding, Angel Investors, Venture Capital and Bank Loans**.**	**6**
	Total	**15**
Sl. No.	**Suggested List of Experiments/Assignments**	
1.	Case Study on Functions of Management in a Real-World Organization	
2.	Preparation of Vision, Mission, and Objectives for a Startup Idea	
3.	Case Study on Evolution of Management Thought – Classical to Modern Approaches	

4.	Case Study on Motivation Strategy Development for Employee Productivity Improvement
5.	Business Communication Activity – Drafting Official Letters, Memos, and Emails
6.	Decision-Making Exercise Using Decision Tree or SWOT Analysis
7.	Preparation of a Basic Business Plan for a Startup
8.	Market Survey and Opportunity Identification for New Ventures
9.	Preparation of Project Report for an Entrepreneurial Idea
10.	Group Activity: Role Play on Leadership and Team Management

Text Books:

1. Stephen Robins, Mary Coulter , David Decenzo. Fundamental of Management, 11th Edition, Pearson, 2020, ISBN 13: 978-0-13-517515-6.
2. Richard L. Hughes, Robert C. Ginnett, Gordon J. Curphy. Leadership, 09th Edition, Mc Graw Hill, 2022, ISBN-13. 978-9355320704.
3. Bygrave, W.D., Zacharakis, A., & Corbett, A.C. Entrepreneurship, 6th Edition, Wiley, 2025. ISBN: 9781394262809.

Reference Books:

1. Jennifer M. George. Contemporary Management, 1st Edition, Mc Graw Hill, 2024, ISBN13: 9781264948390.
2. Ries, Eric. The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses, 1st Edition, Crown Business, 2011. ISBN: 9780307887894.
3. Osterwalder, Alexander & Pigneur, Yves. Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers, 1st Edition, Wiley, 2010. ISBN: 9780470876411.

e-sources:

MOOC / NPTEL/YouTube Links: -

- https://www.coursera.org/learn/entrepreneur-guide-beginners
- https://onlinecourses.nptel.ac.in/noc21_mg70/preview
- https://onlinecourses.nptel.ac.in/noc20_ge08/preview

Course Syllabus
Semester-IV

Program	S.Y. B.Tech. (Electronics and Computer Engineering)			Semester : IV			
Course	Design and Analysis of Algorithms			Code:		ECE25PCC-251	
Credits	Teaching Scheme (Hrs./Week)			Examination Scheme and Marks			
	Lecture	Practical	Tutorial	UT	FA	SA	Total
2	2	-	-	25	25	50	100

Pre-requisites: Prior knowledge of programming concepts**,** data structures, and mathematical reasoning**.**

Course Objectives:

1. To introduce fundamental concepts of algorithm analysis, asymptotic notation and graph algorithms.
2. To explain algorithm design techniques including greedy method, dynamic programming and backtracking.
3. To discuss network flow concepts and their applications in engineering optimization problems.
4. To explain computational complexity concepts including P, NP, NP-completeness and approximation algorithms.

Course Outcomes:

After learning the course, the students will be able to:

CO1: Explain asymptotic notation and working principles of graph algorithms including traversal, shortest path and minimum spanning tree.

CO2: Apply algorithm design techniques such as greedy method, dynamic programming and backtracking to solve basic optimization problems.

CO3: Apply network flow concepts to analyze resource allocation and matching problems.

CO4: Analyze computational complexity of algorithms and identify approximation approaches for NP-complete problems.

Course Contents

Unit	Description	Duration [Hrs]
I	**Algorithm Foundations and Graph Algorithms** Review of asymptotic notation: Big O, Big Ω, Big Θ (basic idea) Characteristics of efficient algorithms, Graph representation - adjacency matrix ,adjacency list, Graph traversal algorithms - Breadth First Search (BFS) , Depth First Search (DFS) , Topological sorting (concept and simple example), Shortest path in unweighted graphs (concept using BFS), Minimum Spanning Tree (concept only) - idea of spanning tree, Kruskal's algorithm (basic working) , Prim's algorithm (basic working) , Applications in communication networks, circuit design and routing	8

II	**Algorithm Design Techniques** Introduction to algorithm design paradigms, Greedy method: greedy choice property, fractional knapsack, activity selection problem, Huffman coding (basic idea). Dynamic Programming - optimal substructure, overlapping sub problems , coin change problem , 0/1 knapsack (concept only) , Backtracking (basic idea) - eight queens problem (conceptual understanding) , Engineering applications of optimization techniques	**8**
III	**Network Flow Concepts** Introduction to flow networks - source **,** sink **,** capacity **,** flow, Maximum flow problem (concept)**,** Ford Fulkerson algorithm (basic steps only)**,** Max flow – min cut theorem (basic idea)**,** Bipartite matching using max flow (concept only)**,** Applications- communication networks , resource allocation , scheduling problems, data routing	**7**
IV	**Complexity and Approximation Algorithms** Algorithm complexity concept, Polynomial time algorithms (basic idea)**,** Class P and NP (concept only)**,** Introduction to NP-complete problems (no proof) - travelling salesman problem (concept) **,** vertex cover problem (concept), Approximation algorithms (basic idea)-vertex cover approach, greedy set cover concept **,** Importance of algorithm efficiency in real world engineering applications	**7**
	Total	**30**

Text Books:

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, Introduction to Algorithms, MIT Press, 4th Edition, ISBN: 9780262046305
2. Jon Kleinberg, Eva Tardos, Algorithm Design, Pearson, 1st Edition, ISBN: 9780137546350
3. Sanjoy Dasgupta, Christos Papadimitriou, Umesh Vazirani, Algorithms, McGraw Hill Education, 1st Edition, ISBN: 9780073523408

Reference Books:

1. Alfred V. Aho, John E. Hopcroft, Jeffrey D. Ullman, The Design and Analysis of Computer Algorithms, Pearson, 1st Edition, ISBN: 9780201000290
2. Steven S. Skiena, The Algorithm Design Manua*l*, Springer, 2nd Edition, ISBN: 9781849967204
3. Anany Levitin, Introduction to the Design and Analysis of Algorithms, Pearson, 3rd Edition, ISBN: 9780132316811

e-sources:

- NPTEL: Design and Analysis of Algorithms – Prof. Madhavan Mukund (Chennai Mathematical Institute)

https://nptel.ac.in/courses/106106131

- NPTEL: Fundamental Algorithms – Design and Analysis – Prof. Sourav Mukhopadhyay (IIT Kharagpur)

  https://nptel.ac.in/courses/106105157

Program	B.Tech. (Electronics and Computer Engineering)			Semester : III			
Course	Object-Oriented Programming using Java			Code:		ECE25PCC-252	
Credits	Teaching Scheme (Hrs./Week)			Examination Scheme and Marks			
	Lecture	Practical	Tutorial	UT	FA	SA	Total
2	2	-	-	25	25	50	100

Pre-requisites: Prior knowledge of Programming and Problem Solving is essential.

Course Objectives:

1. To introduce the fundamentals of Java programming and object-oriented paradigm for developing structured and modular programs.
2. To provide knowledge of control structures, arrays, and collections for solving computational problems effectively.
3. To develop understanding of advanced object-oriented concepts, exception handling, and basic multithreading for building reliable software components.
4. To enable development of basic Java applications using file handling and database connectivity concepts.

Course Outcomes:

After learning the course, the students will be able to:

CO1: Apply Java programming fundamentals to develop simple programs using procedural constructs and basic object-oriented concepts.

CO2: Apply control structures, arrays, and collections to solve structured programming problems in Java.

CO3: Apply and analyze the use of object-oriented principles, exception handling, and basic multithreading in modular Java programs.

CO4: Apply file handling and database connectivity concepts to develop basic Java applications.

Course Contents

Unit	Description	Duration [Hrs]
I	**Fundamentals of Java Programming & OOP Foundations** Introduction to Programming & Java Platform- Introduction to OOP paradigm, Features of Java, JVM architecture and Java platform, Overview of Java Class Libraries, Data Types and Variables -Primitive data types, Variables and literals, Type conversion and casting, Automatic type promotion, Basic Programming Constructs- Structure of Java program ,Methods in Java , Method overloading , Call by value (argument passing) , Object-Oriented Fundamentals- Classes and objects , Encapsulation, UML	8

	class diagrams (basic modeling) , Software Engineering Awareness- Introduction to Clean Code principles (basic awareness) , Code readability and naming conventions , Basic debugging techniques Case Study: Student Record Management System - Class-based student model, Method overloading for grading systems, Object creation and data manipulation	
II	**Control Structures, Arrays & Java Collections Basics** Operators and Control Flow - Arithmetic, relational, logical, bitwise operators , Operator precedence and expressions , Conditional statements: if, switch , Loops: for, while, do-while , break, continue, return statements, Arrays in Java - One-dimensional arrays , Multidimensional arrays , Passing arrays to methods , Array traversal techniques , Difference between arrays and objects, Introduction to Java Collections Framework- Need for Collections Framework , ArrayList (dynamic array concept) , LinkedList (conceptual understanding) , HashMap (key-value storage concept), Difference between array and collection. Case Study: Online Examination System - Store questions using arrays or ArrayList, Use loops for result computation, Apply conditional logic for pass/fail decision, Store student marks using HashMap (Roll Number → Marks)	**7**
III	**Advanced OOP Concepts and Exception Handling** Advanced OOP Concepts - Inheritance (types, super keyword), Polymorphism (overloading & overriding) , Abstraction (abstract classes, interfaces) , Dynamic binding , Object class methods (toString(), equals()), Exception Handling -Try, catch, finally , Throw and throws , Creating custom exception classes, Importance of exception handling in robust applications, Multithreading -Thread lifecycle, Creating threads (Thread, Runnable) , Synchronization , Introduction to Software Design Thinking - Basic idea of cohesion and coupling, Introduction to SOLID principles (awareness), Basic UML class diagram representation, Case Study: Account class hierarchy using inheritance, Polymorphism for interest calculation, Exception handling for invalid transactions, Multithreading concept for multiple users, UML class diagram design.	**8**

