Savitribai Phule Pune University, Pune

Maharashtra, India

Faculty of Science and Technology

National Education Policy (NEP)-2020 Compliant Curriculum

SE - Second Year Engineering (2024 Pattern)

Electronics & Communication Engineering - Advanced Communication Technology

(With effect from Academic Year 2025-26)

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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 Communication Engineering (Advanced Communication Technology) syllabus effective from the Academic Year 2025-26. The present curriculum will be implemented for Second Year of Engineering from the academic year 2025-26. Subsequently this will be carried forward for TE and BE in AY 2026-27, 2027-28, respectively.

Electronics and Communication Engineering is a dynamic discipline that lies at the intersection of electronics engineering and communication technology. It provides the foundation for the design, development, and application of electronic systems and communication devices. This curriculum is designed to provide students with a comprehensive understanding of the fundamental principles, theories, and practices of Electronics and Communication engineering (Advanced Communication Technology), while also preparing them for the ever-evolving technological landscape.

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. Wherever possible, additional resource links of platforms such as NPTEL, Swayam are appropriately provided at the end of each course. 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. This will definitely help learners to facilitate their enhanced learning based on their interest.

This curriculum is the result of extensive consultation with academic experts, industry professionals, and alumni to ensure relevance and excellence. It is designed not only to meet the current industry standards but also to prepare students for higher studies and research in the field of Electronics and Telecommunication engineering.

We hope that this curriculum will inspire students to become competent professionals, responsible citizens, and contributors to the technological advancement of society.

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Chairman
Board of Studies, Electronics & Telecommunication Engg

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Department of Electronics and Communication Engineering

(Advanced Communication Technology)

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 modelling 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.

Department of Electronics and Communication Engineering

(Advanced Communication Technology)

Programme Outcomes (PO)

Program 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, graduating students/graduates will be able to:

PO1	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	Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)
PO3	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, modelling, 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 modelling recognizing their limitations to solve complex engineering problems. (WK2 and WK6)
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, and WK7).
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 ones 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) Page 56.		

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 behavior 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 30 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 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	12 Marks	Units 1 & Unit 2 (6 Marks/Unit)
2	Assignments / Case Study	12 Marks	Units 3 & Unit 4 (6 Marks/Unit)
3	Seminar Presentation / Open Book Test/ Quiz	06 Marks	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)
3	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 cogni- tive levels (Remember, Understand, Apply, Analyze, Evaluate, Create).
  - **Implementation**: Schedule the test after completing Units 1 and 2. Ensure the question paper is balanced and covers key concepts and applications.
- **Sample Question Distribution**
  - Remembering (2 Marks): Define key terms related to [Topic from Units 1 and 2].
  - Understanding (2 Marks): Explain the principle of [Concept] in [Context].
  - Applying (2 Marks): Demonstrate how [Concept] can be used in [Scenario].
  - Analyzing (3 Marks): Compare & contrast [Two related concepts] from Units 1 and 2.
  - Evaluating (3 Marks): 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 Unit 4.
  - **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:**
  - Weeks 1-4: Cover Units 1 and 2
  - Week 5: Conduct Unit Test (12 marks)
  - Weeks 6-8: Cover Units 3 and 4
  - Week 9: Distribute and collect Assignments / Case Study (12 marks)
  - Weeks 10-12: Cover Unit 5
  - Week 13: Conduct Seminar Presentations or Open Book Test or Quiz (6 marks)

- **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-I, 09 Marks for Unit-II, Unit III and Unit IV). 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 understand- 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 Communication Engineering

(Advanced Communication Technology)

Semester III

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	Total	Theory	Tutorial	Practical	Total
Semester I															
PCC-201-ECA	Program Core Course	Electronics Circuits	3	-	-	30	70	-	-	-	**100**	3	-	-	3
PCC-202- ECA	Program Core Course	Engg Mathematics-III	3	-	-	30	70	-	-	-	**100**	3	-	-	3
PCC-203- ECA	Program Core Course	Analog Communication	3	-	-	30	70	-	-	-	**100**	3	-	-	3
PCC-204- ECA	Program Core Course-Lab	Electronics Circuits & Analog Communication Lab	-	-	2	-	-	25	50	-	**75**	-	-	1	1
	Open Elective	Open Elective - I**	2	-	-	15	35	-	-	-	**50**	2	-	-	2
MDM-230- ECA	Multi-disciplinary Minor	Data Structures & Algorithms	3	-	-	30	70	-	-	-	**100**	3	-	-	3
MDM-231- ECA	Multi-disciplinary Minor	Data Structures & Algorithms Lab	-	-	2	-	-	25	25	-	**50**	-	-	1	1
EEM-240- ECA	Entrepreneurship / Economics / Management	Engineering Economics & Applications	-	1	2	-	-	25	-	-	**25**	-	1	1	2
VEC-250- ECA	Value Education	Universal Human Values & Professional Ethics	2	-	-	15	35	-	-	-	**50**	2	-	-	2
CEP-260- ECA	Community Engagement Project	Community Engagement Project	-	-	4#	-	-	25	-	25	**50**	-	-	2	2
Total			**16**	**01**	**10**	**150**	**350**	**100**	**75**	**25**	**700**	**16**	**01**	**05**	**22**

* 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.

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 (2024 Pattern)

Electronics and Communication Engineering

(Advanced Communication Technology)

Semester IV

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	Total	Theory	Tutorial	Practical	Total
Semester II															
PCC-205- ECA	Program Core Course	Digital Communication	3	-	-	30	70	-	-	-	**100**	2	-	-	2
PCC-206- ECA	Program Core Course	Signals and Systems	3	-	-	30	70	-	-	-	**100**	3	-	-	3
PCC-207- ECA	Program Core Course	Digital Circuits	3	-	-	30	70	-	-	-	**100**	3	-	-	3
PCC-208- ECA	Program Core Course-Lab	Digital Communication and Digital Circuits Lab	-	-	2	-	-	25	25	-	**50**	-	-	1	1
	Open Elective	Open Elective - II**	2	-	-	15	35	-	-	-	**50**	2	-	-	2
MDM-232- ECA	Multi-disciplinary Minor	Object-Oriented Programming	3	-	-	30	70	-	-	-	**100**	2	-	-	2
PCC-209- ECA	Program Core Course-Lab	Signals & Systems and Object-Oriented Programming Lab	-	-	2	-	-	25	25	-	**50**	-	-	1	1
VSE-270- ECA	Vocational and Skill Enhancement Course	Electronics Skill Development Lab	-	1	2	-	-	25	25	-	**50**	-	1	1	2
AEC-281- ECA	Ability Enhancement Course	Modern Indian Languages (Marathi/Hindi)	-	1	2	-	-	25	-	-	**25**	-	1	1	2
EEM-241- ECA	Entrepreneur-ship / Economics / Management	Entrepreneurship Skill Development	-	1	2	-	-	25	-	-	**25**	-	1	1	2
VEC-251- ECA	Value Education Course	Environment Awareness	2	-	-	15	35	-	-	-	**50**	2	-	-	2
Total			**16**	**03**	**10**	**150**	**350**	**125**	**75**	**-**	**700**	**14**	**03**	**05**	**22**

* 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 - Electronics and Communication Engineering

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2024 Pattern

Semester III

With effect from Academic Year 2025–26

Savitribai Phule Pune University

Second Year of Electronics and Communication Engineering- (Advanced Communication Technology) (2024 Course)

PCC-201-ECA: Electronics Circuits

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

Prerequisite Courses, if any: Basic Electronics Engineering

Companion Course, if any: PCC-204-ECA - Electronic Circuits Laboratory

Course Objectives:

To make students understand

1. Semiconductor device MOSFET, its characteristics, parameters & applications.
2. Concepts of feedbacks in amplifiers & oscillators.
3. Operational amplifier, concept, parameters & applications.
4. ADC, DAC as an interface between analog & digital domains.
5. Concepts, characteristics & applications of PLL.
6. Voltage to current and current to voltage converters.

