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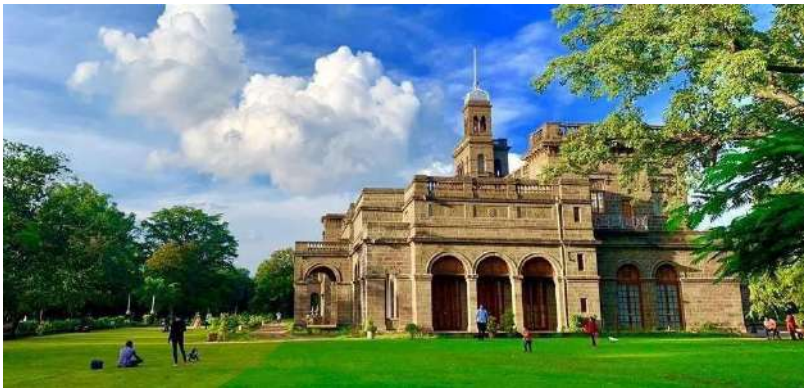
Savitribai Phule Pune University, Pune, Maharashtra, India

Faculty of Science and Technology



National Education Policy (NEP)-2020

Compliant Curriculum

Second Year Engineering (2024 Pattern)

Electronics and Computer Engineering

(With effect from Academic Year 2025-26)

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Nomenclature

AEC Ability Enhancement Course

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Preface by Board of Studies

Dear Students and Teachers,

We, the members of Board of Studies Electronics and Telecommunication Engineering, are very happy to present Second Year Electronics and Computer Engineering (ECE) syllabus effective from the AY Year 2025-26. Subsequently this will be carried forward for TE and BE in the AY 2026-27, 2027-28, respectively.

Electronics and Computer Engineering have emerged as transformative forces reshaping industries, driving innovation, and impacting our daily lives. Recognizing the growing importance and pervasive nature of these fields, we have designed this comprehensive syllabus to equip students with the foundational knowledge, practical skills. This curriculum is meticulously crafted to provide a holistic learning experience, blending theoretical concepts with hands-on applications. It aims to foster critical thinking, problem-solving abilities, enabling graduates to contribute meaningfully to the advancement and responsible deployment of technologies. The revised syllabus falls in line with the objectives of NEP-2020, Savitribai Phule Pune University, AICTE New Delhi, UGC, and various accreditation agencies by keeping an eye on the technological developments, innovations, and industry requirements.

Learners are now getting sufficient time for self-learning either through online courses or additional projects for enhancing their knowledge and skill sets. Learners can be advised to take up online courses, on successful completion they are required to submit certification for the same. We believe that this well-structured and comprehensive syllabus will serve as a robust foundation for aspiring Electronics and Computer Engineering professionals, enabling them to contribute significantly to the techno-logical progress and address the challenges of the 21st century.

We would like to place on record our gratitude to the faculty, students, industry experts and stakeholders for having helped us in the formulation of this syllabus.

Dr. S. D. Shirbahadurkar
Chairman,
Electronics and Telecommunication Engineering

Members of Board of Studies, Electronics & Telecommunication Engineering, Savitribai Phule Pune University, Pune	
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Second Year Electronics and Computer Engineering

Knowledge and Attitude Profile (WK)

A Knowledge and Attitude Profile (KAP), often represented as WK (Knowledge and Attitude Profile) in some contexts, is a framework or assessment tool used to evaluate an individual's knowledge and attitudes related to a specific area, topic, or domain.

WK1	A systematic, theory-based understanding of the natural sciences applicable to the discipline and awareness of relevant social sciences.
WK2	Conceptually-based mathematics, numerical analysis, data analysis, statistics and formal aspects of computer and information science to Support detailed analysis and modeling applicable to the discipline.
WK3	A systematic, theory-based formulation of engineering fundamentals Required in the engineering discipline.
WK4	Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for the accepted practice areas in the engineering discipline; much is at the forefront of the discipline.
WK5	Knowledge, including efficient resource use, environmental impacts, whole-life cost, re-use of resources, net zero carbon, and similar concepts, that supports engineering design and operations in a Practice area.
WK6	Knowledge of engineering practice(technology)in the practice areas In the engineering discipline.
WK7	Knowledge of the role of engineering in society and identified issues in engineering practice in the discipline, such as the professional responsibility of an engineer to public safety and sustainable development.
WK8	Engagement with selected knowledge in the current research literature of the discipline, awareness of the power of critical thinking and creative approaches to evaluate emerging issues.
WK9	Ethics, inclusive behavior and conduct. Knowledge of professional ethics, responsibilities, and norms of engineering practice. Awareness of the need for diversity by reason of ethnicity, gender, age, physical ability etc. with mutual understanding and respect, and of inclusive attitudes.

Reference: Self-Assessment Report (SAR) Format Undergraduate Engineering Programs Graduate Attributes and Professional Competencies Version 4.0 (GAPCV4.0)-(August2024) Page 55.

Programme Outcomes (PO)

Programme Outcomes are statements that describe what students are expected to know and be able to do upon graduating from the program. These relate to the skills, knowledge, attitude and behaviour that students acquire through the program. On successful completion of B.E. in Electronics and Telecommunication Engineering-Eletronics and Computer Engineering, graduating students/graduates will be able to:

PO1	Engineering knowledge	Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop to the solution of complex engineering problems.
PO2	Problem analysis	Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development.(WK1toWK4)
PO3	Design / Development of Solutions	Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. (WK5)
PO4	Conduct Investigations of Complex Problems	Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modeling, analysis & interpretation of data to provide valid conclusions.(WK8).
PO5	Engineering Tool Usage	Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modeling recognizing their limitations to solve complex Engineering problems.(WK2andWK6)
PO6	The Engineer and The World	Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment.(WK1,WK5,andWK7).

PO7	Ethics	Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & International laws.(WK9)
PO8	Individual and Collaborative Team work	Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.
PO9	Communication	Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences
PO10	Project Management and Finance	Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.
PO11	Life-Long Learning	Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change. (WK8)

Reference: Self-Assessment Report (SAR) Format Undergraduate Engineering Programs Graduate Attributes and Professional Competencies Version 4.0 (GAPCV4.0)-(August2024) Page56.

General Rules and Guidelines

- Course Outcomes (CO): Course Outcomes are narrower statements that describe what students are expected to know, and are able to do at the end of each course. These relate to the skills, knowledge and behaviour that students acquire in their progress through the course.
- Assessment: Assessment is one or more processes, carried out by the institution, that identify, collect, and prepare data to evaluate the achievement of Program Educational Objectives and Program Outcomes.
- Evaluation: Evaluation is one or more processes, done by the Evaluation Team, for interpreting the data and evidence accumulated through assessment practices.

Evaluation determines the extent to which Program Educational Objectives or Program Outcomes are being achieved, and results in decisions and actions to improve the program

Guidelines for Examination Scheme

Theory Examination: The theory examination shall be conducted in two different parts Comprehensive Continuous Evaluation (CCE) and End-Semester Examination (ESE).

Comprehensive Continuous Evaluation (CCE) of 30marks based on all the Units of course syllabus to be scheduled and conducted at institute level. To design a Comprehensive Continuous Evaluation (CCE) scheme for a theory subject of 30 marks with the specified parameters, the allocation of marks and the structure can be detailed as follows:

Sr.	Parameters	Marks	Coverage of Units
1	Unit Test	12Marks	Units 1 & Unit 2 (6Marks/Unit)
2	Assignments/ Case Study	12Marks	Units 3 & Unit 4 (6Marks/Unit)
3	Seminar Presentation/ Open Book Test/ Quiz	06Marks	Unit 5

Comprehensive Continuous Evaluation (CCE) of 15 marks based on all the Units of course syllabus to be scheduled and conducted at institute level. To design a Comprehensive Continuous Evaluation (CCE) scheme for a theory subject of 15 marks with the specified parameters, the allocation of marks and the structure can be detailed as follows:

Sr.	Parameters	Marks	Coverage of Units
1	Unit Test	10 Marks	Unit 1 & Unit 2 (5 Marks/Unit)
2	Seminar Presentation / Open Book Test/ Assignments / Case Study	05 Marks	Unit 3 & Unit 4

Note: Students can opt for Open Electives offered by different faculty like Arts, Science, Commerce, Management, Humanities or Inter-Disciplinary studies.
Example Open Elective I- Financial Accounting, Digital Finance, Digital Marketing can be opted from Commerce and Management faculty.
And Elective II - Project Management, Business Analytical, Financial Management can be opted from Inter-Disciplinary studies, Commerce and Management faculty respectively.

- **Unit Test**

  - **Format:** Questions designed as per Bloom's Taxonomy guidelines to assess various cognitive levels (Remember, Understand, Apply, Analyze, Evaluate, Create).
  - **Implementation**: Schedule the test after completing Units 1and 2. Ensure the question paper is balanced and covers key concepts and applications.

- **Sample Question Distribution**

  - Remembering (2Marks): Define key terms related to[Topic from Units 1 and 2].
  - Understanding (2Marks): Explain the principle of [Concept] in [Context].
  - Applying (2Marks): Demonstrate how [Concept]can be used in[Scenario].
  - Analyzing (3Marks): Compare & contrast [Two related concepts] from Units 1and 2.
  - Evaluating (3Marks): Evaluate the effectiveness of [Theory/Model] in [Situation].

- **Assignments / Case Study** : Students should submit one assignment or one Case Study Report based on Unit 3 and one assignment or one Case Study Report based on Unit4.

  - **Format:** Problem-solving tasks, theoretical questions, practical exercises, or case studies that require in-depth analysis and application of concepts.
  - **Implementation:** Distribute the assignments or case study after covering Units 3 and 4. Provide clear guidelines and a rubric for evaluation.

- **Seminar / Presentation:**

  - **Format:** Oral presentation on a topic from Unit 5, followed by a Q&A session.
  - **Deliverables:** Presentation slides, a summary report in 2 to 3 pages, and performance during the presentation.
  - **Implementation:** Schedule the seminar presentations towards the end of the course. Provide students with ample time to prepare and offer guidance on presentation skills.

- **Open Book Test:**

– **Format:** Analytical and application-based questions to assess depth of understanding.

– **Implementation:** Schedule the open book test towards the end of the course, ensuring it covers critical aspects of Unit 5.

- **Quiz:**

– **Format:** Quizzes can help your students practice existing knowledge while stimulating interest in learning about new topic in that course. You can set your quizzes to be completed individually or in small groups.

– **Implementation:** Online tools and software can be used create quiz. Each quiz is made up of a variety of question types including multiple choice, missing words, true or false etc

- **Example Timeline for conducting CCE:**

– Weeks1-4:Cover Units1 and 2

– Week5: Conduct Unit Test (12marks)

– Weeks6-8: Cover Units 3 and 4

– Week9: Distribute and collect Assignments/Case Study(12marks)

– Weeks10-12: Cover Unit 5

– Week13: Conduct Seminar Presentations or Open Book Test or Quiz (6marks)

- **Evaluation and Feedback:**

– **Unit Test:** Evaluate promptly and provide constructive feedback on strengths and areas for improvement.

– **Assignments / Case Study:** Assess the quality of submissions based on the provided rubric. Offer feedback to help students understand their performance.

– **Seminar Presentation:** Evaluate based on content, delivery, and engagement during the Q&A session. Provide feedback on presentation skills and comprehension of the topic.

– **Open Book Test**: Evaluate based on the depth of analysis and application of concepts. Provide feedback on critical thinking and problem-solving skills.

End-Semester Examination (ESE)

End-Semester Examination (ESE) of 70 marks written theory examination based on all the unit of course syllabus scheduled by university. Question papers will be sent by the University through QPD (Question Paper Delivery). University will schedule and conduct ESE at the end of the semester.

- **Format and Implementation:**

– **Question Paper Design**: Below structure is to be followed to design an End-Semester Examination (ESE) for a theory subject of 70 marks on all 5 units of the syllabus with questions set as per Bloom's Taxonomy guidelines and 14 marks allocated per unit.

– **Balanced Coverage**: Ensure balanced coverage of all units with questions that assess different cognitive levels of Bloom's Taxonomy: Remember, Understand, Apply, Analyze,

Evaluate, and Create. The questions should be structured to cover:

∗ Remembering: Basic recall of facts and concepts.
∗ Understanding: Explanation of ideas or concepts.
∗ Applying: Use of information in new situations.
∗ Analyzing: Drawing connections among ideas.
∗ Evaluating: Justifying a decision or course of action.
∗ Creating: Producing new or original work (if applicable).

– **Detailed Scheme for 70 Marks:** Unit-Wise Allocation (14 Marks per Unit): Each unit will have a combination of questions designed to assess different cognitive levels. By following this scheme, you can ensure a comprehensive and fair assessment of students' understanding and application of the course material, adhering to Bloom's Taxonomy guidelines for cognitive skills evaluation.

– **Detailed Scheme for 35 Marks :** Unit wise Allocation (08 Marks for Unit 1, 09 Marks for Unit 2, Unit 3 and Unit 4 each). Each unit will have a combination of questions designed to assess different cognitive levels. By following this scheme, you can ensure a comprehensive and fair assessment of students' understanding and application of the course material, adhering to Bloom's Taxonomy guidelines for cognitive skills evaluation.