IV	**Java Application Development & Industry Exposure** Database Connectivity (JDBC Basics) - JDBC architecture, Steps for database connectivity , CRUD operations , Prepared Statement , Introduction to ORM (Hibernate concept only), File Handling & Data Processing - Reading and writing text files, CSV and JSON formats , Data parsing concepts , Web Development & APIs (Awareness) - Basic idea of REST APIs, HTTP methods: GET, POST, PUT, DELETE, Client-server architecture concept, Introduction to Spring Boot (concept only), Testing & Software Quality - Introduction to unit testing, Basic idea of JUnit framework, Importance of testing in software development, Security & Deployment Awareness - Input validation concept, Basic idea of secure coding, Concept of deployment, Introduction to cloud platforms (AWS/Azure overview), Case Study: Smart Inventory Management System - Database-driven inventory concept, CRUD operation flow, JSON/CSV reporting idea, API interaction concept, Version control workflow idea.	**7**
	Total	**30**

Text Books:

1. Paul Deitel and Harvey Detail, "Java: How to Program", Pearson's Publication, 9thEdition, ISBN-13: 978-0132575669**.**
1. The complete Reference Java, 8th edition, Herbert Schildt, TMH, ISBN-13: 978-0071606301**.**

Reference Books:

1. P. Radha Krishna, Object Oriented Programming through Java, 2nd Edition – Universities Press, ISBN-13: 978-8173719943**.**
2. Bruce Eckel, Thinking in Java, 4th Edition – Pearson Education, ISBN-13: 978-0131872486.
3. S. Malhotra & S. Choudhary, Programming in Java, Revised 2nd Edition – Oxford University Press, ISBN-10: 0199484147**.**
4. Erich Gamma, Richard Helm, Ralph Johnson & John Vlissides, Design Patterns: Elements of Reusable Object-Oriented Software, 1st Edition – Addison-Wesley Professional,ISBN-13: 978-0201633610.

e-sources:

- SWAYAM: JAVA – Prof. Kannan Moudgalya (IIT, Bombay) https://onlinecourses.swayam2.ac.in/e-learning/preview/aic20_sp13
- SWAYAM: Programming in JAVA – Prof. Debasis Samanta (IIT Kharagpur) https://onlinecourses.nptel.ac.in/noc25_cs110/preview

Program	B.Tech. (Electronics and Computer Engineering)				Semester : III		
Course	Object-Oriented Programming using Java Laboratory				Code	ECE25PCC-253	
Credits	Teaching Scheme (Hrs./Week)			Examination Scheme and Marks			
	Lecture	Practical	Tutorial	TW	OR	PR	Total
2	-	4	-	25		50	75

Pre-requisites: Prior knowledge of Object-Oriented Programming (OOP) concepts is essential.

Course Objectives:

1. To develop proficiency in programming using the Java programming language.
2. To gain knowledge of the object-oriented programming paradigm using Java.
3. To learn the use of Java across different platforms and application domains.
4. To develop problem-solving skills by designing and implementing small-scale Java applications using object-oriented and exception-handling concepts.

Course Outcomes:

After learning the course, the students should be able to:

CO1: To develop Java programs using basic programming constructs, data types, operators, and control structures.

CO2: To apply object-oriented programming concepts such as classes, objects, inheritance, polymorphism, and abstraction in program development.

CO3: To implement Java programs using arrays, collections framework, exception handling, and multithreading concepts.

CO4: To develop Java-based applications using file handling and database connectivity concepts.

Course Contents

Guidelines for Laboratory Conduction

- The instructor is expected to conduct **minimum 10 from first 12 assignments/experiments, 13 and 14 assignments/ experiments are mandatory and mini application.**
- Assignments should be implemented in JAVA language.

Suggested List of Experiments/Assignments

Sl. No.	Problem Statement
1	Demonstrate the use of primitive data types, variables, literals, type casting, and automatic type promotion in expressions.
2	Implement methods with different parameter lists to demonstrate method overloading and call by value concept.

3	Design a class to represent Student information and demonstrate creation of objects, data members, and member methods to display student details.
4	Implement decision-making and looping constructs using if–else, switch, for, while, and do–while statements.
5	Implement operations on one-dimensional and two-dimensional arrays including searching elements and matrix operations.
6	Implement data storage and retrieval using ArrayList and HashMap for objects of a user-defined class.
7	Implement inheritance and polymorphism using method overriding and the super keyword.
8	Write a Java program to implement abstraction using abstract classes and interfaces
9	Implement exception handling using try–catch–finally blocks and user-defined exceptions.
10	Implement creation and execution of multiple threads using Thread class and Runnable interface.
11	Implement file handling operations in Java by reading structured data from a CSV file and displaying formatted output after processing the data.
12	Implement database connectivity in Java using JDBC and PreparedStatement to perform CRUD operations on a database table.
13	Apply exception handling mechanisms in Java to perform input validation and handle invalid data in a real-world application (e.g., login validation, marks validation, or bank transaction validation).
14	Develop programs to handle runtime errors using try–catch blocks (Arithmetic Exception, Input Mismatch Exception).
15	Develop a Java-based mini application to perform CRUD operations on student records using object-oriented programming concepts, collections, exception handling, and file handling.

Text Books:

1. Paul Deitel and Harvey Detail, “Java: How to Program”, Pearson's Publication, 9thEdition, ISBN-13: 978-0132575669**.**

2. The complete Reference Java, 8th edition, Herbert Schildt, TMH, ISBN-13: 978-0071606301**.**

Reference Books:

1. P. Radha Krishna, Object Oriented Programming through Java, 2nd Edition – Universities Press, ISBN-13: 978-8173719943**.**

2. Bruce Eckel, Thinking in Java, 4th Edition – Pearson Education, ISBN-13: 978-0131872486.

3. S. Malhotra & S. Choudhary, Programming in Java, Revised 2nd Edition – Oxford University Press, ISBN-10: 0199484147.

4. Erich Gamma, Richard Helm, Ralph Johnson & John Vlissides, Design Patterns: Elements of Reusable Object-Oriented Software, 1st Edition – Addison-Wesley Professional,ISBN-13: 978-0201633610.

e-sources:

- SWAYAM: JAVA – Prof. Kannan Moudgalya (IIT, Bombay) https://onlinecourses.swayam2.ac.in/e-learning/preview/aic20_sp13
- SWAYAM: Programming in JAVA – Prof. Debasis Samanta (IIT Kharagpur) https://onlinecourses.nptel.ac.in/noc25_cs110/preview

Program	S.Y. B.Tech. (Electronics and Computer Engineering)			Semester : IV			
Course	Digital Electronics and Microcontrollers			Code:		ECE25PCC-254	
Credits	Teaching Scheme (Hrs./Week)			Examination Scheme and Marks			
	Lecture	Practical	Tutorial	UT	FA	SA	Total
2	2	-	-	25	25	50	100

Pre-requisites: Basic knowledge of electronic devices, logic gates and programming fundamentals.

Course Objectives: This course aims at enabling students:

1. To introduce fundamentals of digital logic families, number systems, and error detection codes required for analysis of digital electronic circuits.
2. To provide knowledge of analysis and design of combinational and sequential circuits using minimization techniques and memory elements.
3. To provide knowledge of architecture and features of 8051 and PIC microcontrollers for embedded applications.
4. To provide knowledge of Arduino and Raspberry Pi for basic programming and interfacing applications.

Course Outcomes: After completing the course, the learner will be able to:

CO1: Apply number systems, Boolean algebra, digital logic families and error detection codes in the analysis of digital circuits.

CO2: Analyze and design combinational circuits and sequential circuits.

CO3: Explain architecture and features of 8051 and PIC microcontrollers and compare their suitability for embedded applications

CO4: Develop basic programs and interface hardware using Arduino and Raspberry Pi for simple applications.