Course Outcomes:

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

CO1: Assimilate the physics, characteristics and parameters of MOSFET towards its application as amplifier.

CO2: Design MOSFET amplifiers, with and without feedback, & MOSFET oscillators, for given specifications.

CO3: Design, Build and test Op-amp based analog signal processing and conditioning circuits towards various real time applications.

CO4: Understand and compare the principles of various data conversion techniques and PLL with their applications.

CO5: Analyze and assess the performance of linear and switching regulators, with their variants, towards applications in regulated power supplies.

Course Contents

Unit I	MOSFET & its Analysis	(08 Hours)

Enhancement MOSFET: MOSFET DC Load line, AC equivalent circuit, Parameters.

Non ideal characteristics: Finite output resistance, Body effect, Sub-threshold conduction, breakdown effects, temperature effect, effect of W/L ratio, Common source amplifier & analysis, Source follower: circuit diagram, comparison with common source, Frequency response for CS amplifier. Comparison between BJT & MOSFET.

Mapping of Course Outcomes for Unit I

CO1: Assimilate the physics, characteristics and parameters of MOSFET towards its application as amplifier.

Unit II	MOSFET Circuits	(08 Hours)

MOSFET as switch, CMOS inverter, resistor & diode. Current sink & source, Current mirror. Types of feedback, Four types of feedback topologies, Effects of feedback, Voltage series & current series feedback amplifiers and analysis. Barkhausen criterion, Types of Oscillator, RC phase shift oscillator, Crystal Oscillator.

Mapping of Course Outcomes for Unit II

CO2: Design MOSFET amplifiers, with and without feedback, & MOSFET oscillators, for given specifications.

Unit III	Operational amplifier and linear Applications	(09 Hours)

Block diagram, Op amp parameters, Current mirror, Op-amp characteristics (AC & DC). Inverting amplifier (Voltage series), non-inverting amplifier(voltage shunt), Effect on Ri, Ro, gain & bandwidth., Voltage follower, Summing amplifier, Differential amplifier, Practical integrator, first Order Low pass, Practical differentiator, High Pass Filter, Precision half-wave Rectifier

Mapping of Course Outcomes for Unit III

CO3: Design, Build and test Op-amp based analog signal processing and conditioning circuits towards various real time applications.

Unit IV	Op-amp and Non Linear Applications	(09 Hours)

Comparator, Schmitt trigger, Square & triangular wave generator, PWM Generator.

DAC & ADC: Resistor weighted and R-2R DAC, SAR, Flash and dual slope ADC Types / Techniques, Characteristics, block diagrams, Circuits, Specifications, Merits, Demerits, Comparisons.

Mapping of Course Outcomes for Unit IV

CO4: Understand and compare the principles of various data conversion techniques and PLL with their applications.

Unit V	Voltage Regulators	(09 Hours)

Three terminal voltage regulators: Block diagram of power supply, transistor series voltage regulator Types: Fixed and Variable, Block diagram of linear voltage regulator, IC 317 and IC337, Features and specifications, typical circuits, current boosting, Low Dropout Regulator (LDO).

SMPS: Block diagram, Types, features and specifications, typical circuits buck and boost converter

Mapping of Course Outcomes for Unit V

CO5: Analyze and assess the performance of linear and switching regulators, with their variants, towards applications in regulated power supplies.

Mapping of Course Outcomes for Unit V: CO5

Learning Resources

Textbooks:

1. Donald Neaman, Electronic Circuits - Analysis and Design, Mc Graw Hill, 3rd Edition.
2. Ramakant Gaikwad, Op Amps & Linear Integrated Circuits, Pearson Education.

Reference Books:

1. Millman Halkias, Integrated Electronics.
2. Phillip E. Allen and Douglas R. Holberg, CMOS Analog Circuit Design, Oxford, 2nd Edition.
3. Salivahan and Kanchana Bhaskaran, Linear Integrated Circuits, Tata McGraw Hill.

MOOC / NPTEL Courses:

1. NPTEL Course Analog Electronic Circuits https://nptel.ac.in/courses/108/105/108105158/
2. NPTEL Course on Analog Circuits: https://nptel.ac.in/courses/108101094

Savitribai Phule Pune University

Second Year of Electronics and Communication Engineering- (Advanced Communication Technology) (2024 Course)

PCC-202-ECA: Engineering Mathematics III

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

Prerequisite Courses: Differential and Integral calculus, Taylor series, Differential equations of first order and first degree, Fourier series, Vector algebra and Algebra of complex numbers.

Course Objectives:

To familiarize the students with concepts and techniques in Ordinary differential equations, Fourier Transform, Z-Transform, Numerical methods, Vector calculus and Statistics & Probability. The aim is to equip them with the techniques to understand advanced level mathematics and its applications that would enhance analytical thinking power, useful in their disciplines.

Course Outcomes:

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

CO1: Solve higher order linear differential equation using appropriate techniques for modelling, analyzing of electrical circuits and control systems.

CO2: Apply concept of Fourier transform & Z-transform and its applications to continuous & discrete systems, signal & image processing and communication systems.

CO3: Obtain Interpolating polynomials, numerically differentiate and integrate functions, numerical solutions of differential equations using single step and multi-step iterative methods used in modern scientific computing.

CO4: Perform Vector differentiation & integration, analyze the vector fields and apply to electro-magnetic fields & wave theory.

CO5: Apply Statistical methods like correlation, regression and Probability theory as applicable to analyze and interpret experimental data related to signal, communication and information theory.

Course Contents

Unit I	Linear Differential Equations (LDE) and Applications	(09Hours)

LDE of n^{th} order with constant coefficients, Complementary Function, Particular Integral, General method, Short methods, Method of variation of parameters, Cauchys and Legendres differential equations, Simultaneous differential equations, Modeling of electrical circuits.

Unit II	Numerical Methods	(09 Hours)

Interpolation: Finite Differences, Newtons and Lagranges interpolation formulae, Numerical differentiation.

Numerical Integration: Trapezoidal and Simpsons rules, Bound of truncation error.