NEP 2020 Compliant Curriculum Structure
Second Year Engineering (2024 Pattern)
Electronics and Computer Engineering

Level 5.0														
Course Code	Course Type	Course Name	Teaching Scheme (Hrs./week)			Examination Scheme and Marks					Credits			
			Theory	Tutorial	Practical	CCE*	End-Sem	Term work	Practical	Oral	Theory	Tutorial	Practical	Total
Semester III														
PCC-201-ECE	Program Core Course	Analog and Digital Electronic Circuits	3	-	-	30	70	-	-	-	3	-	-	3
PCC-202-ECE	Program Core Course	Data Structure & Algorithms	3	-	-	30	70	-	-	-	3	-		3
PCC-203-ECE	Program Core Course	Discrete Mathematics	3	-	-	30	70	-	-	-	3	-	-	3
PCC-204-ECE	Program Core Course Lab	Analog and Digital Electronic Circuits Lab	-	-	2	-	-	25	50	-	-	-	1	1
PCC-205-ECE	Program Core Course Lab	Data Structure & Algorithms Lab	-	-	2	-	-	25	25	-	-	-	1	1
	Open Elective	Open Elective-I**	2	-	-	15	35	-	-	-	2	-	-	2
MDM-230-ECE	Multidisciplinary Minor	Statistical Data Analysis & Visualization	3	-	-	30	70	-	-	-	3	-	-	3
EEM-240-ECE	Entrepreneurship / Economics/ Management	Engineering Economics & Application	-	1	2	-	-	25	-	-	-	1	1	2
VEC-250-ECE	Value Education	Universal Human Values & Professional ethics	2	-	-	15	35	-	-	-	2	-	-	2
CEP-260-ECE	Community Engagement Project	Community Engagement Project	-	-	4#	-	-	25	-	25	-	-	2	2
Total			**16**	**01**	**10**	**150**	**350**	**100**	**75**	**25**	**16**	**01**	**05**	**22**
			27 Hrs.			**700 Marks**					**22 Credits**			

***Comprehensive Continuous Evaluation**

****Open Elective I - Courses like Financial Accounting, Supply chain management, Digital Finance, Digital Marketing and other courses students can be opted from faculty Commerce and Management, Humanities and Inter-disciplinary bucket.**

#Note: For Community Engagement, the actual teaching load shall consider 2 Hrs/Week and rest 2 Hrs. society engagement for students

NEP 2020 Compliant Curriculum Structure

Second Year Engineering (2024Pattern)

Electronics and Computer Engineering

Level 5.0														
Course Code	Course Type	Course Name	Teaching Scheme (Hrs./week)			Examination Scheme and Marks					Credits			
			Theory	Tutorial	Practical	CCE*	End-Sem	Termwork	Practical	Oral	Theory	Tutorial	Practical	Total
Semester IV														
PCC-206-ECE	Program Core Course	Communication Systems	3	-	-	30	70	-	-	-	2	-	-	2
PCC-207-ECE	Program core Course	Signals and Systems	3	-	-	30	70	-	-	-	3	-	-	3
PCC-208-ECE	Program Core Course	Object Oriented Programming	3	-	-	30	70	-	-	-	3	-	-	3
PCC-209-ECE	Program Core Course Lab	Communication Systems Lab	-	-	2	-	-	25	25	-	-	-	1	1
PCC-210-ECE	Program Core Course Lab	Signals & Systems and Object-oriented Programming Lab	-	-	2	-	-	25	-	25	-	-	1	1
	Open Elective	Open Elective-II**	2	-	-	15	35	-	-	-	2	-	-	2
MDM-231-ECE	Multidisciplinary Minor	AI & Machine learning fundamentals	3	-	-	30	70	-	-	-	2	-	-	2
VSE-270-ECE	Vocational and Skill Enhancement Course	Critical thinking & Programming Lab	-	1	2	-	-	25	25	-	-	1	1	2
AEC-281-ECE	Ability Enhancement Course	Modern Indian Languages (Marathi/Hindi)	-	1	2	-	-	25	-	-	-	1	1	2
EEM-241-ECE	Entrepreneurship/Economics/ Management	Entrepreneurship skill Development	-	1	2	-	-	25	-	-	-	1	1	2
VEC-251-ECE	Value Education Course	Environment Awareness	2	-	-	15	35	-	-	-	2	-	-	2
Total			**16**	**03**	**10**	**150**	**350**	**125**	**50**	**25**	**14**	**03**	**05**	**22**
			29 Hrs.			**700 Marks**					**22 Credit**			

***Comprehensive Continuous Evaluation**

****Open Elective II - Courses like Project Management, Business Analytical, Product management Financial Management and other courses students can be opted from faculty Commerce and Management, Humanities and Inter-disciplinary bucket.**

Savitribai Phule Pune University, Pune

Maharashtra, India

SE -Department of Electronics and Computer Engineering

2024 Pattern

Semester III

With effect from Academic Year 2025–26

Savitribai Phule Pune University
Second Year of Electronics and Computer Engineering (2024Course)

PCC-201-ECE: Analog and Digital Electronic Circuits

Teaching/scheme	Credits	Examination Scheme
Theory: 03Hours/Week	03	**CCE**: 30 Marks **End-Semester:** 70 Marks

Prerequisite Courses, if any: Basic Electronics Engineering and Basic Electrical Engineering

Companion Course, if any: Laboratory Practical

Course Objectives:

The objective of this course is to provide students with

- An understanding of EMOSFET amplifier and ability to design the amplifier circuit
- An understanding of applications of op-amp and ability to design of opamp based circuits
- An understanding of Combinational and Sequential digital ckt and ability to design Combinational and Sequential digital circuit
- An understanding of use of analog and digital circuits in real life applications

Course Outcomes:

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

CO1: Design EMOSFET amplifier circuits

CO2: Design operational amplifier-based circuits for given applications

CO3:Design Combinational and Sequential digital circuits

CO4: Design digital circuits using state machines

CO5: Solve real life problems using digital and analog circuits

Course Contents

Unit I	Design and Analysis of EMOSFET Amplifier	(09 Hours)

Non ideal characteristics of EMOSFET such as Finite output resistance, body effect, sub-threshold conduction, breakdown effects, temperature effect. Comparison of Common Source (CS), Common Drain (CD) and Common gate (CG) amplifier configurations. Concept of DC load line, two port model of EMOSFET, design and analysis of dc circuit for common source amplifier configuration, numerical. Concept of AC load line, AC equivalent circuit of a common source amplifier configuration, design & analysis of common source amplifier configuration with respect to input and output impedance, gain and frequency response, numerical.

#Exemplar	Public address system, transmitter and receiver of wired (telephone) and wireless systems (satellite, mobile), computers etc.

Mapping of Course Outcomes for Unit I	CO1	
Unit II	**EMOSFET and OPAMP Applications**	**(09 Hours)**
EMOSFET Applications - CMOS inverter, resistor & diode, feedback amplifiers and its effects, design and analysis of voltage series feedback amplifier and numerical. Concept of Barkhausen criterion for oscillator, comparison of various oscillator such as Colpitts, Heartily, Wein bridge and RC phase shift, design and analysis of RC phase shift oscillator and numerical. OPAMP applications circuit design and analysis such as voltage follower, summing and differential amplifier, practical integrator, comparator, Schmitt trigger		
#Exemplar	Waveform and frequency generator for application such as receiver and transmitter in TV, mobile, telephone etc, electronic analog computer	
Mapping of Course Outcomes for Unit II	CO2	
Unit III	**Combinational and Sequential Logic Digital Circuits**	**(09Hours)**
Combinational logic Circuit – Decimal to binary and binary to decimal code convertor, 2-bit adder and subtractor, 2- bit digital comparator, 4:1 and 8:1 multiplexers and relevant de-multiplexers. Sequential logic Circuit - 1 Bit memory cell, shift registers, synchronous and asynchronous counters, ring and twisted ring counters, up and down counters.		
#Exemplar	Digital computer, counting mechanism in industry etc	
Mapping of Course Outcomes for Unit III	CO3	
Unit IV	**State Machines and its Application**	**(09 Hours)**
State diagram, state table, state reduction, state assignment, comparison of Mealy and Moore machines, Mealy and Moore machine implementation, programmable logic devices and their architecture - PROM, PAL, PLA, FPGA and CPLD, semiconductor memories types and their characteristic parameters, performance parameters for a digital logic circuit such as speed, power dissipation, figure of merit, fan in, fan out, current, voltage, noise immunity		
#Exemplar	Traffic light control, computer memory etc.	
Mapping of Course Outcomes for Unit IV	CO4	

Unit V	Customer Value	(09 Hours)
Various types of ADCs and DACs and their performance parameters, study of successive approximation ADC and R-2R ladder type of DAC, Square & triangular wave generator, electronic analog computer, traffic light controller using finite state machine, bottling plant counting mechanism using counter		
#Exemplar	audio recording, data acquisition systems, and sensor interfaces, communication systems such as TV receivers, analog computers, computer/pen drive memories, public traffic light system, industrial counting applications	
Mapping of Course Outcomes for Unit V	CO5	

Learning Resources

Textbooks:

1. Donald Neaman, "Electronic Circuits – Analysis and Design" Third edition, Mc Graw Hill.
2. Ramakant Gaikwad, "Op amps & Linear Integrated Circuits", Pearson Education.
3. R.P. Jain, "Modern digital electronics", 3rd edition, 12th reprint Tata McGraw Hill Publication,2007.
4. M. Morris Mano, "Digital Logic and Computer Design" 4the Edition, Prentice Hall of India

Reference Books:

1. Millman Halkias, "Integrated Electronics"
2. David A. Bell, "Electronic Devices and Circuits", 5th Edition, Oxford press
3. Anand Kumar, "Fundamentals of Digital Circuits" 1st edition, Prentice Hall of India, 2001
4. Digital Principles and Applications (SIE) | 8th Edition: Leach, Malvino, Saha

e-Books:

1.https://ebooks.lpude.in/computer_application/ad/DCAP108_DIGITAL_CIRCUITS_AND_LOGIC_DESIGNS.pdf

2.https://mrce.in/ebooks/Analog%20Integrated%20Circuit%20Design%202nd%20Ed.pdf

MOOC / NPTEL/YouTube Links:

1. NPTEL Course "Analog Electronic Circuits" https://nptel.ac.in/courses/108105158
2. NPTEL Course on "Analog Circuits": https://nptel.ac.in/courses/108101094
3. NPTEL Course "Digital Circuits" by Prof. Santanu Chattopadhyay (IIT Kharagpur)
4. NPTEL Course "Digital Circuits" by Prof. Goutam Saha (IIT Kharagpur)

Virtual Labs Links

http://vlabs.iitb.ac.in/vlabs/vlab_bootcamp/bootcamp/electronerds/index.html
http://vlabs.iitkgp.ernet.in/be/
https://nptel.ac.in/courses/108/105/ 108105113/
https://nptel.ac.in/courses/117/106/117106086/
https://nptel.ac.in/courses/108/105/108105132/
https://da-iitb.vlabs.ac.in/exp/generalized-simulator/
https://dld-iitb.vlabs.ac.in/

[#Exemplar: These are the practical applications based on the contents of the particular unit and for information only. *Comprehensive Continuous Evaluation]

Savitribai Phule Pune University
Second Year of Electronics and Computer Engineering (2024Course)

PCC-202-ECE: Data Structures and Algorithms

Teaching/scheme	Credits	Examination Scheme
Theory: 03Hours/Week	03	**CCE**: 30 Marks **End-Semester:** 70 Marks

Prerequisite Courses, if any: Basic mathematics, foundational knowledge of problem-solving and logic building, programming concepts using C language.

Companion Course, if any: Laboratory Practical

Course Objectives:

- To introduce students to the fundamentals of C++ programming with object-oriented concepts.
- To develop understanding of various searching and sorting algorithms and their performance.
- To understand the concepts and applications of linear and non-linear data structures.
- To implement and analyze data structures such as linked lists, stacks, queues, trees, and graphs using C++.
- To enable students to apply data structures and algorithms to solve real-world problems efficiently.

Course Outcomes:

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

CO1: Apply object-oriented programming concepts using C++ for problem solving.

CO2: Analyze searching and sorting algorithms for efficiency.

CO3: Implement various types of linked lists and understand their applications.

CO4: Implement stack and queue data structures and apply them in relevant problems.

CO5: Apply trees and graphs to represent and solve complex problems.

Course Contents

Unit I	Introduction to C++	(09Hours)

Basics of Object-Oriented Programming (OOP), C++ syntax and program structure, data types, variables, operators, Functions and parameter passing, Classes and objects, Constructors and destructors, Function overloading and operator overloading.

Case Study – Complex number arithmetic for scientific and engineering calculations, use of basic C++ concepts — classes, objects, constructors, and operator overloading for complex number arithmetic (Addition, Subtraction, Multiplication)

#Exemplar	System programming, operating systems, Game development, Embedded System, device drivers, scientific simulations, Artificial Intelligence/ Machine Learning Libraries.