Course Contents

Unit	Description	Duration [Hrs]
I	**Digital Logic Families and Boolean Algebra** Transistor as switch (cut-off, saturation), Basic features of DTL, TTL, ECL. Overview of logic families: MOS logic family: NMOS, CMOS. Positive and Negative logic system. TTL characteristics: Fan-in, Fan-out, Noise Margin, Propagation Delay Comparison of logic families, Number systems and codes: Weighted and non-weighted codes, BCD (8421), Excess-3, Gray code, Alphanumeric codes (ASCII). Binary arithmetic: Representation of signed numbers (1's complement, 2's complement).Binary	8

	addition and subtraction. Boolean algebra: Basic laws, theorems, axioms. Simplification of Boolean expressions. Error detection and correction codes: parity concept, Hamming code (Brief).	
II	**Combinational Logic Minimization and Sequential Circuits** Canonical forms: SOP and POS. Minimization techniques: Karnaugh map (completely & incompletely specified functions). Quine-McCluskey method (Concept only). Flip-flops Versus Latch, SR latch, Gated SR latch, D latch, JK flip-flop, T flip-flop. Edge-triggered flip-flops, master-slave flip-flops. Preset and clear inputs. Shift registers: SISO, SIPO, PISO, PIPO, bidirectional and universal shift registers. Counters: Asynchronous counters (Ripple counter), Synchronous counters, Ring counter, Johnson counter, Propagation delay in ripple counters (Concept only)	**8**
III	**Fundamentals of Microcontrollers** Microprocessor versus Microcontroller, Introduction to 8051 – overview, features and applications, Architecture of 8051 , Memory Organization, Pin Diagram, Timers and Serial Communication. Introduction to PIC Microcontroller – overview, features and applications, Architecture of PIC Microcontroller. Comparison between 8051 and PIC Microcontroller	**7**
IV	**Microcontroller Development Platforms** Introduction to Development Boards- Needs, Role in prototyping, Applications in industry, Arduino- features, Hardware overview- Microcontroller, Digital I/O pins, Analog input pins, Software Overview- Arduino IDE, Basic program structure (setup, loop), Applications in industry. Introduction to Raspberry Pi, Hardware overview - Processor, GPIO pins, Memory and storage, Software Overview- Operating system, Python usage, Applications in industry.	**7**
	Total	**30**

Text Books:

1. Thomas L. Floyd, Digital Fundamentals, Pearson, 11th Edition, ISBN: 978-0132737968
2. Muhammad Ali Mazidi, Janice Mazidi, Rolin McKinlay, The 8051 Microcontroller and Embedded Systems, Pearson, 2nd Edition, ISBN: 978-8131724484
3. Muhammad Ali Mazidi, PIC Microcontroller and Embedded Systems using Assembly and C, Pearson, 1st Edition, ISBN: 978-0131194021
4. Simon Monk, Programming Arduino: Getting Started with Sketches, McGraw Hill, 2nd Edition,

ISBN: 978-1259641633

Reference Books:

1. Eben Upton, Gareth Halfacree, Raspberry Pi User Guide, Wiley, 4th Edition, ISBN: 978-1119264361
2. R. P. Jain, Modern Digital Electronics, McGraw Hill, 4th Edition, ISBN: 978-0070669123
3. John B. Peatman, Design with PIC Microcontrollers, Pearson, 1st Edition, ISBN: 978-0130811547
4. Thomas L. Floyd, Digital Fundamentals, Pearson, 11th Edition, ISBN: 978-0132737968

e-sources:

- NPTEL: Digital Circuits – Prof. Santanu Chattopadhyay (IIT Kharagpur) https://nptel.ac.in/courses/108105113
- NPTEL: Microprocessors and Microcontrollers – Prof. Santanu Chattopadhyay (IIT Kharagpur) https://nptel.ac.in/courses/108105102
- NPTEL: Introduction to Internet of Things – Prof. Sudip Misra (IIT Kharagpur) https://nptel.ac.in/courses/106105166 (Lecture 26 and Lecture 27)

Program	S.Y. B.Tech. (Electronics and Computer Engineering)			Semester : IV			
Course	Digital Electronics and Microcontrollers			Code:	ECE25PCC-255		
Credits	Teaching Scheme (Hrs./Week)			Evaluation Scheme and Marks			
	Lecture	Practical	Tutorial	PR	OR	TW	Total
02	-	04	-	25	-	25	50

Pre-requisites: Basic knowledge of electronic devices, logic gates and programming fundamentals.

Course Objectives: This course aims at enabling students:

1. To develop practical skills in designing and implementing combinational and sequential circuits using minimization techniques and flip-flop based designs.
2. To develop hands-on skills in programming and interfacing of 8051 and PIC microcontrollers for embedded applications.
3. To familiarize with modern embedded development platforms such as Arduino and Raspberry Pi for interfacing and control applications.

Course Outcomes: After completing this course, students will be able to

CO1: Apply digital logic to design and implement combinational circuits (adders, subtractors, code converters) and verify truth tables.

CO2: Analyze and implement combinational circuits using Boolean minimization techniques and sequential circuits using flip-flops.

CO3: Develop embedded programs for 8051 and PIC microcontrollers for basic interfacing such as LED, switch, and serial communication.

CO4: Develop and interface Arduino and Raspberry Pi systems for real-time input/output and control applications.

Guidelines for Laboratory Conduction

Assignments should be designed to strengthen the understanding of digital logic design, combinational and sequential circuits, microcontroller programming and hardware interfacing concepts learned in the theory course. Use of **o**pen-source software and hardware platforms is encouraged. Based on the concepts learned, the instructor may assign **o**ne mini-project or application-based experiment suitable to the respective branch, which may extend beyond the syllabus to enhance practical skills and innovation. Emphasis should be given to simulation, programming, circuit implementation and real-time applications**.**

Guidelines for Laboratory /Term Work Assessment

Continuous assessment of laboratory work should be based on overall performance of the student.

Each Laboratory assignment assessment of the student should be based on predefined rubrics finalized during course meetings.

Guidelines for Practical Examination	
Problem statements must be decided jointly by the internal examiner and external examiner. During practical assessment, maximum weightage should be given to satisfactory implementation of the problem statement. Relevant questions may be asked at the time of evaluation to test the student's understanding of the fundamentals, effective and efficient implementation. This will encourage, transparent evaluation and fair approach, and hence will not create any uncertainty or doubt in the minds of the students. So, adhering to these principles will consummate our team efforts to the promising start of student's academics.	
Course Contents	
Suggested List of Experiments/Assignments	
Sl. No.	**Group A**
1	Design and implement Half Adder, Full Adder and Full Subtractor using logic gate ICs and verify truth tables.
2	Design and implement Binary to Gray code converter and BCD to Excess-3 code converter using logic gates.
3	Simplify Boolean expressions using Karnaugh Map (SOP/POS) and implement minimized logic circuit using ICs.
4	Design and implement a counter using JK or T flip-flop and verify the counting sequence.
5	Write and execute an Embedded C program to interface LED with 8051 microcontroller and generate different blinking patterns using output port pins.
6	Write and execute program to interface push button switch with 8051 and control LED based on switch status.
7	Write and execute program to interface push button switch with PIC microcontroller using MPLAB IDE and control output device based on input status.
8	Write and execute a program to perform serial data transmission using the UART module of PIC microcontroller and verify the transmitted data.
9	Write and execute a program using Arduino Uno to read analog input from a sensor (LDR / temperature sensor) and display the measured value on serial monitor.
10	Write and execute a Python program using Raspberry Pi to interface an LED with GPIO pins and control its ON/OFF operation
	Group B:- Mini Project
11	One Mini Project using Arduino UNO/ Raspberry Pi

	Note: • Instructor should maintain progress report of mini project throughout the semester from project group • Practical examination will be on assignments given above in Group only • Mini Project in this course should facilitate the Project Based Learning among students

Text Books:

1. Thomas L. Floyd, Digital Fundamentals, Pearson, 11th Edition, ISBN: 978-0132737968
2. Muhammad Ali Mazidi, Janice Mazidi, Rolin McKinlay, The 8051 Microcontroller and Embedded Systems, Pearson, 2nd Edition, ISBN: 978-8131724484
3. Muhammad Ali Mazidi, PIC Microcontroller and Embedded Systems using Assembly and C, Pearson, 1st Edition, ISBN: 978-0131194021
4. Simon Monk, Programming Arduino: Getting Started with Sketches, McGraw Hill, 2nd Edition, ISBN: 978-1259641633

Reference Books:

1. Eben Upton, Gareth Halfacree, Raspberry Pi User Guide, Wiley, 4th Edition, ISBN: 978-1119264361
2. R. P. Jain, Modern Digital Electronics, McGraw Hill, 4th Edition, ISBN: 978-0070669123
3. John B. Peatman, Design with PIC Microcontrollers, Pearson, 1st Edition, ISBN: 978-0130811547
4. Thomas L. Floyd, Digital Fundamentals, Pearson, 11th Edition, ISBN: 978-0132737968

	Engineering)						
Course	**Fundamentals of Artificial Intelligence**			**Code:**		**ECE25MDM-256**	
Credits	**Teaching Scheme (Hrs./Week)**			**Examination Scheme and Marks**			
	Lecture	**Practical**	**Tutorial**	**UT**	**FA**	**SA**	**Total**
2	**2**	**-**	**-**	**25**	**25**	**50**	**100**

Pre-requisites: Prior knowledge of programming fundamentals, probability basics and data structures.

Course Objectives:

1. To introduce fundamental concepts, scope, characteristics and applications of Artificial Intelligence.
2. To explain problem solving methods using search techniques, heuristic strategies and game playing concepts.
3. To apply knowledge representation methods, logical reasoning techniques, and approaches for handling uncertainty in AI.
4. To analyze basic machine learning concepts and identify AI applications in engineering systems, including embedded and cyber-physical systems.

Course Outcomes:

After learning the course, the students will be able to:

CO1: Describe fundamental concepts, characteristics, intelligent agents and applications of Artificial Intelligence.

CO2: Apply search techniques, heuristic strategies and game playing concepts to solve AI problems.

CO3: Apply knowledge representation methods, logical reasoning and probabilistic concepts for problem solving under uncertainty.

CO4: Classify machine learning paradigms and AI applications in engineering systems including embedded and cyber-physical systems.