Solution of ordinary differential equations: Eulers method, Modified Eulers method, Runge-Kutta 4th order method, Predictor-Corrector methods.

Unit III	Fourier and Z-Transforms	(09 Hours)

Fourier Transform (FT): Complex exponential form of Fourier series, Fourier integral representation, Fourier sine and cosine integrals, Fourier transform, Fourier sine and cosine transforms and their inverses.

Z-Transform (ZT): Introduction, Definition, Standard properties, ZT of standard sequences and their inverses, Solution of difference equations.

Unit IV	**Vector Calculus**	**(09 Hours)**

Vector differentiation: Gradient, Divergence and Curl, Directional derivative, Solenoidal and Irrotational fields, Vector identities.

Vector integration: Line, Surface and Volume integrals, Greens Lemma, Gausss Divergence theorem and Stokes theorem.

Applications to problems in Electro-magnetic fields.

Unit V	**Statistics and Probability**	**(09 Hours)**

Statistics: Measures of central tendency, Measures of dispersion, Coefficient of variation, Moments, Skewness and Kurtosis, Correlation and Regression, Reliability of Regression estimates.

Probability: Probability density function, Probability distributions Binomial, Poisson, Normal.

Test of Hypothesis: Chi-square test.

Learning Resources

Text Books:

1. Higher Engineering Mathematics by B.V. Ramana (Tata McGraw-Hill).
2. Higher Engineering Mathematics by B. S. Grewal (Khanna Publication, Delhi).

Reference Books:

1. Advanced Engineering Mathematics, 10e, by Erwin Kreyszig (Wiley India).
2. Advanced Engineering Mathematics, 2e, by M. D. Greenberg (Pearson Education).
3. Advanced Engineering Mathematics, 7e, by Peter V. ONeil (Cengage Learning).
4. Differential Equations, 3e by S. L. Ross (Wiley India).
5. Numerical Methods for Engineers, 7e by S. C. Chapra and R. P. Canale (McGraw-Hill Education).
6. Introduction to Probability and Statistics for Engineers and Scientists, 5e, by Sheldon M. Ross (Elsevier Academic Press).

Savitribai Phule Pune University

Second Year of Electronics and Communication Engineering- (Advanced Communication Technology) (2024 Course)

PCC-203-ECA: Analog Communication

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

Prerequisite Courses: Basic gates, Number Systems and their conversations of BXE

Companion Course: Laboratory Practicals.

Course Objectives:

To make students understand

Understand Signals & Systems, Spectrum, bandwidth, transmission power requirements & fundamentals of communication systems.

1. Realize the various amplitude modulation and demodulation.
2. Understand the Angle Modulation concepts.
3. Introduce the concept of Sampling theorem and pulse modulation techniques PAM, PWM, PPM.
4. To impart pre-requisites of digital communication systems and explore digital representation techniques like PCM, DPCM, DM and ADM.

Course Outcomes:

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

CO1: Describe Signals & Systems, Spectrum, bandwidth and transmission power requirements by analyzing time and frequency domain spectra of signal required for modulation schemes.

CO2: Explain and analyze the techniques of generation, transmission and reception of Amplitude Modulation Systems.

CO3: Explain generation and detection of PM & FM systems and compare them with AM systems.

CO4: Demonstrate the importance of Sampling Theorem and correlate with Pulse Modulation technique. (PAM, PWM, and PPM).

CO5: Characterize the quantization process and elaborate digital representation techniques (PCM, DM and ADM).

Course Contents		
Unit I	**Fundamentals of Signals & Spectra:**	**(09 Hrs)**
Types of Signal, Time domain description, Frequency domain description, Signal Energy and Energy Spectral Density, Signal Power and Power Spectral Density, Fourier transform & their properties. Spectrum of rectangular, Sine, triangular signal, Introduction to Communication System, Block Diagram of Communication System, Types of Communication System: Analog, Digital, Wired and Wireless, Regenerative repeaters, Concept of baseband and band pass signals.		
Mapping of Course Outcomes for Unit I: CO1		
Unit II	**Amplitude Modulation:**	**(09 Hrs)**
Single tone modulation, AM wave for various modulation Index, Power Relations in AM Waves, Square law modulator, Switching Modulator, Detection of AM waves, Square law detector, Envelope detector, DSB-SC Modulation, Time-domain and frequency domain descriptions of DSB-SC, Generation of DSB-SC: Balanced modulator, Ring modulator, Generation of SSB-SC, Demodulation of SSB-SC, Vestigial side-band modulation, Frequency domain description, Generation of VSB modulated wave, comparison of various AM modulation techniques. Introduction to Superhetrodyne receiver and its parameter.		
Mapping of Course Outcomes for Unit II: CO2		
Unit III	**Angle Modulation**	**(09 Hrs)**
Introduction to Frequency Modulation (FM) & Phase Modulation (PM), Relationship between FM & PM., Modulation Index, Spectrum of FM (single tone): Feature of Bessel Coefficient, Power of FM signal, Bandwidth of FM & PM, Narrowband and Wideband FM. FM Modulators and Demodulators: FM generation & Detection Technique (using PLL), frequency multiplication and application to FM, FM demodulator.		
Mapping of Course Outcomes for Unit III: CO3		
Unit IV	**Pulse Analog Modulation**	**(09 Hrs)**
Need of analog to digital conversion, sampling theorem for low pass signal in time domain, and Nyquist criteria, Types of sampling- natural and flat top. Pulse amplitude modulation (PAM) & concept of TDM: Channel bandwidth for PAM, equalization, Signal Recovery through holding. Pulse Width Modulation (PWM) and Pulse Position Modulation (PPM): Generation , Detection & Comparison.		
Mapping of Course Outcomes for Unit IV: CO4		
Unit V	**Digital Representation of Analog Signals**	**(09 Hrs)**

Quantization of Signals: Quantization error, Uniform & Non-Uniform types of Quantization, Midrise& Mid-tread Quantizer. **Companding:** A-law & μ-law.

Pulse Code Modulation system: Generation & Reconstruction for 2 & 3 bits, Delta Modulation, Adaptive Delta Modulation, Comparison of PCM, DM, ADM. **Line codes:** Properties and spectrum.

Mapping of Course Outcomes for Unit V: CO5

Learning Resources

Textbooks:

1. B P Lathi, Zhi Ding, "Modern Analog and Digital Communication System", Oxford University Press, 4th Edition.

2. Taub, Schilling and Saha, "Principles of Communication Systems", McGraw-Hill,4th Edition.

Reference Books:

1. Bernard Sklar and Prabitra Kumar Ray, "Digital Communications Fundamentals and Applications", Pearson Education 2nd Edition.