Mapping of Course Outcomes for Unit I	CO1	
Unit II	**Searching and Sorting Algorithms**	**(09 Hours)**
Algorithms: Analysis of Iterative and Recursive algorithms, Time and space complexity, Asymptotic notation- Big-O, Theta and Omega notations. Searching methods: Linear, Binary and Fibonacci Search. Sorting methods: Bubble, Insertion, Selection, Merge, and Quick Sort. Implementation of searching and sorting algorithms using C++. Case Study - e-commerce platform, searching products and sorting based on price for a user query. Introduction to dynamic programming, Top-Down Approach (Memoization), Bottom-Up Approach (Tabulation).		
#Exemplar	Voter search, roll number lookup, product search on e-commerce platform, price sorting, merit list generation, sort employee records by salary.	
Mapping of Course Outcomes for Unit II	CO2	
Unit III	**Linked Lists**	**(09 Hours)**
Definition and importance of data structures, Classification of data structures, Singly Linked List: Creation, insertion, deletion, traversal, searching, sorting. Doubly Linked List: Creation, insertion, deletion, traversal, Circular Linked List: Creation, insertion, deletion, traversal, Case Study – Polynomial representation, Use of singly linked lists where each node stores coefficient and exponent of polynomial, polynomial addition. Case Study - Use of doubly linked list to represent playlist with next and previous track options. Songs can be added/removed dynamically and navigated forward/backward		
#Exemplar	Managing a music playlist, Browser History Navigation, undo/redo operations, Round-Robin Scheduling	
Mapping of Course Outcomes for Unit III	CO3	
Unit IV	**Stacks and Queues**	**(09 Hours)**
Stack: Concept, implementation using arrays and linked lists, Stack operations: push, pop, peek, Stack Applications, Case Study - parsing logic in compilers and calculators - conversion of infix to postfix expressions using stack, followed by evaluation. Queue: Implementation using arrays and linked lists, Queue operations- enqueue, dequeue, peek. Types of queues: Circular queue, Priority Queue, Queue Applications,		

Case Study - Hospital Emergency Queue System, Use of priority queue or combination of normal queue + sorting mechanism.		
#Exemplar	Expression parsing, compiler design, calculators, Ticket counters, call center queues, print job management, CPU Job Scheduling	
Mapping of Course Outcomes for Unit IV	CO4	
Unit V	**Trees and Graphs**	**(09 Hours)**
Trees: Terminology, binary trees, binary search trees (BST). Threaded binary tree, Tree traversals: Inorder, Preorder, Postorder, AVL trees: Rotations and balancing, Graphs: Representations (adjacency matrix/list), Graph traversals: BFS, DFS, Minimum Spanning tree- Kruskal's Algorithm, Prim's Algorithm. Case Study – GPS/Map navigation, Use of weighted graphs and Dijkstra's Shortest Path Algorithm.		
#Exemplar	Mapping systems (like Google Maps), social media connections, File system navigation, friend recommendation on social media, organizational charts, search engines, database indexing	
Mapping of Course Outcomes for Unit V	CO5	

Learning Resources

Textbooks:

1. E. Balagurusamy, "Object-Oriented Programming with C++", McGraw Hill
2. Ellis Horowitz, Sartaj Sahni, "Fundamentals of Data Structures in C++", Orient Blackswan
3. Yashavant Kanetkar, "Data Structures Through C++", BPB Publications

Reference Books:

1. Robert Lafore, "Object-Oriented Programming in C++", Sams Publishing
2. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C++", Pearson
3. BjarneStroustrup, "The C++ Programming Language", Addison-Wesley
4. YedidyahLangsam, Moshe J. Augenstein and Aaron M. Tenenbaum, "Data structures using C and C++",Pearson

e-Books:

1. Fundamentals of Programming C++ (Richard L. Halterman)
2. Data Structures and Algorithm Analysis in C++, 3rd Edition (Clifford A. Shaffer)

MOOC / NPTEL/YouTube Links:

1. Data Structures And Algorithms, IIT Delhi, https://nptel.ac.in/courses/106102064
2. Introduction to Data Structures, https://onlinecourses.swayam2.ac.in/cec24_cs17/preview

[#Exemplar: These are the practical applications based on the contents of the particular unit and for information only. *Comprehensive Continuous Evaluation]

Savitribai Phule Pune University
Second Year of Electronics and Computer Engineering (2024 Course)

PCC-203-ECE : Discrete Mathematics

Teaching/scheme	Credits	Examination Scheme
Theory: 03Hours/Week	03	**CCE**: 30 Marks **End-Semester:** 70 Marks

Course Prerequisites: Fundamental of Sets, Permutations & Combinations and Matrix algebra.

Course Objectives:

To familiarize the students with concepts and techniques of discrete mathematics: sets, logic, relations, functions, combinatorics, graphs, trees, and algebraic structures enabling them to understand and apply these theories and principles relevant to computer science.

Course Outcomes:

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

CO1: Formulate, interpret, and solve real-world problems by applying key concepts from sets, logic, combinatorial techniques and formal proof methods relevant to computer science.

CO2: Analyze different types of relations and its closures, construct & use functions and solve recurrence relations to enable algorithmic solution to problems.

CO3: Model and devise algorithmic solution using graphs & trees and solve problems in network theory and data structures.

CO4: Apply the concepts of algebraic structures such as Group, Ring and Field, applied to coding theory

Course Contents

Unit I	Sets and Logic	(09 Hours)

Sets: Introduction, Types of Sets, Operation and Laws, Principle of Inclusion and Exclusion, Multisets

Logic: Propositions, Operations and Connectives, Truth table, Logical Equivalence, Normal Forms, Logical implication, Rules of Inference, Validity, Compactness and Resolution, Predicative and quantifiers, Methods of Proofs and Principle of Mathematical Induction.

Combinatorics: Counting Principle, Permutation and Combination, Pigonhole Principle, Binomial coefficients and Identities.

Unit II	Relations and Functions	(09 Hours)

Relations: Definitions, Types of relations, Properties, n-ary relations, Closure of relations, Equivalence relation, Equivalence classes, Partitions, Partial ordering relations, Hasse Diagram, Lattices, Chain and Antichains, Transitive closure and Warshall's algorithm.

Functions: Definitions, Types of functions, Composition of functions, Invertible functions, Generating functions, Recurrence relations, Solution of linear recurrence relation with Constant Coefficients

Unit III	Graph and Applications	(09 Hours)
Terminology and types of graphs, Hand shaking lemma, Matrix representation of graphs, Adjacency and Incidence matrix, Isomorphism, Connectivity, Eulerian and Hamiltonian graphs, Shortest path, Travelling salesman problem, Dijkstra's algorithm, Planar graph and Euler formula, Graph colouring, Chromatic number, Dual of Graph, Clique number.		
Unit IV	**Trees**	**(09 Hours)**
Introduction, Properties, Rootedtree, Binary Search tree, Treetraversal, Path length, Weighted tree, Prefixcode, Huffmancoding, Spanning tree, Minimal spanning tree, Kruskal algorithm, prims algorithm, Cut set, The Max flow- Min cut theorem (Transport Network).		
Unit V	**Algebraic Structure and Coding Theory**	**(09 Hours)**
Introduction to Algebraic structures, Semi group, Monoid, Group, Abelian group, Cyclic group, Congruence relation, Homomorphism, Normal subgroup, Ring, Field, Galois Theory, Coding Theory.		
Learning Resources		
Textbooks: 1. Kenneth H. Rosen,"Discrete Mathematics and its applications", Tata McGraw Hill. 2. C. L. Liu. "Elements of Discrete Mathematics", Tata McGraw Hill.		
Reference Books: 1. Bernard Kolman, Robert C. Busby, Sharon Ross. "Discrete Mathematical structures", Prentice Hall. 2. Ralph P. Grimaldi. "Discrete and Combinatorial Mathematics" Pearson Addison Wesley. 3. Sriram P and Steven S," Computational Discrete Mathematics" Cambridge University Press. 4. Narsingh Deo, "Graph Theory with Applications to Engineering and Computer Science", Prentice Hall. 5. Edgar G. Goodaire, Michael M Parmenter," Discrete Mathematics with Graph Theory", 3 rd Edition, Pearson Education 6. A R Vasishtha, "Abstract Algebra", Krishna Prakashan.		

Savitribai Phule Pune University
Second Year of Electronics and Computer Engineering (2024 Course)

PCC-204-ECE: Analog and Digital Electronic Circuits Lab

Teaching/scheme	Credits	Examination Scheme
Practical: 02Hours/Week	01	**Term work**: 25 Marks **Practical:** 50 Marks

Companion Course, if any: Analog and Digital Electronic Circuits

Course Objectives:

The objective of this course is to provide students with

- An understanding of EMOSFET amplifier and ability to design the amplifier circuit
- An understanding of applications of op-amp and ability to design of opamp based circuits
- An understanding of Combinational and Sequential digital ckt and ability to design Combinational and Sequential digital circuit
- An understanding of use of analog and digital circuits in real life applications

Course Outcomes:

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

CO1: Design a single stage common source (C.S.) amplifier and oscillator using EMOSFET. (Expt1, Expt2, Expt6)

CO2: Design applications such as Schmitt trigger, waveform generator, oscillator using operational amplifiers. (Expt3, Expt4, Expt5,Expt6)

CO3: Design digital circuits such as adder, subtractor, multiplexer, code converter and counter used in various applications. (Expt7, Expt8, Expt9, Expt10, Expt11, Exp12)

CO4: Solve the complex engineering problem using analog and digital circuits. (Expt13, Expt14, Expt15)

Guidelines for Student's Lab Journal

The students Lab Journal should contain following related to every experiment –

1. Title of the experiment
2. Mapped Objective and Mapped Outcome
3. Hardware and/or software tools used with important specifications
4. Active and Passive Components used with their important datasheet specifications (Attach datasheet)
5. Brief theory related to the experiment.
6. Connection diagram /circuit diagram

7. Design of the circuit (if required)
8. Observation table
9. Sample calculations (if required)
10. Graph (if any)
11. Result table
12. Conclusions (that gives directions about applications with justifications, any impactful trends and its importance, any innovations noted that leads to societal/economical/industrial/environmental change impacting sustainability aspect etc. etc.)

Guidelines for Laboratory/ TW Assessment

1. Continuous assessment of laboratory work is to be done based on overall performance and Laboratory performance of student.
2. Each Laboratory assignment assessment should assign grade/marks based on parameters with appropriate weightage.
3. Suggested parameters for overall term work assessment and weightage include punctuality in attendance (theory as well as in practical) (40%), continuous and timely assessment (10%), performance experimentation (correctness, understanding, originality), assignments, midterm/class tests etc.)(30%), and documentation (20%).

Suggested List of Laboratory Experiments (Any eight)

Group A (Any 4)

1 Design, build and test dc circuit for single stage CS amplifier & verify dc operating point. (CO1)

2 Design, build & test single stage CS amplifier, plot frequency response. Calculate Av, Ri, Ro & bandwidth.(CO1)

3 Design, build & test integrator using Op-amp for given frequency fa and plot frequency response. (CO2)

4 Design, build & test Schmitt trigger using Op-Amp. (CO2)

5 Design, build & test Square and triangular waveform generator using Op-Amp. (CO2)

6	Design, build and test any oscillator for given frequency using operational amplifier or EMOSFET. (CO2)
	Group B (Any 4)
6	Design and implement 8:1 mux using 4:1 mux and verify its truth table. Also design &implement given 4 variable functions using IC74LS153 and verify its truth table. (C03)
7	Design and implement full adder and subtractor function using IC-74LS138. (CO3)
8	Design &implement 3-bit gray to binary/binary to gray code converter using IC-74LS138. (CO3)
9	Design and implement 4-bit binary adder and subtractor using IC-74LS83. (CO3)
10	Design and implement MOD-N and MOD-NN using IC-74LS90 and draw timing diagram. (CO3)
11	Design and implement MOD-N and MOD-NN using IC-74LS93 and draw timing diagram. (CO3)
	Group C (Any 1) (Project Based Learning)
12	Design a traffic light controller for a square using digital and analog circuit. (CO2, CO3, CO5)
13	Design a bottling plant mechanism to count no of bottles using digital and analog circuit. (CO2, CO3, CO5)
14	Design any real-life problem using digital and analog circuit. (CO2, CO3, CO5)

Note: Out of 4 experiments from group A and B each, 2must be realized using hardware and 2using any simulation software. Group C is a mini project for project-based learning to be realized using theoretical design work on paper and then using simulation and hardware, in a group of maximum 5 students. The detailed experimental work should be submitted as a part of write up and considered for term work assessment.

Savitribai Phule Pune University
Second Year of Electronics and Computer Engineering (2024 Course)

PCC-205-ECE: Data Structure & Algorithms Lab

Teaching/scheme	Credits	Examination Scheme
Practical: 02Hours/Week	01	**Term work**: 25 Marks **Practical:** 25 Marks

Companion Course, if any: Data Structure & Algorithms

Course Objectives:

- To introduce basic C++ programming concepts such as classes, objects, constructors, and operator overloading for developing object-oriented solutions.
- To develop problem-solving skills by implementing standard searching and sorting algorithms using C++.
- To provide hands-on experience with dynamic data structures like linked lists, stacks, queues, and trees to reinforce their theoretical understanding.
- To enable students to implement and traverse graphs using adjacency lists and apply depth-first and breadth-first search algorithms

Course Outcomes:

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

CO1: Implement object-oriented programming features in C++ to solve problems such as complex number arithmetic.

CO2: Implement searching and sorting algorithms and evaluate their performance for given data.

CO3: Apply appropriate data structures like linked lists, stacks, queues, and binary search trees to solve basic computational problems.

CO4: Develop graph-based solutions and perform BFS and DFS traversals using adjacency list representation.

Guidelines for Student's Lab Journal

The students Lab Journal should contain following related to every experiment –

1. Title of the experiment
2. Mapped Objective and mapped outcome
3. Software and Tools used.
4. Brief theory, algorithm/flowchart.
5. Sample input/output - test cases with example inputs and corresponding outputs.
6. Conclusions.

Guidelines for Laboratory/ TW Assessment

1. Continuous assessment of laboratory work is to be done based on overall performance.
2. Each lab assignment/experiment assessment will assign grade/marks based on parameters with appropriate weightage.
3. Suggested parameters for overall assessment as well as each laboratory assignment include:
   - ✓ Timely completion.
   - ✓ Performance.
   - ✓ Punctuality and neatness.