Course Contents

Unit	Description	Duration [Hrs]
I	**Introduction to Artificial Intelligence** Definition of Artificial Intelligence, Scope and importance of AI, History and evolution of AI ,Characteristics of intelligent systems, Applications of AI in engineering and technology, Trends and future directions of AI, Intelligent agents and types of environments	**6**
II	**Problem Solving and Search Techniques** AI problem solving approach ,Production systems and state space representation ,Graph search strategies , Uninformed search techniques:	**9**

	Breadth First Search (BFS), Depth First Search (DFS), Uniform Cost Search , Informed search techniques: Greedy Best First Search, A* Algorithm , Heuristic functions and evaluation criteria , Constraint Satisfaction Problems (basic concept) , Game playing strategies - Minimax algorithm (concept) , Alpha-Beta pruning (concept)	
III	**Knowledge Representation and Reasoning** Knowledge representation concepts and techniques ,Propositional logic and inference methods, First Order Predicate Logic basics (syntax and semantics), Rule-based systems and inference mechanisms, Reasoning under uncertainty, Probability basics for AI, Introduction to Bayesian Networks	**7**
IV	**Introduction to Machine Learning and AI Applications** Concept of learning in Artificial Intelligence, Types of Machine Learning - Supervised learning , Unsupervised learning, Reinforcement learning (basic idea) - Decision Tree learning concept, Neural Networks overview. Applications of AI in Computer Vision, Speech Recognition , Robotics , Internet of Things (IoT) systems , AI in embedded and cyber-physical systems, Ethical issues in Artificial Intelligence	**8**
	Total	**30**

Text Books:

1. Russell S., Norvig P., Artificial Intelligence: A Modern Approach, Pearson, 4th Edition, ISBN: 9780134610993

2.Rich E., Knight K., Nair S.B., Artificial Intelligence, Tata McGraw-Hill, 3rd Edition, ISBN: 9780070087705

3.Poole D., Mackworth A., Artificial Intelligence: Foundations of Computational Agents, Cambridge University Press / Taylor & Francis distribution, 2nd Edition, ISBN: 9781107195394

Reference Books:

1. Mitchell T.M., Machine Learning, Tata McGraw-Hill, 1st Edition, ISBN: 9780070428072

2.Sutton R.S., Barto A.G., Reinforcement Learning: An Introduction, MIT Press, 2nd Edition, ISBN: 9780262039246

3.Duda R.O., Hart P.E., Stork D.G., Pattern Classification, Wiley, 2nd Edition, ISBN: 9780471056690

e-sources:

- NPTEL: Fundamentals of Artificial Intelligence – Prof. Shyamanta Hazarika (IIT Guwahati) https://onlinecourses.nptel.ac.in/noc21_ge20/preview
- NPTEL: An Introduction to Artificial Intelligence – Prof. Mausam (IIT Delhi) https://onlinecourses.nptel.ac.in/noc22_cs56/preview

Program	S.Y. B.Tech. (Open Elective Course - II)			Semester : IV			
Course	Digital Marketing			Code:		CE25OEC-257	
Credits	Teaching Scheme (Hrs./Week)			Examination Scheme and Marks			
	Lecture	Practical	Tutorial	UT	FA	SA	Total
2	2	-	-	25	25	50	100

Pre-requisites: Prior knowledge of marketing terms such as target audience, branding, product, pricing, etc. is essential.

Course Objectives:

1. To provide the basic Concepts of Digital Marketing and the road map for successful Digital marketing strategies.
2. To know the importance of Social Media Platforms importance in Digital Marketing.
3. To understand the technological importance of Search Engine Optimization (SEO).
4. To develop skills for creating, managing, and optimizing digital marketing campaigns across various channels.
5. To enable students to analyze digital consumer behavior and create effective online strategies.

Course Outcomes:

After completion of the course, the students will be able to:

CO1: Explain the basic Concepts of Digital marketing.

CO2: Apply digital marketing tools for suitable applications.

CO3: Examine the various social media and design Advertising campaigns.

CO4: Apply SEO, SEM, and content creation techniques to improve online visibility.

Course Contents

Unit	Description	Duration [Hrs]
I	**Introduction to Digital Marketing** Fundamentals of Digital marketing & Its Significance, Traditional marketing Vs Digital Marketing, Evolution of Digital Marketing, Digital Marketing Landscape, Key Drivers, The Digital users in India, Digital marketing Strategy- Consumer Decision journey Digital advertising Market in India, Skills in Digital Marketing, Digital marketing Plan. **Case study**: Launching a Tech Startup's Mobile App - "SmartBudget".	7
II	**Digital Marketing strategy** **strategy** used in Digital Marketing, PPC and online marketing through social media, Social Media Marketing, Google web-master and analytics overview, Email Marketing, Mobile Marketing Display adverting, Buying Models,	8

	different type of ad tools, Display advertising terminology, types of display ads, different ad formats. **Case study:** Social Media Marketing	
III	**Social Media Marketing** Fundamentals of Social Media Marketing& its significance, Necessity of Social media Marketing Facebook Marketing: Facebook for Business, Facebook Insight, Different types of Ad formats, setting up Facebook Advertising Account, Facebook audience & types, Designing Facebook Advertising campaigns, Facebook Avatar, Apps, Live, Hashtags. **Case study**: App Store Optimization (ASO).	**8**
IV	**Search Engine Optimization (SEO)** Introduction to SEO, How Search engine works, SEO Phases, History Of SEO, How SEO Works, Googlebot (Google Crawler), Types of SEO technique, Keyword Planner tools Social media Reach- Video Creation & Submission, Maintenance- SEO tactics, Google search Engine. **Case study: Provide REAL outputs like a mini-project Marketing** plan, Keyword research sheet Google Ads mock screenshot FB Ads audience design Social media creative poster 1 reel script.	**7**
	Total	**30**

Text Books:

1. Dave Chaffey and Fiona Ellis-Chadwick, Digital Marketing, 8th Edition, Pearson Education, 2022, ISBN-13: 978-1292738086.
2. Rajan Gupta and Supriya Madan, Digital Marketing, 1st Edition, Dreamtech Press, 2023, ISBN-13: 978-9355511522.

Reference Books:

1. Klaus Solberg Søilen, “Digital Marketing”, Springer, 2024, ISBN: 9783031695186.
2. Dionne Solomons et al., “eMarketing: The Essential Guide to Marketing in a Digital World”, 6th Edition, 2020, ISBN: 9780639707808.

e-sources:

- NPTEL Course, By Dr. Tejinderpal Singh, Panjab University Chandigarh https://onlinecourses.swayam2.ac.in/ugc19_hs26/preview

Program	S.Y. B.Tech. (Open Elective Course - II)			Semester : IV			
Course	Engineering Economics			Code:		ETC25OEC-257	
Credits	Teaching Scheme (Hrs./Week)			Examination Scheme and Marks			
	Lecture	Practical	Tutorial	UT	FA	SA	Total
2	2	-	-	25	25	50	100

Pre-requisites: Prior knowledge of economics & mathematics is essential.

Course Objectives: This course aims at enabling students:

1. To enable the students to understand the economic theories which may be applied to maximize return and the economic environment in which they have to operate.
2. To introduce fundamental economic principles relevant to engineering analysis and decision-making.
3. To develop the ability to apply time-value-of-money concepts for evaluating engineering alternatives.
4. To learn cost estimation, depreciation, and break-even analysis for effective financial planning in engineering projects.

Course Outcomes:

After successful completion of the course, learner will be able to:

CO1: Identify the core concepts of economics and recognize its potential in addressing modern day socio- economic challenges.

CO2: Compare and analyze alternatives based on present, annual, rate of return, benefit over cost analyses, time value of money in evaluation of investments and projects in real life and the impact of economic factors on feasibility of real life projects.

CO3: Analyze and predict the economic impact of engineering solutions to make financially prudent decisions in everyday life.

CO4: Evaluate the role of economics to give knowledge to the students about various costs for determining the manufacturing of a product.

Course Contents

Unit	Description	Duration [Hrs]
I	**Introduction** Nature and significance of economics, Goods and Utility, Basic Concept of Demand and Supply, Elasticity of Demand- Price elasticity of Demand, Cross elasticity of Demand, Production - Production Function, Production Process and Factors of Production, Market - Introduction to Monopoly, Perfect Competition, Oligopoly and Monopolistic Competition, Cost	8

	Concepts and E-commerce.	
II	**Money- its evaluation and function, Bank** Commercial Bank and Central Bank and brief idea about function of banking system. Tax and Subsidy, Type of Tax- Direct and Indirect, Monetary and fiscal policy, Inflation and Business cycle, IPR & WTO, International trade, terms of Trade, Gain from International Trade, Free Trade vs. Protection, Dumping and Balance of Payment.	**8**
III	**Role of Science, Engineering and Technology in economic Development** Some of the burning problems of rural and slum areas in India and how engineering and technology may be used to alleviate them, example of Green Revolution and White revolution. Reasons for their success and can we replicate them and Sustainable Development.	**7**
IV	**Elementary Economic Analysis; Interest formulas and their Applications:** Calculations of economic equivalence, Bases for Comparison of Alternatives: Present Worth Method, Future worth method, Annual equivalent, Internal Rate of return; Evaluating Production Operations and Business Risk Management.	**7**
	Total	**30**

Text Books:

1. A Textbook of Engineering Economics: The Principles and Applications, D. R. Kiran, BS Publications, 2021, 1st Edition.
2. Engineering Economics Test & Cases, D N Dwivedi, Dr. H L Bhatia & Dr. S N Maheshwari, Vikas Publishing House Pvt. Ltd. Revised / Latest Edition (2024).