2. Wayne Tomasi, "Electronic Communications System", Pearson Education, 5th Edition.

3. A.B Carlson, P B Crully and J C Rutledge, "Communication Systems", Tata McGraw Hill Publication, 5th Edition.

4. Simon Haykin, "Communication Systems",John Wiley & Sons, 4th Edition.

MOOC / NPTEL/YouTube Links:

NPTEL Course "Principles of Communication Systems-I"

https://nptel.ac.in/courses/108/104/108104091/

Exemplars

These are the exemplars to understand the subject applications unit wise , Examiners will not ask the question based on these exemplars

Sr. No.	Subject	Unit No	Exemplars
1	Electronic Circuits	1	IC Fabrication, MOSFET Count in Processors of Computers & Cell phones
		2	Real Time Clock (RTC) IC, Quartz Crystal Oscillators in Clock
		3	Analog Computers, Signal Conditioning Circuits
		4	Real world interfacing with IoT
		5	Cell Phone chargers, Adapters, Vehicle Battery charger
2	Data Structures & Algorithms	1	Recursive factorial, Search engines, (Searching Algorithms), Artificial Intelligence
		2	Online Ticket booking System (Arrays), Working of Browsers (Stack), Token System (Queue)
		3	Play List, Undo/Redo Function, Polynomial Representation
		4	Accessing file system on computers, HTML Document
		5	Google Map/ Routing Algorithms, Social Networks, Word Wide Web (WWW)

Savitribai Phule Pune University
Second Year of Electronics and Communication Engineering- (Advanced Communication Technology)
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PCC-204-ECA: Electronics Circuits & Analog Communication Lab

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

Companion Course, if any: Electronics Circuits

List of Experiments (Electronics Circuits)

Group A: Any Three to be Performed

1. Design, build single stage CS configuration & verify DC operating point and comment on results.
2. Implement current series feedback amplifier & measure R_{if}, R_{of}, G_{mf} and comment on result.
3. Design, build & test integrator/differentiator using Op-Amp and comment on result.
4. Design, build & test Schmitt trigger using Op-Amp and comment on result.
5. Design & implement adjustable voltage regulator using IC LM317/LM337 and comment on result.

Group B: Any Three to be Performed

6. Simulate voltage series feedback amplifier & measure R_{if}, R_{of}, A_{vf}, bandwidth and comment on result.
7. Design, build & test square and triangular waveform generator using Op-Amp.
8. Design, build & test 2 or 3-bit R-2R ladder DAC.
9. Design, build & test half-wave and full-wave rectifier.
10. Design, build & test first order active low pass / high pass filter.

Group C: Course Project (Any 1 Group of 3 Students)

11. Case Study 1: Design and implement a linear regulator variable power supply.
12. Case Study 2: Design and implement signal conditioning circuit for temperature measurement and control system.

Virtual LAB Links:

1. **Integrated Circuits:** http://vlabs.iitb.ac.in/vlabs-dev/vlab_bootcamp/bootcamp/electronerds/index.html
2. **Basic Electronics Virtual Lab:** http://vlabs.iitkgp.ernet.in/be/

Note:

1. One practical from Group A and B should be performed as simulation practical (using any available tool).
2. Additional (min. 2) practicals are to be performed using Virtual Lab.

Savitribai Phule Pune University Second Year of Electronics and Communication Engineering- (Advanced Communication Technology) (2024 Course)	
List of Experiments (Analog Communication)	
Group A: Hardware practical [Any Eight]	
01	AM Generation (DSB-FC): Calculation of modulation index by graphical method, Power of AM Wave for different modulating signals and Observe Spectrum.
02	FM Generation using Varicap /Varactor Diode/ VCO and Demodulation using IC 565 / 566, calculation of modulation index & BW of FM.
03	Verification of Sampling Theorem, PAM Techniques, (Flat top & Natural sampling), reconstruction of original signal, Observe Aliasing Effect in frequency domain.
04	Generation and Detection of PWM using IC 555.
05	Study of PCM.
06	Study of Commanded PCM.
07	**Study of DM:** Generation and detection.
08	**Study of ADM:** Generation and detection.
09	**Study of line codes** (NRZ, RZ, POLAR RZ, BIPOLAR (AMI), MANCHESTER) & their spectral analysis.
Group B: Simulation Practical [Any two]	
10	Simulation program to generate AM for various modulation index.
11	Simulation program to generate FM for various modulation index.
12	Verify Sampling Theorem using simulation.
13	Simulation program to calculate Signal to noise ratio for PCM system & DM system.

Savitribai Phule Pune University
Second Year of Electronics and Communication Engineering- (Advanced Communication Technology)
(2024 Course)

MDM-230-ECA: Multidisciplinary Minor - Data Structures and Algorithms

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

Prerequisite Courses: Fundamentals of Programming Languages, Basics of C Programming

Course Objectives:

To make students understand

1. To understand the significance of data structures and implement searching and sorting methods using the C language.
2. To learn the concept and understand the importance of time and space complexity.
3. To understand data representation, implementation and applications of linear and nonlinear data structures.

Course Outcomes:

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

CO1: Apply and implement the principal sorting and searching algorithms on the given data using the C language.
CO2: Develop applications of stack and queue using arrays.
CO3: Implement and demonstrate the applicability of a Linked List.
CO4: Build, represent and traverse a Binary Search Tree.
CO5: Build, represent and traverse graphs.

Course Contents

Unit I	Introduction to Data Structures and Complexity Analysis	(08 Hours)

Overview of Data Structures Linear vs. Non-linear structures, Abstract Data Types (ADT), **Algorithm Analysis** Time and Space Complexity, **Asymptotic Notations** Big O, Omega, Theta, Best, Worst, and Average Case Analysis, **Searching Algorithms** Linear Search, Binary Search, **Sorting Algorithms** Bubble, Selection, Insertion

Unit II	Stack and Queue	(08 Hours)

Stack Implementation using Arrays, Applications (Infix to Postfix, Expression Evaluation), **Queue** Implementation, Circular Queue, Priority Queue

Unit III	Linked List	(08 Hours)

Pointers: Basic concepts, Pointer declaration and initialisation, **Dynamic Memory Allocation** (malloc, calloc, realloc, free), **Linked Lists** Singly, Doubly, and Circular Linked Lists; Stack and Queue implementation using Linked list

Unit IV	Non-linear Data Structure: Tree	(08 Hours)

Trees Terminology, Binary Trees, Binary Search Trees (BST), Operations, **Tree Traversals** Inorder, Preorder, Postorder (Recursive and Iterative)

Unit V	Non-linear Data Structure: Graphs	(08 Hours)

Graphs: Representation (Adjacency Matrix/List), Traversal: BFS, DFS; Minimum Spanning Tree (Prims and Kruskals Algorithm)

Learning Resources

Textbooks:

1. Ellis Horowitz and Sartaj Sahni, Fundamentals of Data Structures, Galgotia Books Source, 2nd Edition
2. Richard. F. Gilberg and Behrouz A. Forouzan, Data Structures: A Pseudocode Approach with C, Cengage Learning, 2nd Edition.

Reference Books:

1. Reema Thareja, Data Structures using C, Oxford University Press, 2nd Edition
2. Yedidyah Langsam, Moshe J Augenstein and Aaron M Tenenbaum Data structures using C and C++ PHI Publications, 2nd Edition.