Suggested List of Laboratory Experiments

Group A (Any 8)

1. Program to demonstrate basic C++ concepts — classes, objects, constructors, and operator overloading for complex number arithmetic (Addition, Subtraction, Multiplication)
2. Implement a) Linear Search and b) Binary Search algorithms using C++
3. Implement a) Bubble Sort, b) Insertion or Selection Sort algorithms using C++
4. Implement Singly Linked List with insertion, deletion, and display operations.
5. Implement Doubly Linked List with insertion, deletion, and display operations.
6. Implement Stack using a) arrays and b) linked list.
7. Evaluate postfix expression (input will be postfix expression)
8. Implement Queue using a) arrays and b) linked list.
9. Implement Binary Search Tree with insertion, deletion, and traversal (inorder, preorder, postorder).
10. Implement Graph using adjacency list. Perform BFS and DFS traversals.

Group B (Course Project)

Develop an application that solves a real-world problem or simulates a practical system

using appropriate data structures, implemented in C++.

General Guidelines-

- **Team Size:**

  Individual or group of up to 3 students.

- **Selection of Topic:**

  Students must choose a problem where the use of one or more data structures is essential.

  Project must be **interactive** (menu-based or GUI-based).

  Some suggested domains- Railway reservation system, Hospital Queue System, College Result Processing, Phone Book.

- **Mandatory Technical Requirements:**

  Use of **at least one data structure** (e.g., Linked List, Stack, Queue, Tree, Graph).

  Implement **searching and/or sorting algorithms**.

  Include **basic object-oriented concepts** like classes, constructors, and operator overloading.

- **Documentation Must Include:**

  Project Title and Abstract

  Problem Statement

  Data Structures Used and Justification

  System Design / Flowchart / Class Diagram

  Sample Input /Output

  Code (with comments)

  Conclusion and Future Scope

Savitribai Phule Pune University
Second Year of Electronics and Computer Engineering (2024Course)

MDM-230-ECE: Statistical Data Analysis & Visualization

Teaching/scheme	Credits	Examination Scheme
Theory: 03 Hours/Week	03	**CCE:** 30 Marks **End Sem:** 70 Marks

Prerequisite Courses, if any: Fundamental Knowledge of Excel, probability and statistics, basics of programming language, algorithms and data structures are preferred.

Course Objectives:

To impart the fundamental knowledge of Statistical Data Analysis and Visualization, familiarize with the working of Data Analyst, the aim is also to familiarize students with different statistical computational tests, applications and visualization tools.

Course Outcomes:

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

CO1: Explain the foundational concepts and scope of statistical data analysis and visualization.

CO2: Illustrate the project life cycle and functions of phases in Data Analysis

CO3: Analyze large data sets and handle missing or inconsistent values in datasets.

CO4: Compute Statistical analysis using Python/R.

CO5: Discover and visualize datasets using Tableau/Power BI.

Course Contents

Unit I	Introduction to Statistical Data Analysis	(09 Hours)

Data Analytics Lifecycle overview, Key Roles for a Successful Analytics, Background and Overview of Data Analytics Lifecycle Project. Understanding the data, types of data (categorical and numerical), Population vs. Sample, Data collection methods.

Descriptive Statistics: Measures of central tendency: mean, median, mode, Measures of Dispersion: Range, Variance, Standard Deviation, Quartiles and Interquartile range (IQR).Using Pandas and NumPy for basic statistical summaries

#Exemplar	Python for statistical Analysis, Quiz
Mapping of Course Outcomes for Unit I	CO1

Unit II	Probability Theory and Distributions	(09 Hours)
Probability Basics: Random variables, Events and Probability rules (addition, multiplication). Conditional Probability: Baye's Theorem Probability Distributions: Binomial, Normal, Poisson and Exponential Distributions, skewed. Simulating probability distributions in Python		
#Exemplar	Python Libraries: NumPy, Pandas, Matplotlib, Seaborn, SciPy, stats models, Tic-Tac-Toe game logic using Probability Theory and Distributions	
Mapping of Course Outcomes for Unit II	CO2	
Unit III	**Inferential Statistics**	**(09 Hours)**
Sampling methods: Simple, random, stratified, cluster, Central Limit Theorem Hypothesis Testing: Null and Alternative Hypotheses, Type I and Type II Errors, P-Values, Confidence Intervals,Z-tests, T-tests, Chi-square,Analysis of Variance (ANOVA).		
#Exemplar	Numerical on inferential statistics, Performing hypothesis tests on real datasets	
Mapping of Course Outcomes for Unit III	CO3	
Unit IV	**Exploratory Data Analysis (EDA)**	**(09 Hours)**
Identifying patterns and outliers, handling missing data, Using descriptive statistics in EDA Heat maps, pair plots, correlation matrix, Scatter plots with regression lines Visualizing distributions with KDE plots, Correlation analysis: Pearson and Spearman,		
#Exemplar	Plot maps, Regression modeling using scikit-learn, Scatter plots and regression lines	
Mapping of Course Outcomes for Unit IV	CO4	
Unit V	**Recent Trends and Case Studies**	**(09 Hours)**
Time series analysis: trends, seasonality, autocorrelation, Clustering and segmentation (K-Means), Dimensionality reduction (PCA), Data storytelling and reporting, Ethics in data visualization and statistical reporting, End-to-end project: from raw dataset to insights and dashboard. Case studies (e.g., COVID-19 trends, marketing analytics).		
#Exemplar	Statistical Data Analysis and Visualization project	

Mapping of Course Outcomes for Unit V	CO5

Learning Resources

Textbooks:

1. Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data, EMC Education services Wiley Publication
2. Practical Statistics for Data Scientists 50+ Essential Concepts Using R and Python, O'Reilly Publications 2nd Edition
3. Practical Text Mining and statistical Analysis for non-structured text data applications,1st edition, Grey Miner, Thomas Hill.

Reference Books:

1. Data Analytics using R, Bharati Motwani, Wiley Publications
2. Dunn, P. F., & Davis, M. P. (2017). Measurement and data analysis for engineering and science. CRC press.
3. Python for Data Analysis: 3rd Edition, Wes McKinney, Publisher(s): O'Reilly Media, Inc.

MOOC/NPTEL Courses:

1. https://swayam.gov.in/nd1_noc20_cs46/

[#Exemplar: These are the practical applications based on the contents of the particular unit and for information only. *Comprehensive Continuous Evaluation]

Savitribai Phule Pune University
Second Year of Electronics and Computer Engineering (2024Course)

EEM-240-ECE: Engineering Economics & Applications

Teaching/scheme	Credits	Examination Scheme
Tutorial:01Hour/Week	01	**Term Work**:25 Marks
Practical:02Hours/Week	01	

Course Objectives:

- To understand key economic principles and the time value of money for engineering decisions.
- To learn demand forecasting, cost analysis, and decision-making under uncertainty
- To explore market structures, pricing strategies, and value engineering in electronics.
- To develop investment evaluation skills and grasp macroeconomic impacts on tech-businesses.

Course Outcomes:

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

CO1: Apply economic principles and time value of money concepts using practical tools.

CO2: Perform break-even and CVP analyses to support engineering decisions.

CO3: Analyze market competition and pricing strategies with case studies.

CO4: Evaluate projects with capital budgeting and interpret macroeconomic effects on electronics.

Course Contents

Unit I	Theories and Laws of Economics for Engineers	(04 Hours)

Introduction to Engineering Economics, Basic economic concepts: Utility, scarcity, opportunity cost, Economic systems and firm objectives, Laws of demand and supply, elasticity, Value, wealth,andequilibriumprice,Timevalueofmoney(PresentValue,FutureValue,annuity (basics)

Unit II	Principles of Engineering Economics and Costing	(04 Hours)

Demand forecasting techniques and applications in tech markets, Cost behavior: Fixed, variable, marginal, total, Cost-volume-profit and break-even analysis, Decision-making under un-certainty (intro to decision theory), Economies of scale in electronics manufacturing

Unit III	Applications of Economics in Electronics Industry	(04 Hours)

Market structures: Perfect competition, monopoly, monopolistic competition, Pricing strategies and product life cycle costing, Game theory basics and strategic behavior, Make-or-buy decisions and Value Engineering in electronics, Kaizen and productivity in technical operations

Unit IV	Investment Analysis and Applied Macroeconomics	(04 Hours)

Capital budgeting: Payback period, Net Present Value (NPV), Internal Rate of Return (IRR), Profitability Index, Equipment replacement decisions, Overview of macroeconomic indicators: Gross Domestic Product (GDP), Consumer Price Index (CPI), Business cycles, inflation, interest rates, and impact, CSR, sustainability, and policy impacts on tech firms, Exposure to areas like IPR, R&D, and innovation economics

Extra two practical's shall be based on the syllabus of all units apart from the following list:

Any Six practical's can be carried out, below list:

1. Case examples from electronics industries (e.g.,Telecom spectrum pricing, consumer electronics)
2. Excel-based Time Value of Money (TVM)computations
3. Forecast demand for a telecom device (Routing and Switching Networking communication devices /AI enabled Smart IOT devices and sensor)
4. Performbreak-evenand Cost-Volume-Profit(CVP)analysis using spreadsheet
5. Case study: Comparison of Pricing strategy between two service providers such as of Jio, Airtel, BSNL etc.
6. To carryout mini project based on market and pricing strategy analysis of a smart device or IoT product
7. Evaluate a small-scale engineering project(e.g.,set up of lab or unit based)
8. Group discussion: Impact of government policies and budget on electronics and telecom sector
9.

Learning Resources

Textbooks:

1. A Textbook of Engineering Economics: The Principles and Applications, D. R. Kiran, BS Publications, 2021.

2. Engineering Economics Test & Cases, DND wivedi, Dr H L Bhatia & Dr S N Maheshwari, Vikas Publishing House Pvt. Ltd.

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.

Savitribai Phule Pune University
Second Year of Electronics and Computer Engineering (2024Course)

VEC-250-ECE: Universal Human Values and Professional Ethics

Teaching/scheme	Credits	Examination Scheme
Theory: 02Hours/Week	02	**CCE:**15Marks **End-SemesterExam:**35Marks

Course Objectives:

- To help the students develop a holistic, humane world-vision, and appreciate the essential complementarities between values and skills to ensure mutual happiness and prosperity
- To elaborate on 'Self-exploration' as the process for Value Education
- To facilitate the understanding of harmony at various levels starting from self and going towards family and society.
- To elaborate on the salient aspects of harmony in nature and the entire existence
- To explain how the Right understanding forms the basis of Universal human values and definitiveness of Ethical human conduct.
- To provide the vision for a holistic way of living and facilitate transition from chaotic life to an orderly life.

Course Outcomes:

After successful completion of the course, students 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 oneself and the other self as the essential part of relationship and harmony in the family.

CO4: Interpret the interconnectedness, harmony and mutual fulfillment in-herent in the nature and the entire existence.

CO5: Draw ethical conclusions in the light of Right understanding facilitating the development of holistic technologies production systems and management models.

Course Contents

Unit I	Introduction to Value Education	(07 Hours)

(i) Understanding Value Education
(ii) Self-exploration as the Process for Value Education
(iii) Continuous Happiness and Prosperity-the Basic Human Aspirations and their Fulfillment
(iv) Right Understanding, Relationship and Physical Facility

(v) Happiness and Prosperity-Current Scenario
(vi) Method to Fulfil the Basic Human Aspirations

Unit II	Harmony in the Human Being	(07 Hours)

(i) Understanding Human being as the Co-existence of the Self and the Body
(ii) Distinguishing between the Needs of the Self and the Body
(iii) The Body as an Instrument of the Self
(iv) Understanding Harmony in the Self
(v) Harmony of the Self with the Body
(vi) Programme to Ensure self-regulation and Health

Unit III	Harmony in the Family and Society	(08 Hours)

(i) Harmony in the Family - the Basic Unit of Human Interaction "Trust' - the Foundational Value in Relationship
(ii) 'Respect'- as the Right Evaluation
(iii) Values in Human-to-Human Relationship
(iv) Understanding Harmony in the Society
(v) Vision for the Universal Human Order

Unit IV	Harmony in the Nature (Existence)	(08 Hours)

(i) Understanding Harmony in the Nature
(ii) Interconnectedness, self-regulation and Mutual Fulfilment among the Four Orders of Nature
(iii) Realizing Existence as Co-existence at All Levels
(iv) The Holistic Perception of Harmony in Existence
(v) Professional Ethics in the light of Right Understanding
(vi) Strategies for Transition towards Value-based Life and Profession

Learning Resources

Textbooks:

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, R R Gaur, R Asthana, G P 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. P.L.Dhar, R. R. Gaur, 1990, Science and Humanism, Common wealth Publishers.
2. A. Nagaraj, 1999, Jeevan Vidya: Ek Parichaya, Jeevan Vidya Prakashan, Amarkantak
3. B.P.Banerjee, 2005, Foundations of Ethics and Management, Excel Books.
4. A.N.Tripathy, 2003, Human Values, New Age International Publishers.
5. E.G.Seebauer & Robert L.Berry, 2000, Fundamentals of Ethics for Scientists & Engineers, Oxford University Press
6. B.L.Bajpai, 2004, Indian Ethos and Modern Management, New Royal Book Co., Lucknow. Reprinted 2008.
7. M. Govindrajran, S Natrajan & V.S. Senthil Kumar, Engineering Ethics and Human Values, Eastern Economy Edition, Prentice Hall of India Ltd.
8. M.K.Gandhi,"TheStoryofmyExperimentswithTruth",DiscoveryPublisher

MOOC/NPTEL Courses:

1. Swayam Course on"Understanding Human Being Nature and Existence Comprehensively " by Dr. Kumar Sambhav, Director, UP Institute of Design (UPID), Noida.https://onlinecourses.swayam2.ac
2. NPTEL Course on "Exploring Human Values: Visions of Happiness and Perfect Society" by Prof. A. K.Sharma, Department of Humanities and Social Sciences, IIT Kanpur. https://nptel.ac.in/courses/

E-Resources:-

1. https://fdp-si.aicte-india.org/download.php#1/
2. https://madhyasth-darshan.info/postulations/knowledge/knowledge-of-humane-conduct/
3. https://www.youtube.com/channel/UCQxWr5QB_eZUnwxSwxXEkQw

Savitribai Phule Pune University
Second Year of Electronics and Computer Engineering (2024Course)

CEP-260-ECE: Community Engagement Project

Teaching/scheme	Credits	Examination Scheme
Practical:04Hours/Week	02	**TermWork:**25Marks **Oral/Presentation:**25Marks

Prerequisite: Students should have prior knowledge of

1. Basic understanding of social and ethical responsibilities
2. Teamwork and communication skills acquired in prior course work or group activities
3. Familiarity with problem-solving methodologies and project planning
4. Conversation in local language

Companion Course:

- CEP is an experiential learning approach that combines education, learning, community development, and meaningful community service.
- Project involves students in community development and service activities and applies the experience to personal and academic development.
- The targeted contribution of college students to the village/local development will benefit the community.
- The college has an opportunity to help students become more socially conscious and responsible while simultaneously becoming a socially conscious organization.