Reference Books:

1. Principles of Engineering Economics with Applications, Zahid A. Khan, Arshad N. Siddiquee, Brajesh Kumar, Mustufa H. Abidi, 2nd Edition, Cambridge University.
2. Practical Applications of Engineering Economics, Kal R. Sharma, Momentum Press. Engineering Economics, R. Panneerselvam, PHI Learning Private Ltd, 1st Edition.

e-sources:

- https://youtu.be/-5q7RB1GWEA

Program	S.Y. B.Tech. (Open Elective Course - II)			Semester: IV			
Course	Digital Finance			Code:		ME25OEC-257	
Credits	Teaching Scheme (Hrs./Week)			Examination Scheme and Marks			
	Lecture	Practical	Tutorial	UT	FA	SA	Total
2	2	-	-	25	25	50	100

Pre-requisites: Prior knowledge of Finance and Economics**,** Cyber Security & Digital Payments is essential.

Course Objectives: This course aims at enabling students

1. To understand the evolution of digital finance and the role of big data in modern financial systems.
2. To gain insight into digital payment ecosystems and ongoing transformations in digital banking.
3. To acquire foundational knowledge of blockchain technology, cryptocurrencies, and decentralized finance.
4. To explore applications of artificial intelligence, machine learning, and data analytics in financial services

Course Outcomes:

After successful completion of the course, learner will be able to:

CO1: Explain the basics of digital finance, big data, and regulatory frameworks.

CO2: Analyze digital payments, FinTech trends, and neo-banking models.

CO3: Illustrate blockchain, cryptocurrencies, and DeFi systems.

CO4: Discuss the role of AI/ML for financial analytics.

CO5: Apply cybersecurity and compliance strategies for digital finance.

Course Contents

Unit	Description	Duration [Hrs]
I	**Digital Finance Fundamentals & Big Data** **Evolution & Fundamentals of Digital Finance:** Evolution of digital finance and the shift from traditional to digital systems. Introduction to FinTech and technological transformations in financial services. Overview of regulatory frameworks and compliance in the digital era. **The Rise of Big Data in Finance:** Role of big data in shaping financial decision-making and risk management. Leveraging data science for personalization and modern financial services **Case Study:** DBS Bank's Digital Transformation	7
II	**Digital Payment Systems & Digital Banking Transformation** **Digital Payment Ecosystems:** Historical evolution and digitalization of payment	7

	systems (ECS, RTGS, NEFT, IMPS, UPI, mobile wallets, contactless payments), Attributes of a well-functioning payment system and the role of banks. **Fintech Innovations & Disruption:** FinTech startups, challenger banks, and peer-to-peer lending models, FinTech applications across banking, NBFCs, insurance, lending, audit, and compliance, Regulatory guidelines (e.g., RBI guidelines) and risks associated with new payment models. The Future of Digital Banking: How traditional banks are adapting and the rise of neo-banks, Digital banking trends and evolving customer expectations **Case Study:** Unified Payments Interface (UPI) in India Case Study: Unified Payments Interface (UPI) in India.	
III	**Blockchain, Cryptocurrencies & Decentralized Finance** **Blockchain Technology:** Fundamentals of blockchain and underlying cryptographic techniques, Smart contracts and decentralized finance (DeFi) applications. Cryptocurrencies & Digital Assets: Overview and evolution of cryptocurrencies (Bitcoin, Ethereum, etc.), Central Bank Digital Currencies (CBDCs) and other emerging digital assets. **Advanced Applications & Case Studies:** Impact of blockchain on payments, lending, and financial settlements, Real-world case studies and disruptive potential in global finance **Case study:** The Sand Dollar (Bahamas' CBDC)	**8**
IV	**Artificial Intelligence, Machine Learning in Financial Analytics** **AI & Machine Learning in Finance:** Predictive analytics in stock markets, trading, and algorithmic/high frequency trading, Credit risk analysis and automated decision-making using AI. Data Analytics & Financial Applications: Data sourcing, cleaning, processing, and visualization for financial data, Sentiment analysis and AI-driven portfolio management. **Practical Projects & Case Studies:** Hands-on projects: building stock price prediction models, fraud detection systems, and credit score prediction models, Real-world applications in digital lending and wealth management **Case study:** Thread programming Using Pthreads, POSIX	**8**
	Total	**30**

Text Books:

1. C. Skinner, Digital Finance: Big Data, Startups, and the Future of Financial Services, 1st edition.

Hoboken, NJ, USA: Wiley, 2016.
2. J. H. M. T. Jeffry, Introduction to FinTech, 1st edition. Noida, India: Pearson Publications, 2018
3. D. Tapscott and A. Tapscott, The Blockchain Revolution: How the Technology Behind Bitcoin and Other Cryptocurrencies is Changing the World, 1st edition. New York, NY, USA: Penguin Random House, 2016.
4. M. López de Prado, Machine Learning for Asset Managers, 1st edition. Cambridge, UK: Cambridge University Press, 2020.
5. "FinTech: The Impact and Role of Financial Technology" by Parag K. Patel, Wiley publications, 1st edition

Reference Books:

1. R. Ghose, Future Money: Fintech, AI and Web3. London, UK: Kogan Page, 2024.
2. Y. Hilpisch, Artificial Intelligence in Finance: A Python-Based Guide, 1st edition. Sebastopol, CA, USA: O'Reilly Media, 2020.
3. M. López de Prado, Advances in Financial Machine Learning, 1st edition. Hoboken, NJ, USA: Wiley, 2018.
4. S. Chishti and J. Barberis, The FINTECH Book: The Financial Technology Handbook for Investors, Entrepreneurs, and Visionaries, 1st edition. Hoboken, NJ, USA: Wiley, 2016.
5. D. Drescher, Blockchain Basics: A Non-Technical Introduction in 25 Steps, 1st edition. Berkeley, CA, USA: Apress, 2017.
6. B. Hines, Digital Finance: Security Tokens and Unlocking the Real Potential of Blockchain, 1st edition. Hoboken, NJ, USA: Wiley, 2020

e-sources:

E- Books:

1. P. H. Beaumont, Digital Finance: Big Data, Start-ups, and the Future of Financial Services, 1st edition. London, U.K.: Routledge, 2019.
   Link: https://download.e-bookshelf.de/download/0015/1963/23/L G-0015196323-0047264745.pdf.
2. N. Urbach and M. Roglinger, Big Data and Artificial Intelligence in Digital Finance, 1st edition. Cham, Switzerland: Springer, 2022
3. L. Perlman, An Introduction to Digital Financial Services, 1st edition., 2018.
   Link: https://www.academia.edu

MOOC/NPTEL/YouTube Links:

1. https://www.my-mooc.com/en/mooc/introduction-to-fintech/
2. https://mooc.besideproject.eu/courses/blockchain-use-cases-in-digital-finance/
3. 3. https://www.coursera.org/specializations/digital-transformation-financial-services

Program	S.Y. B.Tech. (Value Education Course - II)			Semester : IV			
Course	Indian Constitution			Code:		CE25VEC-258	
Credits	Teaching Scheme (Hrs./Week)			Examination Scheme and Marks			
	Lecture	Practical	Tutorial	UT	FA	TW	Total
2	1	-	1	-	-	25	25

Pre-requisites: Prior knowledge of and Indian history, civics, and societal structure to comprehend constitutional principles and governance frameworks is essential.

Course Objectives: This course aims at enabling students:

1. To acquaint the students with legacies of constitutional development in India and help those to understand the most diversified legal document of India and philosophy behind it.
2. To make students aware of the theoretical and functional aspects of the Indian Parliamentary System.
3. To channelize students' thinking towards basic understanding of the constitutional principles and statutory institutions.
4. To enable students to critically evaluate constitutional provisions and apply them to contemporary social, political, and administrative contexts.

Course Outcomes:

After completion of the course, the students will be able to:

CO1: Identify and explore the basic features and modalities about Indian constitution.

CO2: Differentiate and relate the functioning of Indian Parliamentary System at the center and state level.

CO3: Analyze the administrative structure of various branches of government.

CO4: Examine different aspects of Indian Legal System and its related bodies.

Course Contents

Unit	Description	Duration [Hrs]
I	**Introduction to Constitution** Meaning & Constitutionalism, Introduction to Constitution: Meaning of the constitution law and constitutionalism, making of constitution, Salient features and characteristics of the Constitution of India, Preamble, Fundamental Rights, Directive Principles of State Policy, Fundamental Duties and its legal status, Citizenship. **Case Study:** The Kesavananda Bharati Case (1973) – Basic Structure & Constitutionalism.	4

II	**System of Government- Center & State level and local level** Structure and Function of Central Government, President, Vice President, Prime Minister, Cabinet, Parliament, Supreme Court of India, Judicial Review, Federal structure, and distribution of legislative and financial powers between the Union and the States, local self-government. **Case Study:** S.R. Bommai v. Union of India (1994) – Misuse of President's Rule.	**4**
III	**Government: Union & State** Executive & Legislature, composition, powers and functions, Local Self Governments – Panchayat Raj Institutions & Urban Local Bodies (Municipalities). Statutory Institutions: Elections-Election Commission of India, National Human Rights Commission, National Commission for Women. **Case Study:** Indira Gandhi v. Raj Narain (1975) – Executive Accountability(Powers of Election Commission, Executive accountability, Free & fair elections).	**4**
IV	**Constitution Functions** Indian Federal System and its characteristics, Federal structure & distribution of legislative and financial powers between the Union and the States. Centre & State Relations, President's Rule, Constitutional Amendments and powers, Constitutional Functionaries, Emergency Provisions, Assessment of working of the Parliamentary System in India. **Case Study:** GST & Federal Structure (2017–2023).	**3**
	Total	**15**

Text Books:

1. E 1. Durga Das Basu, ―Introduction to the Constitution of India ―, Prentice Hall of India, New Delhi,24th edition,2020, ISBN-109388548868.
2. Clarendon Press, Subhash C, Kashyap, ― Our Constitution: An Introduction to India's Constitution andconstitutional Law‖, NBT, 5th edition, 2014, ISBN-9781107034624.