MOOC / NPTEL Courses:

1. Data Structure using C Programming by Dr. Dipti Verma and Mr. Aditya Tiwari: https://onlinecourses.swayam2.ac.in/nou23_cs13/preview
2. Data Structures and Algorithms: https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_013842032404848640104 70_shared/overview
3. Data Structures in C: https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_013299625203884032379/overview

Savitribai Phule Pune University Second Year of Electronics and Communication Engineering- (Advanced Communication Technology) (2024 Course)		
MDM-231-ECA: Multidisciplinary Minor - Data Structures and Algorithms Lab		
Teaching Scheme	**Credits**	**Examination Scheme**
Practical : 02 Hours/Week	01	**Term Work:** 25 Marks **Practical :** 25 Marks
Companion Courses: Data Structures and Algorithms		

List of Laboratory Experiments (Implement using C language)	
Group A: Compulsory	
1	**Student Database Management** *You are developing a student result management system. The database should support updating records, adding new entries, searching for specific students, and sorting based on performance.* Using an array of structures, implement a student database with attributes: roll no, name, program, course, subject marks, total, and average. Support operations: display, search, and sort. (Students can additionally perform modify, append.)
2	**Stack or Queue using Array (Static Implementation)** *Simulate a parcel handling system at a post office where packages are stacked (LIFO) or queued (FIFO).* Use an array to implement a stack (push, pop, display) or a queue (add, delete, display). Choose the appropriate model based on the scenario.
3	**Singly Linked List Operations** *You are building a text editor where lines of text are stored dynamically. You need to allow insertion and deletion of lines at any position, and display text both normally and in reverse.* Use a singly linked list to implement: display, insert (front/end/middle), delete (front/end/middle), display in reverse, and reverse the list.
4	**Binary Search Tree Operations** *An online directory system uses a BST to keep names in a sorted manner and support fast searching.* Create a binary search tree and implement recursive traversals (inorder, preorder, postorder) and search for a specific name in the directory.

5	**Graph Traversal** *You are designing a navigation system for a campus with multiple buildings. The system should explore possible paths (routes) using BFS or DFS.* Create a graph using an adjacency matrix and implement Breadth-First Search and Depth-First Search to explore the building connectivity.
Group B: [Any 5 to be performed]	
6	**Write a program in C to display the following patterns like** Right-angle triangle with a number: 1 12 123 1234 Diamond shape with numbers: 1 2 2 3 3 3 4 4 4 4 3 3 3 2 2 1 Pyramid with an asterisk: * * * * * * * * * * Pyramid using the alphabet: A A B A A B C B A A B C D C B A
7	**Searching Techniques** *You are building a contact manager app. A user wants to search for a contact either by scanning one by one or by using a fast lookup if the list is sorted.* Write a program that locates a specific name using both sequential and binary search techniques.
8	**Sorting Algorithms** *An online store wants to sort its product prices to help customers compare them easily. Choose suitable sorting techniques for small to medium datasets.* Implement bubble sort, selection sort, and insertion sort to reorder product prices.
9	**Stack or Queue using Linked List (Dynamic Implementation)** *Design a service window system where customers arrive and are served in order (FIFO), or a browser history system where the last visited page is accessed first (LIFO).* Use a linked list to implement a dynamic stack (push, pop, display) or queue (add, delete, display) based on the given use case.
10	**Balanced Parentheses or Decimal to Binary** Write a program to check for balanced parentheses in a given expression (including (), {}, []) using a stack implemented with arrays or linked lists. **OR** Write a program to convert a Decimal number to a binary number using a stack.
11	**Height and Depth in BST** Develop a program that constructs a Binary Search Tree and computes the height of the tree and the depth of a given node.

12	**Count and Classify Nodes** Write a program to count the number of: - Leaf nodes - Internal nodes - Nodes with only one child in a given binary tree.
13	**Train Ticket Booking System:** Implement a system to manage train ticket bookings using queues. Confirm bookings if seats are available; otherwise, add passengers to a waiting list. On cancellation, shift the first waiting passenger to confirmed status.

Group Assignment

Group Assignment Guidelines:

– Make a Group of 4 students in a batch (Batch of 20).

– The group will select any of the listed group assignments or propose a similar one with the course teacher's approval.

– After completing the assignment, the group will present it during the practical slot.

The distribution of work in a group during a presentation may include:

Algorithm / Flowchart Program Explanation Applications

Group Assignments

1	**Matchstick Game (AI vs Human):** Design and implement a console-based **Matchstick game** where the total number of matchsticks is 21. Two players (user and computer) take turns to pick 1 to 4 match-sticks. The player forced to pick the last matchstick loses. Implement logic so that the computer never loses the game. Use control structures and functions in C. **Key Concepts:** Loops, conditionals, basic AI, user input validation
2	**Tic-Tac-Toe Game (2-Player Console Version):** Create a **2-player Tic-Tac-Toe game** that runs in the console. The game board is a 3x3 grid where players take turns marking X or O. The game should detect a win, loss, or draw condition and display the result accordingly. Use arrays and functions for board management and input handling. **Key Concepts:** 2D arrays, game logic, functions, modular programming
3	**Tower of Hanoi (Recursive Approach):** Write a program to simulate the **Tower of Hanoi** puzzle using recursion. The user provides several disks, and the program outputs the sequence of moves to transfer all disks from the source peg to the destination peg following the game rules. **Key Concepts:** Recursion, stack behavior, algorithm design

4	**Banking Transactions Mini Statement Generator:** Develop a **Banking Transaction System** that allows the user to enter their account number and perform basic transactions such as deposit and withdrawal. Maintain a log of the last 5 transactions and display them as a **mini statement**. Use structures to simulate user accounts and transaction history. **Key Concepts:** Structures, arrays, file handling, menu-driven programs
5	**Typing Tutor (Accuracy and Speed Tracker):** Build a **Typing Tutor** that displays a random sentence for the user to type. After typing, the program calculates the typing speed (WPM), accuracy (%), and suggests corrections for misspelt words. **Key Concepts:** Strings, time library, error handling, user input analysis
6	**Calendar Generation by Year:** Create a program that accepts a **year as input** and displays the **calendar for the entire year**. It should accurately calculate leap years and place correct dates under weekdays. Use arrays and functions to handle months, days, and leap year conditions. **Key Concepts:** Control structures, arrays, functions, date-time logic

Savitribai Phule Pune University
Second Year of Electronics and Communication Engineering- (Advanced Communication Technology)
(2024 Course)

EEM-240-ECA: Engineering Economics & Applications

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

Course Objectives:

To make students understand

1. To understand key economic principles and the time value of money for engineering decisions.
2. To learn demand forecasting, cost analysis, and decision-making under uncertainty.
3. To explore market structures, pricing strategies, and value engineering in electronics.
4. 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, and equilibrium price, Time value of money (Present Value, Future Value, annuity basics)		
Unit II	**Principles of Engineering Economics and Costing**	**(04 Hours)**
Demand forecasting techniques and applications in tech markets, Cost behaviour: Fixed, variable, marginal, total, Cost-volume-profit and break-even analysis, Decision-making under uncertainty (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 lifecycle costing, Game theory basics and strategic behaviour, 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. Perform break-even and Cost-Volume-Profit (CVP) analysis using spreadsheets
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., setup of a lab or unit based)
8. Group discussion: Impact of government policies and budget on electronics and telecom sector