Course Objectives:

- Establish a mutually beneficial relationship between the college and the community
- Opportunities to engage with their local community, fostering empathy, teamwork, and problem- solving skills while contributing positively to their surroundings.
- An understanding of the challenges faced by the local community and the role of engineering in addressing those challenges.
- The ability to apply technical knowledge and skills to design solutions or interventions that create a positive impact on the community.
- The skills to evaluate and critically analyze the outcomes of their engagement activities, deriving actionable insights for sustainable impact

Course Outcomes:

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

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

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

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

Course Contents
Implementation

- 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 authorities / NGOs etc. concerned, allotted by the district administration, during the duration of the project.
- The Community Engagement Project should be different from the regular programs of NSS/NCC/Gr 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.
- 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.
- Students groups can conduct an awareness program 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.
- Oral Examination shall consist of presentation and demonstration of the project work carried out by the project groups.

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Suggestive list of topics under Community Engagement Project

The below lists are not exhaustive and open for HoD's or mentors to add, delete or modify. It is expected that the focus should be on specific local issues in their nearby areas.

The students are expected to carry out these projects with involvement, commitment, responsibility and accountability. The mentors of a student/group of students shall

1. Use/miss-use of cell phones
2. Career orientation of youth
3. Water facilities and drinking water availability
4. Health and hygiene of the school going students, homemakers and old personals
5. Health intervention and awareness programs
6. Horticulture
7. Herbal and Nutrition
8. Traditional and Modern healthcare methods
9. Food habits
10. Air/Sound/Water pollution
11. Plantation and Soil protection
12. Renewable energy and Solar Systems
13. Yoga awareness and practice
14. Healthcare awareness programs and their impact
15. Organic farming, IoT implementations
16. Food adulteration
17. Incidence of Diabetes and other chronic diseases
18. Blood groups and blood levels
19. Chemicals in daily life
20. Music and dance
21. Women education and empowerment

Project Scope

- Conduct workshops or awareness drives on topics like digital literacy, environmental sustainability, 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

Textbooks:

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.
3. Design Thinking for Social Innovation. IDEO Press, 2015.
4. Dostilio, L.D., et al. The Community Engagement Professional's Guide book : A Companion to The Community Engagement Professional in Higher Education. Stylus Publishing, 2017

MOOC/NPTEL/YouTube Links:

1. NPTELcourse:EcologyandSociety,https://onlinecourses.nptel.ac.in/noc20_hs77/preview

Web Links:-

1. UNESCO : Education for Sustainable Development https://www.unesco.org
2. EPICS (Engineering Projects in Community Service) https://engineering.purdue.edu/EPICS
3. Ashoka : Innovators for the Public https://www.ashoka.org Design for Change - https://www.dfcworld.com

Savitribai Phule Pune University, Pune

Maharashtra, India

SE - Department of Electronics and Computer Engineering

2024 Pattern

Semester IV

With effect from Academic Year 2025–26

Savitribai Phule Pune University
Second Year of Electronics and Computer Engineering (2024 Course)

PCC-206-ECE: Communication Systems

Teaching/scheme	Credits	Examination Scheme
Theory: 03Hours/Week	02	**CCE**: 30 Marks **End-Semester:** 70 Marks

Prerequisite Courses, if any: Analog and Digital Electronics

Companion Course, if any: Laboratory Practical

Course Objectives:

The objective of this course is to provide students with

1. Introduction to the fundamental principles used in modern communication systems**.**
2. Provide students with a comprehensive understanding of the basic concepts of analog and digital communication systems**.**
3. Analyze various Modulation and Demodulation techniques like AM, FM, PAM, PWM, PPM, PCM, DM, ADM.
4. Familiarize students with the communication applications such as Satellite Communication and Television Broadcasting**.**

Course Outcomes:

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

CO1: Explain elements and basic parameters of communication system**.**

CO2: Apply mathematical equations to compute Amplitude Modulation parameters.

CO3: Analyze mathematical equations to compute Frequency Modulation parameters.

CO4: Evaluate Pulse Modulation Techniques for communication system.

CO5: Interpret Real World applications of communication system.

Course Contents

Unit I	Introduction to Communication Systems	(09 Hours)

Basics of Communication System, Elements of Communication System, Types of Communication- Analog, Digital, Wired and Wireless, Regenerative Repeater, Sources of Noise: Classification of Noise (External and Internal Noise), Noise Calculations, Noise Figure. Fundamentals of Electromagnetic Waves, Effects of Environment, Propagation of Waves (Ground wave, Sky wave, Space wave), Tropospheric Scatter Propagation.

#Exemplar	Wi-Fi, Bluetooth, Infrared Remote Control, Ethernet Cable.

Mapping of Course Outcomes for Unit I: CO1

Unit II	Amplitude Modulation and Demodulation Techniques	(09 Hours)

Need of Modulation, Types of Modulation, Mathematical Analysis of Amplitude Modulation (AM), Modulation Index, AM Spectrum, Types of AM: Double Sideband Full Carrier (DSB-FC), Double Sideband Suppressed Carrier (DSB-SC), Single Sideband (SSB), Vestigial Sideband (VSB), Envelope Detection, Super Heterodyne AM Receiver.

#Exemplar	Terrestrial Communication, Computer Modem.

Mapping of Course Outcomes for Unit II: CO2

Unit III	FM Modulation and Demodulation Techniques	(09 Hours)
Concept of Angle Modulation, Mathematical Analysis of Frequency Modulation and Phase Modulation (Modulation Index, Spectrum, Bandwidth, power), Relation between Phase Modulation and Frequency Modulation, Types of FM: Narrowband and Wideband, FM Generation by Armstrong Method, FM Detection by Phase Lock Loop (PLL).		
#Exemplar	Magnetic Tape Recording, Stereophonic FM Multiplex System	
Mapping of Course Outcomes for Unit III: CO3		
Unit IV	**Pulse Modulation Techniques**	**(09 Hours)**
Sampling Theorem, Nyquist Criteria, Types of Sampling: Ideal, Natural and Flat Top, Pulse Amplitude Modulation (PAM), Pulse Width Modulation (PWM), Pulse Position Modulation (PPM), Line Codes and it's types (RZ, NRZ, Unipolar, Bipolar, AMI, Manchester), Quantization of signals, Types of Quantization: Uniform and Non-uniform Quantization, Pulse Code Modulation (PCM), Delta Modulation (DM), Quantization Noise, Adaptive Delta Modulation (ADM)		
#Exemplar	Wireless Communication, Optical Recording	
Mapping of Course Outcomes for Unit IV: CO4		
Unit V	**Applications of Communication System**	**(09 Hours)**
IEEE Standards 802.11, **Case Study:** Television Broadcasting, FM Radio Broadcasting, Satellite Communication, Walkie –Talkie, Industrial Automation: Remote Control and Monitoring, Machine to Machine Communication, Weather Monitoring, Air Traffic Control System.		
#Exemplar	Dish TV, Smart Meters	
Mapping of Course Outcomes for Unit V: CO5		

Learning Resources

Textbooks:

1. George Kennedy, "Electronic Communication Systems" 5th Edition, McGraw-Hill.
2. B P Lathi, Zhi Ding, "Modern Analog and Digital Communication Systems", 4th Edition, Oxford University Press

Reference Books:

1. Taub, Schilling and Saha, "Principles of Communication Systems", 4th Edition, McGraw Hill.
2. A.B Carlson, P B Crully, J C Rutledge, "Communication Systems", 5th Edition, Tata McGraw Hill.
3. Wayne Tomasi, "Electronic Communications System", 5th Edition, Pearson Education

e-Books:

George Kennedy, "Electronic Communication Systems" 5th Edition, McGraw-Hill.
https://soaneemrana.com/onewebmedia/ELECTRONIC%20COMMUNICATION%20SYSTEM%20BY%20GEORGE%20KENNEDY.pdf

MOOC / NPTEL/YouTube Links:

https://nptel.ac.in/courses/108/104/108104091/
https://onlinecourses.nptel.ac.in/noc24_ee135/preview

[#Exemplar: These are the practical applications based on the contents of the particular unit and for information only. *Comprehensive Continuous Evaluation]

Savitribai Phule Pune University
Second Year of Electronics and Computer Engineering (2024 Course)

PCC-207-ECE: Signals and Systems

Teaching/scheme	Credits	Examination Scheme
Theory: 03Hours/Week	03	**CCE**: 30 Marks **End-Semester:** 70 Marks

Prerequisite Courses, if any: Fundamentals of calculus

Companion Course, if any: Laboratory Practical

Course Objectives:

To impart the fundamental knowledge of signals and systems to all the students of give comprehensive idea about operations to be performed on signals and systems, The aim is to make the concepts of transforming the signals from time domain to frequency, S and Z domain.

Course Outcomes:

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

CO1: Apply the mathematical equations of continuous and discrete time signals and perform fundamental operations on signals and classify systems

CO2: Find response of a system for any arbitrary input signal using the convolution process and aware of its modern applications. Test the system stability using the impulse response.

CO3: Analyze and resolve the signals in frequency domain using Fourier Transform

CO4: Apply Laplace transform for continuous time signals and perform system analysis.

CO5: Apply z-transform to discrete time signals and perform the system analysis

Course Contents

Unit I	Fundamentals of Signals S Systems	(09 Hours)

Signal: Definition, Continuous Time signal, Sampling Theorem, Discrete Signal, Signal Representation: Graphical, Functional, Tabular and Sequence. Basic Elementary signals and their relationships: Unit Impulse, Unit step, Unit ramp, Unit parabolic, rectangular pulse, Triangular, Signum, Sinusoidal, Real exponential, Complex exponential, Sinc and Gaussian function, Operations on signals such as addition, subtraction, shifting, scaling. System: Definition, Classification, static and dynamic systems, causal and non-causal systems, Linear and Non- linear systems, time variant and time invariant systems, stable and unstable systems, invertible and non- invertible systems. System interconnections.

#Exemplar	Examples of real-life signals such as: Speech, ECG, EEG, EMG etc. Examples of real-life systems such as: Communication, Control systems etc.

Mapping of Course Outcomes for Unit I: CO1

Unit II	Time Domain Representation of LTI System	(09 Hours)

System Input-output relation, definition of impulse response, Introduction to convolution, convolution sum, methods of finding convolution sum: tabular and graphical, convolution integral, computation of convolution integral using graphical method for unit step to unit step, unit step to exponential, exponential to exponential, unit step to rectangular and rectangular to rectangular only. Properties of convolution sum and convolution integral. System interconnection, system properties in terms of impulse response, step response in terms of impulse response. Concept of correlation, Auto-correlation, Cross Correlation, significance.

#Exemplar	Modern applications of the convolution; Speech recognition, Voice Assistants, Real-Time Translation, Medical Speech Processing

Mapping of Course Outcomes for Unit II: CO2

Unit III	**Fourier Transform and Application**	**(09 Hours)**

Introduction to Fourier Series: Fourier Series (FS) representation of periodic Continuous-Time (CT) signals using trigonometric and exponential forms, Dirichlet conditions for the existence of Fourier Series, Gibbs phenomenon.

Fourier Transform (FT): Fourier Transform representation of aperiodic CT signals; Dirichlet conditions for the existence of Fourier Transform; evaluation of magnitude and phase response; Fourier Transform of standard CT signals; properties and their significance; interplay between time and frequency domains using sinc and rectangular signals; Fourier Transform for periodic signals

#Exemplar	Applications of Fourier Transform for spectral analysis, communication, Biomedical signal analysis, Image processing.

Mapping of Course Outcomes for Unit III: CO3

Unit IV	**Laplace Transform**	**(09 Hours)**

Definition of Laplace transform, Limitations of Fourier transform and need of Laplace transform, ROC, Properties of ROC, Laplace transform of standard periodic and aperiodic functions, properties of Laplace transform and their significance, Laplace transform evaluation using properties, Inverse Laplace transform based on partial fraction expansion, stability considerations in S domain, Application of Laplace Transforms: RL, RC, RLC Circuit analysis, transfer function and impulse response.

#Exemplar	Laplace transform for Data Mining and Machine Learning, semiconductor mobility

Mapping of Course Outcomes for Unit IV: CO4

Unit V	**Z Transform**	**(09 Hours)**

Introduction to Z transform and its definition, ROC, Z transform applications to discrete-time signal and system analysis. Properties of the Z-transform, standard Z-transform pairs, inverse Z-transform by partial fraction method, the relationship between the Z-transform and the Fourier transform.

#Exemplar	Application of Z Transform in Digital Signal Processing, control systems and system identification.