Reference Books:

1. Maciver and Page, ―Society: An Introduction Analysis ― Laxmi Publications, 4th edition, 2007, ISBN-100333916166
2. PM Bhakshi, ―The constitution of India‖, Universal Law Publishing - An imprint of Lexis Nexis, 14th edition,2017, ISBN-108131262375
3. Indian Constitution by Subhash C. Kashyap, National Book Trust, New Delhi.

4. Constitution of India and Professional Ethics, Dr. G. B. Reddy & Mohd. Suhaib, Dreamtech Press.

e-sources:

e-Books:

1. The full text of the Constitution of India (latest version) — available for download in English (and other Indian languages). Legislative Dashboard+2legislative.gov.in+2
2. Updated 2024 edition (English + Hindi Diglot) — PDF version. S3WaaS
3. Official publication with all amendments (as on May 2022) — PDF version. S3WaaS
4. A simple introductory book: The Constitution of India — An Introduction (by NCERT) — which gives a good basic overview. NCERT

MOOC / NPTEL/YouTube Links:

1. **Constitution Law and Public Administration in India** (NPTEL-NOC, IIT Madras) — comprehensive course covering constitutional law + public administration. https://onlinecourses.nptel.ac.in/noc20_lw03/preview
2. Playlist on YouTube: **"Constitutional Studies" (NPTEL)** lectures by law professors covering fundamentals, history, structure, rights etc. https://www.youtube.com/playlist?app=desktop&list=PLyqSpQzTE6M-Zj2GBVpJ3c7cfvMTcKrPL&utm_source=chatgpt.com

Program	S.Y. B.Tech. (Value Education Course - II)			Semester : IV			
Course	Environmental Science			Code:			AIDS25VEC-258
Credits	Teaching Scheme (Hrs./Week)			Examination Scheme and Marks			
	Lecture	Practical	Tutorial	UT	FA	TW	Total
2	1	-	1	-	-	25	25

Pre-requisites: Prior **k**nowledge of Multidisciplinary nature of environmental studies; components of environment — atmosphere, hydrosphere, lithosphere and biosphere.is essential.

Course Objectives: This course aims at enabling students:

1. To gain an understanding of the Environment where we live.
2. To comprehend the importance of water.
3. To educate about Air and Noise pollution.
4. To explain the concepts of E- waste and Green Computing.

Course Outcomes: After successful completion of the course, learner will be able to:

CO1: Analyze the impacts of different types of environmental pollution on ecosystems and physical resources.

CO2: Describe the sources and effects of water, air, and noise pollution on human health and the environment.

CO3: Identify sources and types of e-waste and analyze basic e-waste management practices.

CO4: Apply green computing principles to promote environmental sustainability and reduce ecological impact.

Course Contents

Unit	Description	Duration [Hrs]
I	**Environmental pollution** Environment and its importance, Definition, Types. Effect of environmental pollution on Plants, Non-living things.	3
II	**Water Pollution** Definition, Sources of water Pollution, Types of waste water-Domestic and industrial waste.	4
III	**Air pollution** Definition, Sources/causes of air pollution. Atmospheric layers, Effects on human. **Noise Pollution:** Definition of Noise Pollution, Types of Noise Pollution.	4
IV	**E-waste management**	4

	Definition of E-waste, Sources of E-waste, Types of E-waste, **Green computing:** Definition, Objectives of Green Computing, Necessity, Environmental benefits.	
	Total	**15**

Tutorial Conduction and Term Work Guidelines (Set of Suggested Activities)	
1	Report/Presentation on the effect of Environmental Pollution on any world famous Structure/ monument.
2	Report/Presentation on importance of different sources of water available nearby them.
3	Report/Presentation based on the data collected from the local authorities on air pollution and noise pollution.
4	Report/Presentation on the E-Waste generated in the campus.
5	Time-series analysis of natural resource consumption of a given country using publicly available data

Text Books:

1. 'Environmental Science: A Global Concern' Cunningham W.P. & Saigo S.W. 5th edition (1 July 1998) WCB, McGraw Hill
2. "The text book of Environmental studies", Dr. P. D. Raut, Shivaji University, 2013.
3. "A Text Book of Environmental Studies", Dr. D. K. Asthana, S. Chand.
4. "Environmental Pollution, monitoring and control", S. M. Khopkar, New Age Publication.

Reference Books:

1. Bharucha, E., ―Textbook of Environmental Studies‖, Universities Press (2005), ISBN-10:8173715408, 1st Edition.
2. Mahua Basu, ―Environmental Studies‖, Cambridge University Press, ISBN-978-1-107-5317-3, 1st Edition.

e-sources:

- https://onlineethics.org/cases/life-and-environmental-science-ethics-case-studies

Program	S.Y. B.Tech. (Electronics and Computer Engineering)			Semester : IV			
Course	Community Engagement Project			Code:		ECE25ELC-259	
Credits	Teaching Scheme (Hrs./Week)			Examination Scheme and Marks			
	Lecture	Practical	Tutorial	PR	OR	TW	Total
2	-	4	-	-	50	-	50

Pre-requisites: Prior knowledge of social and ethical responsibilities, Teamwork and communication skills are essential.

Course Objectives:

1. To establish a mutually beneficial relationship between the college and the community.
2. To engage with their local community, fostering empathy, teamwork, and problem
3. To understand challenges faced by the local community and the role of engineering in addressing those challenges.
4. To evaluate and critically analyze the outcomes of their engagement activities, deriving actionable insights for sustainable impact

Course Outcomes:

After completion of the course, the students will be able to:

CO1: Identify local community needs and challenges by engaging with stake holders and evaluating real-world problems.

CO2: Implement practical, creative, and context-specific solutions using engineering principles to address community issues.

CO3: Evaluate the effectiveness of their interventions and articulate lessons learned through reports and presentations.

CO4: To apply technical knowledge and skills to design solutions or interventions that create a positive impact on the community.

Course Contents:

Guidelines for Laboratory Conduction

- A group of 3 to 4 students could be assigned for a particular habitation or village or municipal ward, as far as possible, in the near vicinity of their place of stay/college premise.
- Each group /practical batch is allotted to a faculty member of the department as a mentor.
- A division of 60 students can have 3 batches of minimum 20 students. Practical load of 4 hours to be allocated to each batch.
- The group of students will be associated with a government official / village authority /NGOs etc. concerned, allotted by the district administration, during the duration of the project.
- The Community Engagement Project should be different from the regular programmes of

NSS/NCC /Green Club/Hobby Clubs, Special Interests Groups etc.

- An activity book has to be maintained by each of the students to record the activities under taken/involved and will be countersigned by the concerned mentor/HoD.
- Project report shall be submitted by each student/group of students.
- Students groups can conduct an awareness programme on Health and Hygiene or in Organic Farming or in Fisheries or in advocating prohibition of liquor or about renewable energy, e waste management or any other activity in an area of their studies and as per his/her aptitude.

Guidelines for Oral Examination

- An internal evaluation shall also be conducted by a committee constituted by the HoD. Evaluation to be done based on the active participation of the student and marks could be awarded by the mentor/HoD.
- Oral Examination shall consist of presentation and demonstration of the project work carried out by the project groups.

Suggestive list of topics under Community Engagement Project

- The students are expected to carry out these projects with involvement, commitment, responsibility and accountability. The mentors of a student/group of students shall.
- Use/ miss-use of cell phones
- Career orientation of youth
- Water facilities and drinking water availability
- Health and hygiene of the school going students, home makers and old personals
- Health intervention and awareness programmes
- Horticulture
- Herbal and Nutrition
- Traditional and Modern health care methods
- Food habits
- Air /Sound /Water pollution
- Plantation and Soil protection
- Renewable energy and Solar Systems
- Yoga awareness and practice
- Health care awareness programmes and their impact
- Organic farming
- Food adulteration
- Incidence of Diabetes and other chronic diseases
- Blood groups and blood levels

- Chemicals in daily life
- Music and dance
- Women education and empowerment

Project Scope

- Conduct workshops or awareness drives on topics like digital literacy, environmental sustain ability, mental health, or career planning for local stakeholders.
- Develop a simple prototype or solution that addresses a real-world problem (e.g., a water-saving device, simple mobile apps, or tools for community use).
- Organize clean-up drives, tree plantations, recycling campaigns, or energy conservation initiatives.
- Promote health through awareness programs on hygiene, nutrition, and exercise.
- Teach basic computer or technical skills to students, staff, or the community.