Textbooks:

1. A Textbook of Engineering Economics: The Principles and Applications, D. R. Kiran, BS Publications, 2021.
2. Engineering Economics Test & Cases, D N Dwivedi, 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 Communication Engineering- (Advanced Communication Technology)
(2024 Course)

VEC-250-ECA: Universal Human Values & Professional Ethics

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

Prerequisite Courses: Student Induction Program (SIP)

Course Objectives:

1. To help the students develop a holistic, humane world-vision, and appreciate the essential complementarity between values and skills to ensure mutual happiness and prosperity
2. To elaborate on Self-exploration as the process for Value Education
3. To facilitate the understanding of harmony at various levels starting from self and going towards family and society
4. To elaborate on the salient aspects of harmony in nature and the entire existence
5. To explain how the Right understanding forms the basis of Universal human values and definitiveness of Ethical human conduct
6. 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 one self and the other self as the essential part of relationship and harmony in the family.

CO4: Interpret the interconnectedness, harmony and mutual fulfilment inherent in the nature and the entire existence.

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 Fulfilment
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, RR Gaur, R Asthana, GP Bagaria, 3rd revised edition, UHV Publications, 2023, ISBN: 978-81-957703-5-9 (Printed Copy), 978-81-957703-0-4 (e-Book)

Reference Books:

1. P. L. Dhar, R. R. Gaur, 1990, Science and Humanism, Commonwealth 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, The Story of my Experiments with Truth, Discovery Publisher

MOOC / NPTEL/YouTube Links:

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.in/aic22_ge23/preview
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/109104068
3. https://www.youtube.com/channel/UCQxWr5QB_eZUnwxSwxXEkQw
4. https://www.youtube.com/playlist?list=PLoVRJrAl0FT1DNRtDpYa3SGeMEm06O3Dv

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 Communication Engineering- (Advanced Communication Technology) (2024 Course)		
CEP-260-ECA: Community Engagement Project		
Teaching Scheme	**Credits**	**Examination Scheme**
Practical : 04 Hours/Week*	02	**Term Work :** 25 Marks **Oral :** 25 Marks

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

Course Objectives: The course aims to:

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

Course Outcomes: Upon successful completion of this course,

students will be able to:

1. CO1 - **Identify** and **Analyze** local community needs and challenges by engaging with stakeholders and evaluating real-world problems.
2. CO2- **Design** and **Implement** practical, creative, and context-specific solutions using engineering principles to address community issues.
3. CO3 - **Reflect** and **Evaluate** the effectiveness of their interventions and articulate lessons learned through reports and presentations.
4.

Course Contents

Implementation

- A group of 3 to 4 students or a single student 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 is allotted to a faculty member of the department as a mentor.
- The group of students will be associated with a government official / village authority /NGOs etc. concerned, allotted by the district administration, during the duration of the project.
- The Community Engagement Project should be different from the regular programmes of NSS/NC-C/Green Club/Hobby Clubs, Special Interests Groups etc
- An activity book has to be maintained by each of the students to record the activities undertaken/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 programme on Health and Hygiene or in Organic Farming or in Fisheries or in advocating prohibition of liquor or about renewable energy, e- waste management or any other activity in an area of their studies and as per his/her aptitude.

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

- Use and/or miss-use of cell phones
- Career orientation of youth
- Water facilities and drinking water availability
- Health and hygiene of the school going students, home makers and old personals
- Health intervention and awareness programs
- Horticulture
- Herbal and Nutrition
- Traditional and Modern health care methods
- Food habits
- Air /Sound /Water pollution
- Plantation and Soil protection

- Renewable energy and Solar Systems
- Yoga awareness and practice
- Health care awareness programs and their impact
- Organic farming, IoT implementation
- Food adulteration
- Incidence of Diabetes and other chronic diseases
- Blood groups and blood levels
- Chemicals in daily life
- Music and dance
- Women education and empowerment

Project Scope

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

Text Books:

1. Waterman, A. Service-Learning: A Guide to Planning, Implementing, and Assessing Student Projects. Routledge, 1997.
2. Beckman, M., and Long, J. F. Community-Based Research: Teaching for Community Impact. Stylus Publishing, 2016.
3. Design Thinking for Social Innovation. IDEO Press, 2015.
4. Dostilio, L. D., et al. The Community Engagement Professional's Guidebook: A Companion to The Community Engagement Professional in Higher Education. Stylus Publishing, 2017

MOOC / NPTEL/YouTube Links:

1. NPTEL course: Ecology and Society 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
4. Design for Change https://www.dfcworld.com

Savitribai Phule Pune University, Pune

Maharashtra, India

SE - Electronics and Communication Engineering

(Advanced Communication Technology)

2024 Pattern

Semester IV

With effect from Academic Year 2025–26

Savitribai Phule Pune University
Second Year of Electronics and Communication Engineering- (Advanced Communication Technology)
(2024 Course)

PCC-205-ECA: Digital Communication

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

Companion Course, if any:

1. Basic Electronics Engineering
2. Analog Communication

Course Objectives:

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

- To familiarize students with various digital modulation techniques used in digital communication systems.
- To equip students, the students with tools required for performance analysis of digital communication systems.
- To introduce the students with the concept of information theory & coding techniques.

Course Outcomes:

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

- CO1: Understand the fundamentals of probability theory, random variables and Apply concepts to analyze signal behavior and their impact on performance.
- CO2: Analyze and compare digital modulation techniques and their performance metrics.
- CO3: Describe and analyze the digital communication system with spread spectrum modulation.
- CO4: Analyze a communication system using information theoretic approach.
- CO5: Use error control coding techniques to improve performance of a digital communication system