Mapping of Course Outcomes for Unit V: CO5

Learning Resources

Textbooks:

1. Signals S Systems Simplifies by A Nagoor Kani, Mc Graw Hill Education 2nd Edition
2. Signals S Systems by Alan Openheim and Alan Willesky Prentice-Hall Publication, 2nd Edition
3. Signals and Systems by Ramesh Babu, SCITECH Publication, 2nd edition
4. John G. Proakis and Dimitris G. Manolakis, "Digital signal Processing: Principles, Algorithms, and Applications", 4E. Sept. 2007

Reference Books:

1. Charles Phillips, “Signals, Systems and Transforms”, Pearson Education, 3rd Edition
2. Simon Haykin, “Signals and Systems”, John Wiley 2nd edition.

e-Books: https://studentshubblog.wordpress.com/wp-content/uploads/2014/12/signals-and-systems-simon-haykin.pdf https://books.google.co.in/books/about/Signals_and_Systems_Edition_3_0.html?id=ZTUPEAAAQBAJSprintsec=frontcoverSsource=kp_read_buttonShl=enSredir_esc=y#v=onepageSqSf=false
MOOC / NPTEL/YouTube Links: https://onlinecourses.nptel.ac.in/noc21_ee28/preview

[#Exemplar: These are the practical applications based on the contents of the particular unit and for information only. *Comprehensive Continuous Evaluation]

Savitribai Phule Pune University
Second Year of Electronics and Computer Engineering (2024 Course)

PCC-208-ECE: Object Oriented Programming

Teaching/scheme	Credits	Examination Scheme
Theory: 03Hours/Week	03	**CCE**: 30 Marks **End-Semester:** 70 Marks

Course Prerequisites: Fundamental of Programming

Course Objectives:

1. Make the students familiar with basic concepts and techniques of object-oriented programming in Java.
2. Develop an ability to write programs in Java for problem solving.

Course Outcomes:

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

CO1: Explain the basic principles of the Java programming language

CO2: Develop Java programs by applying the concepts of classes and objects

CO3: Implement programs using Inheritance, interfaces, and packages in Java

CO4: Analyze multithreading and exception handling mechanisms to create robust Java programs.

CO5: Construct graphical applications using the Graphics class, AWT packages, and manage file I/O operations in Java.

Course Contents

Unit I	Java Fundamentals	(09 Hours)

Evolution of Java, Comparison of Java with other programming languages, Java features, Java Environment, Simple Java Program, Java Tokens, Java Statements, Constants, variables, data types. Declaration of variables, giving values to variables, Scope of variables, arrays, Symbolic constants, Typecasting, Getting values of variables, Standard default values, Operators, Expressions, Type conversion in expressions, Operator precedence and associativity.

#Exemplar	Simple Java Program to Print Hello Word

Mapping of Course Outcomes for Unit I: CO1

Unit II	Classes, Methods S Objects in Java	(09 Hours)

Class Fundamentals, Declaring Objects, Assigning Object reference variables, Methods, Constructors, The This keyword, Garbage collection, finalize method, overloading methods, using objects as parameters, Argument passing, returning objects, Recursion, access control, static, final, arrays, strings class, Command line arguments.

#Exemplar	Program for Matrix addition using array

Mapping of Course Outcomes for Unit II: CO2

Unit III	Inheritance, Packages and Interfaces	(09 Hours)

Inheritance: Basics, Using Super, Creating Multilevel hierarchy, Constructors in derived class, Method overriding, dynamic method dispatch, Using Abstract classes, Using final with inheritance,

Packages: Java API Packages, Using System Packages, creating accessing and using a package, importing packages, adding a class to a Package, Hiding classes

Interfaces: Define, implement and extend, Accessing Interface variables, Default interface methods, using static method in interface.

#Exemplar	Write a program using method overriding in the inheritance

Mapping of Course Outcomes for Unit III: CO3

Unit IV	Multithreading, Exception handling	(09 Hours)

Introduction to multithreading: Introduction, creating thread and extending thread class. Stopping and blocking a thread, Life Cycle of a Thread, using thread methods,

Concept of Exception handling: Introduction, Types of errors, Exception handling syntax, multiple catch statements, using final statement, throwing our own exceptions

I/O basics, reading console inputs, Writing Console output.

#Exemplar	Write a program for handing exception using try and multiple catch

Mapping of Course Outcomes for Unit IV: CO4

Unit V	Graphics Programming and File Handling	(09 Hours)

Graphics class, Lines, Rectangle, circles and ellipses, Introduction to AWT packages, handling events on AWT components, Introduction to Swing package, components and containers.

Managing input/output files: Concept of streams, Stream Classes, Byte stream, Character stream, Using Stream, creation of files, reading/writing a file.

#Exemplar	Bouncing ball, student management system

Mapping of Course Outcomes for Unit V: CO5

Learning Resources

Textbooks:

- E Balagurusamy, "Programming with JAVA", Tata McGraw Hill, 6th Edition
- Herbert Schildt, Java: The complete reference, Tata McGraw Hill, 7th Editon.

Reference Books:

1. Matt Weisfeld, "The Object-Oriented Thought Process", Pearson
2. Cox Brad, "Object –Oriented Programming: An Evolutionary Approach", Addison –Wesley
3. Y. Daniel Liang (2010), "Introduction to Java programming", Pearson Education, India, 7th Edition

MOOC / NPTEL/YouTube Links

https://nptel.ac.in/courses/106/105/106105191/

[#Exemplar: These are the practical applications based on the contents of the particular unit and for information only. *Comprehensive Continuous Evaluation]

Savitribai Phule Pune University
Second Year of Electronics and Computer Engineering (2024 Course)

PCC-209-ECE: Communication Systems Lab

Teaching/scheme	Credits	Examination Scheme
Practical: 02Hours/Week	01	**Term Work**: 25 Marks **Practical:** 25 Marks

Course Objectives:

1. To measure the practical parameters of modulation techniques such as AM and FM
2. To introduce the concept of sampling theorem and pulse modulation techniques
3. To provide students with comprehensive understanding of digital modulation techniques like PCM, DM and ADM.
4. To provide foundational knowledge to develop practical skills through experiential learning.

Course Outcomes:

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

CO1: Generate and demodulate analog modulated signals such as AM, DSB-SC, SSB, FM, and PM using hardware.

CO2: Apply sampling theorem to given signals and Interpret time-domain and frequency domain representations of sampling theorem.

CO3: Measure the performance characteristics of digital modulation techniques.

CO4: Analyze, compare and contrast different line coding techniques and their applications.

CO5: Make use of simulation tools to model and analyze digital communication systems.

CO6: Write a report on the project/industrial visit/case study/poster presentation.

Guidelines for Student's Lab Journal

The students Lab Journal should contain the following contains related to every experiment as applicable.

Title of the experiment

Objective

Apparatus with their detailed specifications. (Hardware / Software)

Brief theory related to the experiment.

Connection diagram /Circuit diagram / Block diagram / Flowchart.

Observation table

Sample calculations / Software Program

Results and Waveforms

Conclusions.

Guidelines for Laboratory/ TW Assessment

1. Continuous assessment of laboratory work is to be done based on overall performance and Laboratory performance of the student.
2. Each Laboratory assignment assessment should assign grade/marks based on parameters with

	appropriate weightage.
3.	Suggested parameters for overall assessment as well as each Laboratory assignment include timely completion, performance, efficiency, punctuality, and neatness.
Suggested List of Laboratory Experiments (Any 10)	
Group A: Hardware Practical's (Any 6)	
1.	AM Generation and Detection: Measurement of modulation index by using Graphical method, Trapezoidal Method and Total Power
2.	FM Generation and Detection: Measurement of modulation index and Bandwidth using Phase Lock Loop (IC 565)
3.	Verification of Sampling Theorem by using PAM Techniques (Flat top and Natural sampling) and reconstruction of original signal.
4.	Observe waveforms for Pulse Code Modulation
5.	Measure and Plot Delta Modulation waveforms.
6.	Measure and Plot Adaptive Delta Modulation waveforms
7.	Plot line codes (Unipolar RZ, Unipolar NRZ, Polar RZ, Polar RZ, Bipolar (AMI), Split phase Manchester) and its spectral analysis
Group B: Software Practical's (Any 3)	
8.	Write a program to generate White Noise and calculate Signal to Noise Ratio (SNR) and Noise Figure of the system
9.	Write a program to verify Sampling Theorem
10.	Write a program to calculate Signal to Noise ratio for PCM system and DM system.
11.	Any Case study with simulation using suitable platform. (Matlab, Scilab, Python etc.)
Group C: Experiential Learning (Any 1)	
10.	Industrial Visit to Radio Broadcasting Center / All India Radio Station/ TV Transmitter Station / Digital TV Studio / Industries related to Communication System.
11.	Project Based Learning / Poster Presentation

Savitribai Phule Pune University
Second Year of Electronics and Computer Engineering (2024 Course)

PCC-210-ECE: Signal and Systems and Object-Oriented Lab

Teaching/scheme	Credits	Examination Scheme
Practical: 02Hours/Week	01	**Term Work**: 25Marks **Oral:** 25Marks

Course Objectives:

1. To offer practical experience with the concepts of signal, basic operations on signals, signal analysis using transforms in software environment.
2. To learn Constants, Variables, and Data Types, Operators and Expressions, Decision making statements in Java.
3. Introduce the principles of Object-Oriented Programming (OOP) such as classes, objects, inheritance, encapsulation and abstraction.
4. Explore exception handling, multithreading, file I/O, and GUI development

Course Outcomes:

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

CO1: Generate and perform operations on the Signals

CO2: Determine the system response by using convolution.

CO3: Perform Fourier analysis on signals and understand spectral characteristics of the signal.

CO4: Create Java programs using classes, objects, and methods to model real-world scenarios

CO5: Apply inheritance, polymorphism, encapsulation, and abstraction in Java programs

CO6: Collaborate in teams to debug, test, and document Java projects using industry-standard tools.

Guidelines for Student's Lab Journal

The students Lab Journal should contain following related to every experiment –

- Title of the experiment
- Objective
- Computer detailed specifications.
- Brief theory related to the experiment.
- Program with its output print and Conclusions.

Guidelines for Laboratory/ TW Assessment

- Continuous assessment of laboratory work is to be done based on overall performance and Laboratory performance of student.
- Each Laboratory assignment assessment should assign grade/marks based on parameters with appropriate weightage.
- Suggested parameters for overall assessment as well as each Laboratory assignment include
- Timely completion, performance, efficiency, punctuality, and neatness.

Suggested List of Laboratory Experiments

Group A: Signals and Systems (any 6)	
1.	Write a program to generate and plot the following signals in time domain and also sketch its amplitude and phase spectrum. Verify the result for: • Impulse • Unit Step • Exponential • Unit ramp • Sinc • Rectangular signals.
2.	Write a program to perform Addition, Subtraction, Time shifting and Time scaling operation on given signal and plot the signals
3.	Write a program to for Sampling Theorem and aliasing effect: Consider trigonometric signals.
4.	Write a program to find the convolution integral of Unit step and exponential signals and write a program to sketch the out response of the system. Also verify any one property of convolution integral
5.	Write a program to find the auto-correlation and cross-correlation between two signals.
6.	Write a program record or use the recorded music samples of different instruments (at least four) and write a program to record the music signal and sketch it in time domain, its amplitude spectrum and phase spectrum. Also comment on the result
7.	Write a program to find Fourier Transform coefficients of any given signal. Using these coefficients, reconstruct the signal. Observe the effect of Gibb's phenomenon.
********(Any of MATLAB/Sci-lab/Octave/Python programming platform can be used) **********	
GROUP B: Object Oriented Programming (Any 6)	
1.	Write some simple programs in Java such as 1. To find factorial of number. 2. To display first 50 prime numbers. 3. To find sum and average of N numbers.
2.	Write a program in Java to implement a Calculator with simple arithmetic operations such as add, subtract, multiply, divide, factorial etc. using switch case and other simple java statements.
3.	Write a program in Java to create a player class. Inherit the classes Cricket player, Football player and Hockey player from player class.
4.	Write a Java program which imports user defined package and uses members of the classes contained in the package
5.	Write a Java program which implements interface.
6.	Write a java program which use try and catch for exception handling.
7.	A Mini project in Java: A group of 4 students can develop a small application in Java

Savitribai Phule Pune University
Second Year of Electronics and Computer Engineering (2024 Course)

MDM-231-ECE: AI and Machine Learning Fundamentals

Teaching/scheme	Credits	Examination Scheme
Theory: 03Hours/Week	02	**CCE**: 30 Marks **End-Semester:** 70 Marks

Prerequisite Courses, if any: Programming Fundamentals (Preferably Python), Mathematics for Machine Learning, Basic Understanding of Data Handling.

Companion Course, if any: NA

Course Objectives:

The objective of this course is to provide students with

1. To introduce fundamental concepts, types, history, and real-world applications of AI and ML.
2. To develop logical thinking and problem-solving skills using search algorithms such as Breadth-First Search (BFS), Depth-First Search (DFS), Minimax.
3. To understand common machine learning algorithms, such as linear regression, logistic regression, decision trees, K-nearest neighbours, and clustering techniques.
4. To apply supervised learning techniques for prediction and classification.
5. To explore clustering algorithms and feature reduction techniques used in unsupervised learning

Course Outcomes:

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

CO1: Explain the foundational concepts and scope of AI and ML.

CO2: Implement search algorithms like BFS, DFS, and Minimax to AI problems.

CO3: Make use of supervised learning models such as Linear Regression, KNN.

CO4: Demonstrate unsupervised learning techniques such as K-Means and PCA

CO5: Analyze model performance using metrics like accuracy, precision, recall and F1- score.