Proposal Submission

- CEP Group should submit a two-page project proposal, preferably prior to the term commencement outlining the following:
- Title of the project
- Aim, Objective and expected outcome
- Plan of execution (timeline and activities).
- Place of the CEP and involvement of any local authority, NGP
- Required resources (if any).
- Get approval from the designated faculty mentor.

Learning Resources

Text Books:

1. Waterman, A. Service-Learning: A Guide to Planning, Implementing, and Assessing Student Projects. Routledge, 1997.
2. Beckman, M., and Long, J. F. Community-Based Research: Teaching for Community Impact. Stylus Publishing, 2016.

e-sources:

MOOC/NPTEL/YouTube Links:

- NPTEL course: Ecology and Society, https://onlinecourses.nptel.ac.in/noc20_hs77/preview

Program	S.Y. B.Tech. (Entrepreneurship Management Course)				Semester : IV		
Course	Entrepreneurship Skills Development				Code	ILI25EMC-260	
Credits	Teaching Scheme (Hrs./Week)			Examination Scheme and Marks			
	Lecture	Practical	Tutorial	TW	OR	PR	Total
2	-	2	1	25	-	-	25

Pre-requisites: Prior knowledge of Engineering Environment, Communication Skills, Mathematical and Analytical Skills are essential.

Course Objectives:

1. Introduce the fundamental principles of entrepreneurship, forms of business organizations, and the start-up ecosystem.
2. Enable students to identify, evaluate, and select viable business opportunities using structured techniques.
3. Familiarize students with business models, financial planning, and market validation strategies.
4. Expose students to key marketing strategies, customer acquisition techniques, and branding essentials for start-ups.
5. Develop students' entrepreneurial mind-set and their ability to communicate and pitch business ideas effectively using structured storytelling techniques.

Course Outcomes:

After learning the course, the students should be able to:

CO1: Describe the role of entrepreneurship in economic growth and the start-up ecosystem.

CO2: Apply creative techniques to viable business ideas based on customer needs.

CO3: Develop a basic business model using tools like the Business Model Canvas through market research.

CO4: Implement basic marketing strategies for start-ups.

CO5: Deliver a concise business pitch using storytelling and effective communication techniques.

Course Contents

Unit	Description	Duration [Hrs]
I	**Introduction to Entrepreneurship** Entrepreneurship**:** Definition and evolution, Role of entrepreneurship in economic development, Role in job creation, GDP, and innovation. Characteristics of an Entrepreneur: Key traits: Risk-taking, innovation, pro-activeness, Leadership, perseverance, and resilience. Types of Entrepreneurships: Startup entrepreneurship, Social entrepreneurship, Intrapreneurship (corporate entrepreneurship), Lifestyle and small business entrepreneurship, Forms of Business Organization – Sole proprietorship, partnership, private limited, public	3

	limited. Entrepreneurial Mindset: Growth mindset and adaptability, Creativity and problem-solving, Opportunity recognition and initiative-taking. Overview of the Startup Ecosystem: Key stakeholders: Incubators, accelerators, angel investors, VCs, Government support schemes (Startup India, Atal Innovation Mission, etc.) and Global vs. Indian startup ecosystems.	
II	**Idea Generation & Opportunity Recognition** Creativity Techniques for Idea Generation: Definition and importance of creativity in entrepreneur- ship. Brainstorming: Rules of effective brainstorming. Individual vs. group brainstorming. Mind Mapping: Visual idea structuring using central themes and branches. Tools (manual and digital) for mind mapping. Understanding Customer Needs and Pain Points: Customer pain points and their identification, Problem-solution fit: Linking pain points to possible solutions. Observational techniques, user inter- views, and empathy mapping. Evaluating Opportunities: Difference between an "idea" and an "opportunity." Basic filters: Desir- ability, feasibility, and viability. Tools: SWOT Analysis, Opportunity Matrix, Industry trends and market gaps.	**3**
III	**Business Model Development** Introduction to Business Model Canvas: Definition and purpose of a business model, Overview of the Business Model Canvas by Osterwalder, Benefits of using BMC for startups. Key Components of BMC: Value Proposition: Defining what unique value the product/service of- fers. Addressing customer pain points. Customer Segments: Identifying target customers. Creating customer personas Revenue Models: Direct sales, subscriptions, freemium, licensing, etc. Basic Market Research for Validation: Importance of market research in early-stage business de- velopment. Designing effective surveys and customer feedback forms. Conducting basic interviews and analyzing responses. Introduction to MVP (Minimum Viable Product) and feedback loops.	**3**
IV	**Customer Acquisition , Pitching & Funding Sources** Search Engine Optimization (SEO): Basics of how search engines work, Keyword research and content optimization, On-page vs. off-page SEO Importance of Digital Presence – Website essentials, blogs, and analytics tools. Customer Acquisition Strategies: Understanding the Customer Journey – Awareness, interest, de- cision, action. Early-Stage Customer Acquisition Tactics: Word-of-mouth & referrals, Influencer mar- keting (micro-influencers), Email marketing basics, building a landing page and collecting lead. Crafting an Elevator Pitch:	**6**

	Definition and purpose, Key elements: Problem, solution, value propo- sition, target audience, Delivery tips: Clarity, brevity, confidence Overview of Funding Sources: Public & private capital sources, venture capital, debt financing. Bootstrapping: Meaning, benefits, and risks, Angel investors: Role, expectations, approach, Brief on incubators, government schemes and crowdfunding.	
	Total	**15**

Suggested List of Experiments/Assignments

Sl. No.	Title	Objective	Description
1	Entrepreneurial Mindset Reflection	To encourage students to explore their personal views on entrepreneurship and recognize the key characteristics of an entrepreneurial mindset by studying the journey of a real-world entrepreneur.	**Write a reflective essay** (500–600 words) based on the following: • Explain what entrepreneurship means to you personally. • Identify an entrepreneur (Indian or global) whom you admire and explain the reasons for your admiration. • Highlight specific mindset traits (e.g., risk-taking, resilience, innovation, adaptability) that contributed to this entrepreneur's success. • Reflect on how these traits align with your own strengths or indicate areas you wish to develop.
2		To foster creativity,	**Generate 10 Business Ideas** Use any structured brainstorming technique

	Idea Generation Challenge	structured brainstorming, and the ability to identify potential business opportunities based on real-world problems.	Ideas can be tech-based, social impact, service-based, or product-based 2. Select One Idea- Choose the most promising idea from your list 3. Write a 1-page Concept Summary, include the following: • Problem Identified: Describe the specific problem or pain point your idea addresses. • Solution Overview: Briefly describe your business idea. • Target Audience: Identify the group of people or organizations that would benefit. • Market Potential: Discuss the viability and scalability of the idea.
3	Business Model & Customer Validation	To help students develop a clear, structured business model and test its assumptions through customer conversations. The goal is to learn how to validate ideas through real-world feedback and refine the business concept accordingly.	**Part A: Business Model Canvas** 1. Choose a business idea (from Assignment 2 or a new one). 2. Create a Business Model Canvas with all 9 key blocks: o Customer Segments o Value Propositions o Channels o Customer Relationships o Revenue Streams o Key Resources o Key Activities

			o Key Partnerships o Cost Structure 3. Present the BMC in visual or tabular format. **Part B: Customer Interviews & Insights** 1. Identify 2–3 potential customers from your target segment. 2. Conduct brief interviews (5–10 minutes each) to gather insights on: o Their pain points o Their reaction to your proposed solution o Willingness to pay or use your product/service 3. Summarize findings in a 1–1.5 page report that includes: o Key customer quotes or paraphrased insights o A revised Value Proposition or Customer Segment block (if needed) 4. A short reflection: key learnings and potential changes to your idea.
4	Business Launch Plan – Marketing & Financial Snapshot	To develop a practical understanding of how marketing stratey and financial planning go hand-in-hand in launching	You are preparing to launch your business idea. Prepare a combined Marketing and Financial

		a startup. Students will define a basic marketing campaign and align it with estimated costs, pricing, and projected revenue	Snapshot including the following **Part A: Marketing Campaign Plan** • Define your target market by identifying primary customers. • Design a mini-campaign using one or more of the following channels: Social media (e.g., Instagram, LinkedIn) Print/digital flyers Email marketing • Describe the campaign content, including the message or offer to be promoted. Optionally, create 1–2 sample marketing materials. Write a 300-word explanation outlining your marketing strategy and expected impact. **Part B: Financial Snapshot** 1. Startup Costs – Estimate your initial costs (fixed + variable) 2. Pricing Strategy – State your pricing model and justification Break-even Analysis – Basic cost vs. sales

			estimate 4. 6-Month Revenue Projection – Expected sales and income Format: Use a simple table or spreadsheet (optional)
5	Elevator Pitch Video	To help students develop confidence and clarity in presenting their business idea in a short, compelling format. The exercise simulates real-world investor or networking scenarios where entrepreneurs must grab attention quickly.	**Prepare a 90-second elevator pitch for your business idea** (the same or refined idea used in earlier assignments). Your pitch should cover the following elements: The Problem – Problem Identification The Solution – Description of your product/service. Value Proposition – The unique value proposition. Target Audience – Audience for your idea. o Call to Action – E.g. request for support, funding, feedback, etc. **Deliver Your Pitch:** o Record a video and submit it with written version of your pitch. o Ensure clear speech, confident body language (for video), and persuasive tone. o

			Reflection (Short Write-up): o Share what you learned about communicating your idea Describe challenges or rewards you experienced in the process.