Course Contents		
Unit I	**Probability and Random Processes**	**(09 Hrs.)**
Probability and Random Processes: Basic introduction, Properties of probability, Random variables, CDF & PDF of random variables, Joint CDF & PDF, Statistical averages/mean, Correlation and covariance Functions, Random processes, types of random processes (stationary and ergodic) Gaussian Process, Transmission of Random process through linear filter. ***Application: Wireless communication: Signal fading is modeled as a random variable. Finance: Stock prices modeled as random variables over time. Stock market trends: Prices modeled using stochastic processes. Medical diagnosis: PDF used in likelihood functions for disease prediction.***		
Mapping of Course Outcomes for Unit I : CO1: Understand the fundamentals of probability theory, random variables and Apply concepts to analyze signal behavior and their impact on performance.		
Unit II	**Continuous Wave Modulation Techniques**	**(09 Hrs.)**
Pass band transmission model, Signal space diagram, Generation and detection, Error Probability derivation and Power spectra of coherent BPSK, BFSK and QPSK. Geometric representation, Generation and detection of - M-ary PSK, M-ary QAM and their error probability, Generation and detection of -Minimum Shift Keying, Gaussian MSK, Non-coherent BFSK, DPSK and DEPSK, Orthogonal Frequency Division Multiplexing (OFDM), Comparison of digital modulation systems. ***Applications: Constellation design: Used in QAM and PSK to represent modulation formats, Satellite and space communication: BPSK and QPSK used due to good BER at low SNR, OFDM in 4G and 5G.***		
Mapping of Course Outcomes for Unit II CO2: Analyze and compare digital modulation techniques and their performance metrics.		
Unit III	**Spread Spectrum Communications**	**(09 Hrs.)**
Use Of Spread Spectrum, Frequency Hopping Spread Spectrum (FHSS) Systems, Direct Sequence Spread Spectrum, Resilient Features Of DSSS, Code Division Multiple-Access (CDMA) Of DSSS, Modern Practical DSSS CDMA Systems, Generation And Characteristics of Pseudorandom (PN) Sequences. ***Applications: Spread spectrum techniques in military radios to hide transmissions and resist jamming or eavesdropping. 3G Mobile Networks: CDMA enables multiple users to share the same frequency by assigning unique codes, Secure Communication Systems PN sequences make the spread signal resemble noise, ensuring privacy.***		

Mapping of Course Outcomes for Unit III:

CO3: Describe and analyze the digital communication system with spread spectrum modulation.

Unit IV	Information Theory & Source Coding	(09 Hrs.)

Introduction to information theory, Entropy and its properties, Source coding theorem, Huffman coding, Shannon-Fano coding, Run Length Encoding, Discrete memory less channel, Mutual information. Examples of Source Coding-Audio and Video Compression.

Applications: Huffman coding used for lossless compression in MP3, JPEG, PNG Compression, RLE in BMP images and for PDF, Source Coding for Audio and Video Compression.

Mapping of Course Outcomes for Unit IV

CO4: Analyze a communication system using information theoretic approach.

Unit V	Information Capacity & Channel Coding	(09 Hrs.)

Information Capacity theorem, Channel capacity, Channel coding theorem, Differential entropy and mutual Information for continuous ensembles, Information Capacity theorem, Linear Block Codes: Syndrome and error detection, Error detection and correction capability, Standard array and syndrome decoding, Cyclic Codes: Coding & Decoding.

Applications: Channel Capacity in Bandwidth Allocation and to calculate throughput limits in Cellular Networks. Uses mutual information for capacity analysis in MIMO Systems in 5G, Cyclic codes for low-complexity, energy-efficient data integrity in Wireless Sensor Networks

Mapping of Course Outcomes for Unit V

CO5: Use error control coding techniques to improve performance of a digital communication system.

Learning Resources

Textbooks:

1. Taub, Schilling and Saha, "Principles of Communication Systems", McGraw-Hill, 4th Edition
2. B.P. Lathi, Zhi Ding , "Modern Analog and Digital Communication System", Oxford University Press, 4th Edition.

MOOC / NPTEL Courses:

1. NPTEL Course on "Digital Communications"

Link of the Course: https://nptel.ac.in/courses/108/102/108102096/

**Applications are included to create interest in teaching learning process. No question should be asked on applications.

Savitribai Phule Pune University
Second Year of Electronics and Communication Engineering- (Advanced Communication Technology)
(2024 Course)

PCC-206-ECA: Signals and Systems

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

Companion Course, if any: PCC-210-ETC: Control Systems and Signals & Systems Lab

Course Objectives:

1. To introduce signals, its operations with examples and to classify signals into different categories.
2. To classify systems into different categories.
3. To analyze the Liner Time Invariant (LTI) systems and finding the system response in time domain.
4. To acquire knowledge about Fourier Series and Transform and its significance in signal analysis.
5. To understand the limitations of Fourier transform and need for Laplace transform and develop the ability to analyze the system in s- domain.

Course Outcomes:

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

CO1: Develop the mathematical equations of continuous and discrete time signals and perform fundamental operations on signals and Categorize signals into different categories.

CO2: Analyze different systems by applying the knowledge of system classification.

CO3: 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.

CO4: Analyze and resolve the signals in frequency domain using Fourier Transform.

CO5: Apply Laplace transform for continuous time signals and perform system analysis.

Course Contents		
Unit I	**Introduction to Signals**	**(09 Hours)**
Signals: Introduction, Continuous and Discrete time signals 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 (CT and DT):** Amplitude scaling, signal addition, subtraction, signal multiplication, signal differentiation, signal integration, difference, accumulation, time shifting, time reversal, and time scaling. **Classification of signals (CT and DT):** Deterministic and Random, Periodic and Non-periodic, Even and odd, Energy and Power, and Stationary and non-stationary.		
Mapping of Course Outcomes for Unit I CO1: Develop the mathematical equations of continuous and discrete time signals and perform fundamental operations on signals and Categorize signals into different categories		
Unit II	**Introduction to Systems**	**(09 Hours)**
Introduction to systems: Communication, control etc., Classification of systems using input-output relationship: static and dynamic, causal and non-causal, Linear and Non- linear, time variant and time invariant, stable and unstable, invertible and non- invertible. Linear Time Invariant (LTI) systems, impulse response, basic concepts of Finite Impulse Response (FIR) and Infinite Impulse Response (IIR), FIR and IIR system structures, comparison and applications of FIR and IIR systems.		
Exemplar: Applications of FIR and IIR systems.		
Mapping of Course Outcomes for Unit II CO2: Analyze different systems by applying the knowledge of system classification.		
Unit III	**Time-domain Analysis of LTI Systems and Applications**	**(09 Hours)**
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.		
Exemplar: Introduction to the modern applications of the convolution; (i) Speech recognition and natural language processing (NLP): Voice Assistants, Real-Time Translation, Medical Speech Processing, (ii) Convolutional Neural Networks (CNNs): Facial Recognition, Self-Driving Cars, Medical Imaging, Augmented Reality (AR)		
Mapping of Course Outcomes for Unit III CO3: 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.		
Unit IV	**Fourier Analysis and Applications**	**(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 in spectral analysis, communication, filtering, and biomedical signal processing.

Mapping of Course Outcomes for Unit IV

CO4: Analyze and resolve the signals in frequency domain using Fourier Transform.

Unit V	Laplace Transform and Applications	(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: Feedback Inverted Pendulum.

Mapping of Course Outcomes for Unit V

CO5: Apply Laplace transform for continuous time signals and perform system analysis.

Learning Resources

Textbooks:

1. Simon Haykins and Barry Van Veen, Signals and Systems, Wiley India, 2nd Edition.
2. A. V. Oppenheim, A. S. Willsky, "Signals and Systems", Pearson, 2nd Edition.
3. B. P. Lathi, "Linear Systems and Signals" Oxford University Press, 2nd Edition.