Course Contents

Unit I	Introduction to Artificial Intelligence	(09 Hours)

Definition, history, and evolution of AI, Applications of AI in various domains (healthcare, robotics, finance, etc.), Challenges in AI. Types of AI: Narrow AI, General AI, Super AI Intelligent agents and their structure, Agents and Environments, Concept of Rationality, Nature of Environments, Structure of Agents. Basics of AI programming: Symbolic vs. sub-symbolic AI.

Case studies: AI Chatbot for Healthcare Pre-Diagnosis. (A telemedicine platform aimed to reduce the load on doctors by pre-diagnosing common symptoms.)

#Exemplar	Quiz on types of AI and ML

Mapping of Course Outcomes for Unit I: CO1

Unit II	Problem Solving and Search in AI	(09 Hours)

Problem formulation, Search strategies: Uninformed (BFS, DFS), Informed (A*, Greedy),

Game playing: Minimax algorithm, Alpha-Beta pruning, Constraint Satisfaction Problems, Heuristics and their importance in AI. Search in Complex Environments, Local Search and Optimization Problems		
#Exemplar	Tic-Tac-Toe game logic using Minimax	
Mapping of Course Outcomes for Unit II: CO2		
Unit III	**Fundamentals of Machine Learning**	**(09 Hours)**
Introduction to Machine Learning (ML), Difference between AI, ML, and Deep Learning, Types of ML: Supervised, Unsupervised, Reinforcement Learning, Steps in building ML models- Data collection and preprocessing, splitting data: Training and testing sets, Model selection, training, and evaluation, Model deployment (basic overview). Performance metrics: Accuracy, Precision, Recall, F1-score, Introduction to Python-based ML libraries (scikit-learn, pandas, matplotlib). Case study: Build a small ML model using real dataset. (Predicting Iris Flower Species using Machine Learning).		
#Exemplar	Building a basic decision tree for classification	
Mapping of Course Outcomes for Unit III: CO3		
Unit IV	**Supervised Learning Techniques**	**(09 Hours)**
Regression: Linear Regression, Line of best fit and cost function (MSE), Multiple Linear Regression. Classification: Logistic Regression, Binary classification problem. K-Nearest Neighbors (KNN), Concept of distance metric (Euclidean distance), Choosing the right value of k. Decision Trees, Overfitting and underfitting, Cross-validation and hyperparameter tuning, Bias-variance tradeoff. Case study: Predict whether a person has diabetes based on diagnostic health data		
#Exemplar	Implementing KNN to reduce feature dimensions in a dataset	
Mapping of Course Outcomes for Unit IV: CO4		
Unit V	**Un-supervised Learning and Recent Trends**	**(09 Hours)**
Clustering: Importance of clustering, Introduction to clustering algorithms, Types of clustering: Hard vs Soft. K-Means, Choosing the number of clusters (k), Elbow Method and Inertia. Hierarchical Clustering, Agglomerative vs Divisive clustering, Dendrograms and linkage methods. Dimensionality Reduction: PCA, Applications of AI/ML in IoT, Edge Computing, and Robotics, Ethical considerations and challenges in AI/ML, Future trends: Generative AI, Explainable AI (XAI).		
#Exemplar	NLP project: Sentiment analysis on Twitter data	
Mapping of Course Outcomes for Unit V: CO5		
Learning Resources		

Textbooks:

1) Elaine Rich, Kevin Knight, Shivashankar B. Nair “Artificial Intelligence”: (2nd edition), Publisher: McGraw Hill Education.
2) Andreas C. Müller, Sarah Guido "Introduction to Machine Learning with Python", (1st edition), Publisher: O’Reilly Media.
3) Joel Grus, " Data Science from Scratch “, (2nd edition), Publisher: O’Reilly Media.

Reference Books:

1) Stuart Russell, Peter Norvig "Artificial Intelligence: A Modern Approach", (3rd edition), Publisher-Pearson Education
2) Tom M. Mitchell "Machine Learning", (Indian edition), Publisher: McGraw Hill.
3) Aurélien Géron "Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow" (2nd edition) Publisher: O'Reilly Media.

e-Books:

https://www.nrigroupindia.com/ebook/Introduction%20to%20Machine%20Learning%20with%20Python%20(%20PDFDrive.com%20)-min.pdf

MOOC / NPTEL/YouTube Links:

https://nptel.ac.in/courses/106102220

[#Exemplar: These are the practical applications based on the contents of the particular unit and for information only. *Comprehensive Continuous Evaluation]

Savitribai Phule Pune University
Second Year of Electronics and Computer Engineering (2024 Course)

VSE-270-ECE: Critical Thinking and Programming Lab

Teaching/scheme	Credits	Examination Scheme
Theory: 03Hours/Week	02	**Term Work**: 25 Marks **Practical:** 25 Marks

Prerequisite Courses, if any: DSA (Preferably Python, Java)

Course Objectives:

The objective of this course is to provide students with

1) To develop logical thinking and problem-solving skills through structured programming assignments using real-world scenarios.
2) To enable students to apply basic programming constructs such as loops, conditionals, arrays, functions, and recursion in Python and Java.
3) To cultivate critical thinking abilities by analyzing, designing, and implementing algorithms for mathematical and pattern-based problems.
4) To introduce students to foundational software development practices, including code modularity, reusability, debugging, and testing.
5) To familiarize students with data handling and file operations for building simple applications like calculators, attendance systems, and voting machines.
6) To encourage the development of mini-projects and simulations that promotes innovation, teamwork, and communication of technical ideas effectively.

Course Outcomes:

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

CO1: Apply fundamental programming concepts such as variables, conditionals, loops, and functions to solve computational problems using Python and Java.

CO2: Solve real-life problems by designing efficient algorithms and implementing logic through structured programs.

CO3: Demonstrate the ability to work with user-defined and library functions to perform tasks like recursion, string operations, and file handling.

CO4: Develop programs that integrate control structures and data structures to manage data and perform operations such as sorting, searching, and matrix manipulation.

CO5: Construct small applications that simulate real-world systems like calculators, voting systems, and attendance trackers using procedural and object-oriented programming principles.

CO6: Exhibit improved critical thinking and debugging skills by identifying logical errors, refining algorithms, and testing program correctness.

Guidelines for Student's Lab Journal

The students Lab Journal should contain following related to every experiment –

Title of the experiment.

Objective.

Software required.

Brief theory related to the experiment.

Algorithms/flowcharts.

Software code.

Result and discussion.

Conclusion

Guidelines for Laboratory/ TW Assessment	
1.	Continuous assessment of laboratory work is to be done based on overall performance and Laboratory performance of student.
2.	Each Laboratory assignment assessment should assign grade/marks based on parameters with appropriate weightage.
3.	Suggested parameters for overall assessment as well as each Laboratory assignment include timely completion, performance, efficiency, punctuality, and neatness.

List of Laboratory Experiments (Using Python) Group A (Any Five)	
1.	Write a program to print pyramid/star patterns using nested loops
2.	Create a program to calculate average, percentage, and grades from 5 subjects
3.	Build a calculator that performs arithmetic and stores operation history
4.	Check if a given number is both palindrome and prime.
5.	Build a basic quiz game with multiple choice questions and scoring
6.	Write a Python program that reads a text file and counts the frequency of each word in the file.
List of Laboratory Experiments (Using Java) Group-B (Any Five)	
1.	Generate right-angled and pyramid patterns using loops.
2.	Accept subject marks and display grade using if-else ladder
3.	Simulate an election voting system for 3 candidates.
4.	Implement recursive functions for factorial and Fibonacci series.
5.	Convert decimal numbers into binary, octal, and hexadecimal.
6.	Maintain and Display percentage attendance of students.
Learning Resources	
Textbooks:	

1) Cay S. Horstmann, Gary Cornell, “Core Java Volume I – Fundamentals”, 11th Edition – Pearson Education, 2018.
2) Jeri R. Hanly, Elliot B. Koffman, “Problem Solving and Program Design in C”, 8th Edition – Pearson Education, 2015.

Reference Books:

1) John Zelle, “Python Programming: An Introduction to Computer Science”, 3rd Edition – Franklin, Beedle & Associates Inc., 2016.
2) Herbert Schildt, “Java: The Complete Reference”, 11th Edition – McGraw-Hill Education, 2018.
3) George T. Heineman, Gary Pollice, Stanley Selkow, “Algorithms in a Nutshell”, 2nd Edition – O'Reilly Media, 2016.

NPTEL:

https://onlinecourses.nptel.ac.in/noc22_cs47/preview

https://onlinecourses.swayam2.ac.in/cec22_cs20/preview

[#Exemplar: These are the practical applications based on the contents of the particular unit and for information only. *Comprehensive Continuous Evaluation]

Savitribai Phule Pune University
Second Year of Electronics and Computer Engineering (2024 Course)

AEC-281-ECE: Modern Indian Languages (Marathi)

Teaching/scheme	Credits	Examination Scheme
Tutorial: 01Hours/Week **Practical:** 02 Hours/Week	02	**Term Work**: 25 Marks

Course Objectives:

अभ्यासक्रमाची उद्दिष्टे :

१. प्रगत भाषिक कौशल्यांची क्षमता विकसित करणे.
२. प्रसारमाध्यमांतील संज्ञापनातील स्वरूप आणि स्थान स्पष्ट करणे.
३. व्यक्तिमत्त्व विकास आणि भाषा यांच्यातील सहसंबंध स्पष्ट करणे.
४. लोकशाहीतील जीवनव्यवहार आणि प्रसारमाध्यमे यांचे परस्पर संबंध स्पष्ट करणे.
५. प्रसारमाध्यमांसाठी लेखनक्षमता विकसित करणे.

UNIT I & UNIT II

घटक	तपशील
१	१. भाषा आणि व्यक्तिमत्त्व विकास : सहसंबंध २. लोकशाहीतील जीवनव्यवहार आणि प्रसारमाध्यमे
२	प्रसारमाध्यमांसाठी लेखन १ वृत्तपत्रासाठी बातमीलेखन आणि मुद्रितशोधन २ नभोवाणीसाठी भाषणाची संहितालेखन ३ दूरचित्रवाणीसाठी माहितीपटासाठी संहितालेखन

UNIT III & UNIT IV

१	१. भाषा, जीवन व्यवहार आणि नवमाध्यमे, समाजमाध्यमे २. नवमाध्यमे आणि समाजमाध्यमांचे प्रकार : ब्लॉग, फेसबुक, ट्विटर. ३. नवमाध्यमे आणि समाजमाध्यमांविषयक साक्षरता, दक्षता, वापर आणि परिणाम
२	१. वेबसाईट आणि ब्लॉग, ट्विटरसाठी लेखन २. व्यावसायिक पत्रव्यवहार

Learning Resources

संदर्भ ग्रंथ :

१ सायबर संस्कृती, डॉ. रमेश वरखेडे

२ उपयोजित मराठी, संपादक डॉ. केतकी मोडक, संतोष शेणई, सुजाता शेणई

३ ओळख माहिती तंत्रज्ञानाची, टिमोथी जे. ओ लिअरी

४ संगणक, अच्युत गोडबोले, मौज प्रकाशन, मुंबई.

५ इंटरनेट, डॉ. प्रबोध चोबे, मनोरमा प्रकाशन, मुंबई.

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

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

Savitribai Phule Pune University
Second Year of Electronics and Computer Engineering (2024 Course)

AEC-281-ECE: Modern Indian Languages (Hindi)

Teaching/scheme	Credits	Examination Scheme
Tutorial: 01Hours/Week **Practical:** 02 Hours/Week	02	**Term Work**: 25 Marks

Course Objectives:

उद्देश्य :

१. छात्रों में हिंदी भाषा श्रवण कौशल विकसित करना।
२. छात्रों में हिंदी भाषा संवाद कौशल विकसित करना।
३. छात्रों में हिंदी भाषा वाचन कौशल विकसित करना।
४. छात्रों में हिंदी भाषा लेखन कौशल विकसित करना।
५. हिंदी भाषा—विधि तथा भाषा—व्यवहार से अवगत करना।

UNIT I & UNIT II

इकाई	पाठ्यविषय
इकाई— I	**वर्ण विचार :** १) हिंदी वर्णमाला — परिचय २) लिपि — परिचय ३) वर्णों का उच्चारण और वर्गीकरण ४) स्वराघात ५) संधि : स्वर संधि, व्यंजन संधि, विसर्ग संधि।

UNIT III & UNIT IV

इकाई— II	**भाषा कौशल शिक्षण : लघुकथाओं द्वारा भाषा कौशल शिक्षण (श्रवण, संवाद, वाचन, लेखन)** १) शिक्षा — ज्योति जैन २) पानी के पेड़ — ज्योति जैन ३) पशुभाषा — ज्योति जैन ४) अपशगुन — ज्योति जैन

Learning Resources

संदर्भ ग्रंथ :

१. हिंदी भाषा शिक्षण — संपा. हिंदी अध्ययन मंडल, सावित्रीबाई फुले पुणे विश्वविद्यालय, पुणे, राजकमल प्रकाशन, नई दिल्ली।

२. हिंदी व्याकरण — पं. कामताप्रसाद गुरु, प्रकाशन संस्थान, नई दिल्ली।

३. प्रयोजनमूलक हिंदी — डॉ. माधव सोनटक्के, लोकभारती प्रकाशन, नई दिल्ली।

Savitribai Phule Pune University Second Year of Electronics & Computer Engineering (2024 Course)		
EEM-241- ECE : Entrepreneurship Skill Development		
Teaching Scheme	**Credits**	**Examination Scheme**
Tutorial : 01 Hour/Week **Practical :** 02 Hours/Week	01 01	**Term Work** : 25 Marks

Course Objectives: The course aims to:

1. Introduce the fundamental principles of entrepreneurship, forms of business organizations, and the startup 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 startups
5. Develop students' entrepreneurial mindset and their ability to communicate and pitch business ideas effectively using structured storytelling techniques

Course Outcomes: Upon successful completion of this course, students will be able to:

- CO1: Describe the role of entrepreneurship in economic growth and the startup 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 startups.
- CO5: Deliver a concise business pitch using storytelling and effective communication techniques.