Text Books:

1. Bygrave, W.D., Zacharakis, A., & Corbett, A.C. Entrepreneurship, 6th Edition, Wiley, 2025. ISBN: 9781394262809.
2. Drucker, Peter F. Innovation and Entrepreneurship: Practice and Principles, Reprint Edition, Harper Business, 2006. ISBN: 9780060851132.
3. Osterwalder, Alexander & Pigneur, Yves. Business Model Generation: A Handbook for Visionar- ies, Game Changers, and Challengers, 1st Edition, Wiley, 2010. ISBN: 9780470876411.

Reference Books:

1. Ries, Eric. The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses, 1st Edition, Crown Business, 2011. ISBN: 9780307887894.
2. Kawasaki, Guy. The Art of the Start 2.0: The Time-Tested, Battle-Hardened Guide for Anyone Starting Anything, Portfolio (Penguin Random House), 2015. ISBN: 9781591847847.

e-sources:

1. https://onlinecourses.nptel.ac.in/noc20_ge08/preview
2. https://onlinecourses.nptel.ac.in/noc21_mg70/preview
3. https://onlinecourses.nptel.ac.in/noc20_mg35
4. https://www.coursera.org/learn/entrepreneur-guide-beginners
5. https://wadhwanifoundation.org/
6. https://www.youtube.com/@wadhwani-foundation/videos

Program	S.Y. B.Tech. (Ability Enhancement Course)			Semester : IV			
Course	Modern Indian Language (Marathi)			Code:		IL25AEC-261	
Credits	Teaching Scheme (Hrs./Week)			Examination Scheme and Marks			
	Lecture	Practical	Tutorial	PR	OR	TW	Total
2	1	2	-	-	-	25	25

Pre-requisites : --

अभ्यासक्रमाची उद्दिष्टे :

१. प्रात भौषिक कौशल्यांची क्षमता विकसित करणे.

२. प्रसारमाध्यमांतिल संज्ञापनातिल स्वरूप आणि स्थान स्पष्ट करणे.

३. व्यक्तिमत्व विकास आणि भाषा यांतील सहसंबंध स्पष्ट करणे.

४. लोकशाहीतील जीवनव्यवहार आणि प्रसारमाध्यमे यांचे परस्पर संबंध स्पष्ट करणे.

५. प्रसारमाध्यमांसाठी लेखनक्षमता विकसित करणे.

अभ्यासक्रम परिणाम (COs)

अभ्यासक्रम यशस्वीपणे पूर्ण केल्यानंतर विद्यार्थी खालील परिणाम साध्य करू शकतील:

CO1: शैक्षणिक व व्यावसायिक वातावरणात प्रातभाषिक संवाद कौशल्ये प्रभावीपणे प्रदर्शित करणे.

CO2: प्रसारमाध्यमांच्या संज्ञापनातील रचना, भूमिका आणि महत्त्व स्पष्टपणे समजावून सांगणे.

CO3: व्यक्तिमत्व विकास आणि भाषाज्ञान यांतील परस्पर संबंधांचे विश्लेषण करणे.

CO4: लोकशाहीतील जीवनशैली व प्रसारमाध्यमे यांच्यातील परस्पर संबंधांचे मूल्यांकन करणे.

CO5: विविध प्रसारमाध्यमांसाठी अचूक, संरचित आणि प्रभावी लेखन तयार करणे.

Course Contents

Unit	Description	Duration [Hrs]
१.	भाषा आणि व्यक्तिमत्व विकास : सहसंबंध लोकशाहीतील जीवनव्यवहार आणि प्रसारमाध्यमे	७
२.	**प्रसारमाध्यमांसाठी लेखन** वृत्तपत्रासाठी बातमीलेखन आणि मुद्रितसंपादन नभोवाणीासाठी भाषणाची संहितालेखन दूरचित्रवाणीासाठी माहितीपटासाठी संहितालेखन	७
३.	भाषा, जीवन व्यवहार आणि नवमाध्यमे, सामाजिक माध्यमे नवमाध्यमे आणि समाजमाध्यमांचे प्रकार : ब्लॉग, फेसबुक, ट्विटर नवमाध्यमे आणि समाजमाध्यमांविषयक साक्षरता, दक्षता, वापर आणि	७

	परिणाम	
४.	वेबसाइट आणि ब्लॉग, ट्विटरासाठी लेखन व्यावसायिक पत्रव्यवहार	७
	Total	२८

संदर्भ ग्रंथ :

१. सायबर संस्कृती, डॉ. रमेश वसखेडे

२. उपयोगित मराठी, संपादक डॉ. केतकी मोडक, संतोष शेंगई, सुजाता शेंगई

३. ओळख माहिती तंत्रज्ञानाची, टिमोथी जे. ओ'लिरी

४. संगणक, अच्युत गोडबोले, मोज प्रकाशन, मुंबई

५. इंटरनेट, डॉ. प्रभोध चौबे, मनोरमा प्रकाशन, मुंबई

६. व्यावहारिक मराठी, डॉ. ल. रा. नसराबादकर, फडके प्रकाशन, कोल्हापूर

७. आधुनिक माहिती तंत्रज्ञानाच्या विश्वात, शिक्षापूंकर दीपक, मराठे उज्ज्वल, उत्कर्ष प्रकाशन, पुणे

Course Contents

Sl. No.	Suggested List of Experiments/Assignments
1	Read a specific column (Sports, political, finance, editorial, education, international news etc) in the daily Marathi newspapers, summarize and present in the practical. A summary should be added as part of the journal. "दैनिक मराठी वर्तमानपत्रांमध्ये विशिष्ट कॉलम (क्रीडा, राजकीय, वित्त, संपादकीय, शिक्षण, आंतरराष्ट्रीय बातम्या इ.) वाचा, सारांश द्या आणि व सादरीकरण करा. त्या संदर्भातील सगळा सारांश जर्नल मध्ये जमा करावा."
2	Write blogs and posts on social media up to 200 words on recent development in their field of study. "सोशल मीडियावर त्यांच्या अभ्यासाच्या क्षेत्रातील अलीकडील विकासावर 200 शब्दांपर्यंत ब्लॉग लिहा, आणि पोस्ट करावा"
3	Professional letter / report writing. a. Write letter to the principal for organizing NSS camp in nearby village. Preparation of the budget, permission letters and report submission in the University

	"जवळच्या गावात एनएसएस शिबिर आयोजित करण्यासाठी मुख्याध्यापकांना पत्र लिहा. विद्यापीठात बजेट, परवानगी पत्रे आणि अहवाल सादर करणे." b.Write a letter for internship sponsorship to any organization. कोणत्याही संस्थेला इंटर्नशिप प्रायोजकत्वासाठी पत्र लिहा."
4	Book Review – Students are expected to read any novel, fiction or literature book of their choice and write a review on post it on social media of their choice. "पुस्तक पुनरावलोकन - विद्यार्थ्यांनी त्यांच्या आवडीचे कोणतेही कादंबरी, काल्पनिक कथा किंवा साहित्य पुस्तक वाचावे आणि त्यावर पुनरावलोकन लिहून ते त्यांच्या आवडीच्या सोशल मीडियावर पोस्ट करावे अशी अपेक्षा आहे."
5	Participation in Competitions (in college/outside the college) debate, declamation, elocution – A Report should be submitted स्पर्धेमध्ये (महाविद्यालयात/महाविद्यालयाबाहेर) सहभाग वादविवाद, भाषण, वक्तृत्व – अहवाल सादर करावा.
6	Group Activity: Road show, skit play, one-act play गट क्रियाकलाप : रोड शो, स्किट प्ले, एकांकिका
7	Participation in Purushottam karandam, Firodia karandak, Dajikaka Gadgil Karandak and Shreetej Karandak. पुष्कोतम करंडक, फिरोदिया करंडक, दाजीकाका गाडगीळ करंडक आणि श्रीतेज करंडक या स्पर्धेमध्ये सहभाग नोंदवावा.
8	Marathi film Review – Social Marathi movie available and write a review on post it on social media of their choice. मराठी चित्रपट पुनरावलोकन – सामाजिक आशयावर आधारित मराठी चित्रपट उपलब्ध आहे आणि त्या चित्रपटाची समीक्षा करून त्यावर सारांश लिहावा व तो वर्तमानपत्रे किंवा सोशल मीडियावर पोस्ट करावा पसंतीच्या सोशल मीडियावर पोस्ट करा.

संदर्भ ग्रंथ :

१. सायबर संस्कृती, डॉ. रमेश वसखेडे

२. उपयोगित मराठी, संपादक डॉ. केतकी मोडक, संतोष शेंगई, सुजाता शेंगई

३. ओळख माहिती तंत्रज्ञानाची, टिमोथी जे. ओ'लिरी

४. संगणक, अच्युत गोडबोले, मोज प्रकाशन, मुंबई
५. इंटरनेट, डॉ. प्रभोध चौबे, मनोरमा प्रकाशन, मुंबई
६. व्यावहारिक मराठी, डॉ. ल. रा. नसराबादकर, फडके प्रकाशन, कोल्हापूर
७. आधुनिक माहिती तंत्रज्ञानाच्या विश्वात, शिक्षापूंकर दीपक, मराठे उज्ज्वल, उत्कर्ष प्रकाशन, पुणे