Course Contents

Complete the syllabus within 20 hrs. Discuss the issues and content in more details during practical hours batchwise.

Unit I - Introduction to Entrepreneurship

Entrepreneurship: Definition and evolution, Role of entrepreneurship in economic development 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 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.), Global vs. Indian startup ecosystems

Case Study:

1. Ritesh Agarwal – Founder of OYO Rooms (India)
2. Falguni Nayar – Founder of Nykaa (India)
3. Nandan Nilekani – Co-founder of Infosys & Architect of Aadhaar (India) etc.

Unit II -Idea Generation & Opportunity Recognition

Creativity Techniques for Idea Generation: Definition and importance of creativity in entrepreneurship. 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 interviews, and empathy mapping.
Evaluating Opportunities: Difference between an "idea" and an "opportunity." Basic filters: Desirability, feasibility, and viability. Tools: SWOT Analysis, Opportunity Matrix, Industry trends, market gaps.
Feasibility Analysis Basics: Market Need Assessment: about the users, the problem complexity. Scalability Check: Geographically or vertically growth of the idea, Barriers to scaling. Introduction to the "Lean Canvas".

Case Study : Analyzing how "Dunzo" or "BigBasket" identified urban pain points and How "Zerodha" scaled in India with a digital-first approach

Unit 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 offers. 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 development. Designing effective surveys and customer feedback forms. Conducting basic interviews and analyzing responses. Introduction to MVP (Minimum Viable Product) and feedback loops.

Case study: Map the BMC for a well-known startup (e.g., Uber or Zomato).

Unit IV - Marketing Strategies & Customer Acquisition

Basics of Branding and Positioning: Introduction to Brand – Elements of brand identity: name, logo, voice, tone, and values. Positioning – How to create a unique space in the customer's mind. Positioning maps, Value-based positioning vs. competitor-based positioning Startup Branding Challenges – Limited budget, building trust, clarity in messaging.

Costing & Pricing Strategies – Fixed vs. variable costs, break-even analysis.

Introduction to Digital Marketing: Distribution Channels: Traditional vs. digital distribution. Social Media Marketing: Platforms overview (Instagram, LinkedIn, Facebook, X/Twitter) Creating a content strategy and calendar Organic vs. paid reach

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, decision, action. Early-Stage Customer Acquisition Tactics: Word-of-mouth & referrals, Influencer marketing (micro-influencers), Email marketing basics, building a landing page and collecting leads Retention vs. Acquisition – Importance of building long-term customer relationships.

Case Studies :

1. Zomato – Branding & Positioning in a Competitive Market
2. Mamaearth – Digital-First Customer Acquisition
3. Nykaa – Customer Segmentation and Channel Strategy

Unit V - Pitching & Business Communication

Crafting an Elevator Pitch: Definition and purpose, Key elements: Problem, solution, value proposition, target audience, Delivery tips: Clarity, brevity, confidence

Storytelling & Communication: Importance of Storytelling in Business, Structure of a Business Story: Setup, Conflict, Resolution. Communication Skills: Verbal and Non-verbal

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, crowdfunding.

Case study:

1. Shark Tank India – Pitch Analysis (Any Season)
2. Airbnb – The Original Pitch Deck
3. Dropbox – Storytelling Through Demonstration
4. Dunzo – Investor Pitch Evolution

Learning Resources

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 Visionaries, 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.

MOOC / NPTEL/YouTube Links: -

1. Entrepreneurship Essentials By Prof. Manoj Kumar Mondal IIT Kharagpur
   https://onlinecourses.nptel.ac.in/noc20_ge08/preview
2. Entrepreneurship By Prof. C Bhaktavatsala Rao
   IIT Madras 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/

YouTube/Video Links

1. https://www.youtube.com/@wadhwani-foundation/videos

List of Assignments to be carried out during practical session

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	Idea Generation Challenge	To foster creativity, structured brainstorming, and the ability to identify potential business opportunities based on real-world problems.	**Generate 10 Business Ideas** Use any structured brainstorming technique 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) o 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 a startup. Students will define a basic marketing campaign and align it with estimated costs, pricing, and projected revenue.	You are preparing to launch your business idea. Prepare a combined Marketing and Financial 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 3. Break-even Analysis – Basic cost vs. sales estimate 4. 6-Month Revenue Projection – Expected sales and income 5. 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: o The Problem – Problem Identification o The Solution – Description of your product/service. o Value Proposition – The unique value proposition. o 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. **Reflection (Short Write-up):** o Share what you learned about communicating your idea o Describe challenges or rewards you experienced in the process

Savitribai Phule Pune University
Second Year of Electronics and Computer Engineering (2024 Course)

VEC-251-ECE: Environment Awareness

Teaching/scheme	Credits	Examination Scheme
Theory: 02Hours/Week	02	**CCE**: 15 Marks **End-Semester:** 35 Marks

Course Objectives:

The objective of this course is to provide students with

1. To introduce the multidisciplinary nature and scope of environmental studies.
2. To understand ecosystem structures, biodiversity, and ecological balance through hands-on ob- servation and documentation.
3. To examine the use and impact of natural resources on environmental sustainability.
4. To explore biodiversity conservation practices and develop eco-sensitive thinking through field-based inquiry.

Course Outcomes:

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

CO1: Illustrate the interdependence of ecosystems through activity-based exploration

CO2: Analyze the role of natural resources in sustainable development using real-world data**.**

CO3: Investigate biodiversity threats and conservation strategies through surveys and projects

CO4: Create awareness tools or reports promoting sustainability based on their findings.

Course Contents

Environment and Ecosystem

1. Environment Meaning of Environment, Types of Environments, Components of Environment,
2. Man- Environment relationship, importance of environment,
3. Need for Public Awareness
4. Ecosystem-Meaning, Major Components of Ecosystem
5. Case studies of Forest Ecosystem, Grassland Ecosystem, Desert Ecosystem, Aquatic Ecosystem
6. Stability of Ecosystem in Sustainable Environment

Environment Pollution

1. Definition of Pollution, Types of Pollution
2. Air Pollution-Meaning, Sources, effects of air pollution, Air Pollution Act
3. Water Pollution Meaning, Sources, Effects of Water pollution, Water Pollution Act
4. Noise Pollution Meaning, Sources, Effect of Noise Pollution
5. Solid Waste Pollution Meaning, sources, Effect of Waste Pollution
6. Environment Protection Act Air (Prevention and control of Pollution) Act,
7. Water Act (Prevention and control of Pollution) Act,
8. Solid waste Pollution Act in India

9. E-waste management

Practical Assignments	
Week	Topic to be covered
1	Introduction: Group discussion and poster making on "Why Environmental Studies Matter for Technologists"
2	Eco Mapping: Identify and document elements of an ecosystem within the college campus
3	Model the Food Web: Create food chains and food webs using flowcharts (digital tools like Canva / Lucid chart)
4	Case Study Review: Present real-world examples of forest, grassland, and aquatic ecosystems
5	Soil and Water Testing Activity: Test soil pH, water quality (use school-level kits), and interpret results
6	Field Visit / Virtual Tour: Document deforestation or mining impact in a chosen region; students prepare a comparative report
7	Water Audit Exercise: Estimate water usage at home/hostel and identify areas of overuse; propose conservation measures
8	Renewable Energy Models: Create a simple model or PPT on any renewable energy source (e.g., solar cooker, wind energy demo)
9	Biodiversity Documentation: Survey nearby areas for plant/animal species; identify any endemic/endangered species
10	Conservation Proposal Pitch: In groups, students prepare a mini proposal for biodiversity conservation at local level
11	Group Project Work: Work on mini project report/documentation on any ecosystem/natural resource/e-waste management topics
12	Presentation & Viva: Final presentation and oral examination based on project work and learning portfolio

Learning Resources

Textbooks:

1. Odum, Eugene P. "Fundamentals of Ecology"
2. R. Rajagopalan, "Environmental Studies – From Crisis to Cure", Oxford

Reference Books:

1. Erach Bharucha, "Textbook of Environmental Studies", UGC
2. Anubha Kaushik and C.P. Kaushik, "Environmental Studies", New Age International

e-Books:

1. https://www.environment.gov.in
2. https://www.unep.org

Savitribai Phule Pune University, Pune

Maharashtra, India

Task Force for Curriculum Design and Development

Programme Co-ordinator

Dr. Prachi Mukherji, Dr. S. K. Moon
Member, Board of Studies-Electronics & Telecomm Engineering

Core Committee Members

Dr. Prachi Mukherji	MKSSS Cummins College of Engg for Women, Pune
Dr. S. K. Moon	Pune Institute of Computer Technology, Pune
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Dr. B. S. Agarkar	Sanjivani College of Engineering, Kopargaon

Team Members for Course Design

Analog and Digital Electronic Circuits	
Dr.B.D. Jadhav (M-BoS)	Rajarshi Shahu College of Engineering, Pune
Dr .S.K.Moon (M-BoS)	Pune Institute of Computer Technology, Pune
Dr. Yogesh Thakre	PVGs College of Engineering, Pune
Dr. P. P. Chitte	Pravara Rural Engineering College, Loni
Dr. S. V. Mahajan	Sir Visvesvaraya Institute of Technology, Nashik

Data Structure and Algorithms	
Dr. S. K. Moon(M-BoS)	Pune Institute of Computer Technology, Pune
Dr. G. R. Patil	AIT., Pune
Dr. S. B. Rahane	Amrutvahini College of Engineering, Samgamner
Mr. S. D. Anap	Pravara Rural Engineering College, Loni
Prof. Dhekale Santosh B.	AISSMS, CoE, Pune
Dr. Varsha Deogaonkar	I2IT, Pune

Discrete Mathematics	
Dr. N.S. Mujumdar	JSPM's Rajarshi Shahu College of Engineering, Pune
Dr. Pravin Thakare	Zeal College of Engg & Research, Narhe, Pune
Dr. Radhika Menon	BoS Engg Science Co-ordinator, SPPU
Dr. Dipak Mahurkar	Sanjivani College of Engineering, Kopargaon
Ms. T. B. Katte	Pravara Rural Engineering College, Loni
Ms. N. S. Sapike	Pravara Rural Engineering College, Loni

Statistical Data Analysis and Visualization	
Dr. Prachi Mukherji(M-BoS)	MKSSS Cummins College of Engineering for Women, Pune
Ms. Sneha Nahatkar	Pune Institute of Computer Technology, Pune

Engineering Economics & Applications	
Dr. B. S. Agarkar(M-BoS)	Sanjivani College of Engineering, Kopargaon
Dr. Pratap Shinde	BSCOER, Narhe, Pune
Dr. S. P. Ghodake	Sanjivani College of Engineering, Kopargaon
Dr. Makrand Jadhav	RMD Sinhgad SoE, Pune
Dr. J. P. Shinde	RMD Sinhgad SoE, Pune

Community Engagement Project	
Dr. Shailesh Kulkarni (M-BoS)	VIIT, Pune
Mr. R. R. Bhambare	Pravara Rural Engineering College, Loni
Dr. A.N. Paithane	Rajarshi Shahu College of Engineering, Pune
Dr. P.M. Ghate	Rajarshi Shahu College of Engineering, Pune

Communication Systems	
Dr. Prachi Mukherji(M-BoS)	MKSSS Cummins College of Engineering for Women, Pune
Dr. S. K. Jagtap	NBN Sinhgad Technical Institutes Campus, Pune
Kavita Waghmode	Dattakala Group of Institutions Faculty of Engineering, Bhigwan
Swapnil Bangal	Pravara Rural Engineering College, Loni
Dr. P. N. Kota	MECOE, Pune

Signals and Systems	
Dr .R. S. Pawase (M-BoS)	Amrutvahini College of Engineering, Sangamner
Dr.D. G. Bhalke	Dr. D. Y. Patil Institute of Technology, Pune
Dr. R. G. Mapari	PCCOER, Pune
Dr. (Mrs.) S. S. Gundal	Amrutvahini College of Engineering, Sangamner
Dr. Manjare C. A.	JSCOE, Pune

Object Oriented Programming	
Dr. S. K. Moon(M-BoS)	Pune Institute of Computer Technology, Pune
Dr. V. S. Ubale	Amrutvahini College of Engineering, Sangamner

Dr. S. B. Rahane	Amrutvahini College of Engineering, Sangamner
Shashikala Koti	Sinhgad College of Engineering, Pune
AI and Machine Learning Fundamentals	
Dr. S. K. Moon(M-BoS)	Pune Institute of Computer Technology, Pune
Dr. B. H. Pan sambal	Zeal College of Engineering & Research, Pune
Dr. S. A Shaikh	Pravara Rural Engineering College, Loni
Dr. Minakshi Patil	Sinhgad Academy of Engineering, Pune

Vocational and Skill Enhancement Course-III	
Dr. Prachi Mukherji (M-BoS)	MKSSS Cummins College of Engineering for Women, Pune
Dr. B. H. Pansambal	Zeal College of Engineering & Research, Pune
Dr. Sumit Patil	Zeal College of Engineering & Research, Pune

Entrepreneurship skill Development	
Dr. Sandeep Musale (M-BoS)	MKSSS Cummins College of Engineering for Women, Pune
Dr Pratap Shinde	BSCOER, Narhe, Pune
Mr. R. R. Bhambre	Pravara Rural Engineering College, Loni
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