Reference Books:

1. A. Nagoor Kanni Signals and Systems, Mc Graw Hill, 2nd Edition
2. John G. Proakis and Dimitris G. Manolakis, "Digital signal Processing: Principles, Algorithms, and Applications", 4th Edition. Sept. 2007.
3. Ian Goodfellow, Yoshua Bengio, Aaron Courville, Deep Learning, MIT Press, 2016.
4. Charles Phillips, Signals, Systems and Transforms, Pearson Education, 3rd Edition

e-Books:

1. Linear Systems And Signal Processing By B.b Lathi 2nd Edition : LIBRARIAN IECW : Free Download, Borrow, and Streaming : Internet Archive
https://archive.org/details/linear-systems-and-signal-processing-by-b.b-lathi-2nd-edition
2. Engineering-Books/Signals and Systems/Oppenheim, Willsky, Nawab - Signals & Systems [2nd Edition].pdf at https://github.com/gigahidjrikaaa/Engineering-Books/blob/main/Signals%20and%20Systems/Oppenheim%2C%20Willsky%2C%20Nawab%20-%20Signals%20%26%20Systems%20%5B2nd%20Edition%5D.pdf

MOOC / NPTEL/YouTube Links:

https://archive.nptel.ac.in/courses/108/106/108106163/
https://ocw.mit.edu/courses/res-6-007-signals-and-systems-spring-2011

Savitribai Phule Pune University
Second Year of Electronics and Communication Engineering- (Advanced Communication Technology)
(2024 Course)

PCC-207-ECA: Digital Circuits

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

Prerequisite Courses: Basic gates, Number Systems and their conversations of BXE

Companion Course: Laboratory Practicals.

Course Objectives:

To make students understand

- To understand K-map and its use to the design the various applications of combinational digital circuits.
- To analyze sequential logic using flip flops and their applications viz. counters, processes and implement logical operations.
- To understand the concepts of sequential circuits and apply them in state machines.
- To understand the digital logic families and system design using programmable logic devices.
- To understand the fundamental principles of logic and various devices used to implement logical operations on variables.

Course Outcomes:

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

- **CO1**: Analyze, design and implement combinational logic circuits.
- **CO2**: Analyze, design and implement sequential circuits.
- **CO3**: Analyze, design FSM and ASM.
- **CO4:** Understand various digital parameters and analyze digital system design using PLD .
- **CO5**: Understand and Design CMOS circuits for specified applications.

Course Contents

Unit I	Combinational Logic Design	(09 Hours)

Definition of combinational logic, Standard representations for logic functions, k-map representation of logic functions (SOP and POS forms), minimization of logical functions for min-terms and max-terms (upto 4 variables), don't care conditions, Design Examples: Half Adder, Full adder, Half Subtractor, Full Subtractor, Adder and their use as subtractor, look ahead carry generator, Code converters (BCD to Gray, BCD to Excess-3, 4-bit Binary to Gray), 2-bit Comparator, Multiplexers, multiplexer trees, Demultiplexers, Demultiplexer trees and 3:8 Decoders.

Exemplar: Arithmetic Logic Unit (ALU), Scientific calculator, computing engines, industrial control systems, consumer electronics.

Mapping of Course Outcomes for Unit I: CO1

Unit II	Sequential Logic Design	(09 Hours)

1-Bit Memory Cell/latch, Clocked SR flip flop, J-K flip flop, M-S J-K flip flop, D and T flip-flops. Use of preset and clear terminals in flip flops, Excitation Table for flip flops, Conversion of flip flops, Registers, Shift registers, Counters (ring counters, twisted ring counters), ripple counters, Mod-n counters, up/down counters, synchronous counters, Sequence Generators using flip flops.

Exemplar: Memories, Rolling display boards, Microprocessors, Consumer electronics.

Mapping of Course Outcomes for Unit II: CO2

Unit III	State Machines	(09 Hours)

Moore and Mealy machines, State diagram, State table, State reduction, State assignment, Finite state machine implementation, Sequence detector. Introduction to Algorithmic state machines- construction of ASM chart and realization for sequential circuits.

Exemplar: ATM machine, vending machine and traffic lights

Mapping of Course Outcomes for Unit III: CO3

Unit IV	Programmable Logic Devices	(09 Hours)

Programmable logic devices: Detail architecture, Study of PROM, PAL, PLA, General Architecture, features and typical specifications of FPGA and CPLD. Semiconductor memories: memory organization and operation, Classification and characteristics of memories, RAM ROM, EPROM, EEPROM, NVRAM, SRAM, and DRAM.

Exemplar: Digital computers, automotive electronics and medical devices.

Mapping of Course Outcomes for Unit IV: CO4

Unit V	Digital Logic Family and CMOS Circuits	(09 Hours)

Digital Logic Family: Characteristics of digital logic families, TTL logic. Operation of TTL NAND gate, active pull up, wired AND, open collector output, unconnected inputs. Tri-State logic. Comparison of different Logic Families: RTL, DTL, TTL and ECL.

CMOS Circuits: CMOS inverter, NAND, NOR gates CMOS and concept of MOSFET parasitic.

Exemplar: Battery Operated Devices, High-Density Integrated Circuits.

Mapping of Course Outcomes for Unit V: CO5

Learning Resources

Textbooks:

1. R. P. Jain, "Modern Digital Electronics", Tata McGraw Hill Publication
2. Thomas Floyd, "Digital Fundamentals", Pearson Publication, India

Reference Books:

1. John. F. Wakerly, "Digital Design- Principles and Practices", Pearson Publication
2. M. M. Mano, "Digital Design," Prentice Hall India.
3. Stephen Brown, "Fundamentals of digital logic design with VHDL" Tata McGraw Hill Publication

e-Books: https://www.mheducation.co.in/modern-digital-electronics-9789355321770-india

MOOC / NPTEL/YouTube Links: https://nptel.ac.in/courses/108/105/108105132/

Exemplars

These are the exemplars to understand the subject applications unit wise, Examiners will not ask the question based on these exemplars

Sr. No.	Subject	Unit No	Exemplars
1	**Digital Communication**	**1**	Wireless communication: Signal fading is modeled as a random variable. Finance: Stock prices modeled as random variables over time.
		2	Satellite and space communication: BPSK and QPSK used due to good BER at low SNR, OFDM in 4G and 5G.
		3	Spread spectrum techniques in military radios to hide transmissions and resist jamming or eavesdropping. 3G Mobile Networks: CDMA enables multiple users to share the same frequency by assigning unique codes, Secure Communication Systems
		4	Huffman coding used for lossless compression in MP3, JPEG, PNG Compression, RLE in BMP images and for PDF.
		5	Capacity analysis in MIMO Systems in 5G, Cyclic codes for low-complexity, energy-efficient data integrity in Wireless Sensor Networks
2	**Signals and Systems**	**1**	Nature of Real life audio (voice), video, radio Signals and electrical currents
		2	Applications of FIR and IIR systems
		3	Introduction to the modern applications of the convolution; (i) Speech recognition and natural language processing (NLP): Voice Assistants, Real-Time Translation, Medical Speech Processing, (ii) Convolutional Neural Networks (CNNs): Facial Recognition, Self- Driving Cars, Medical Imaging, Augmented Reality (AR)
		4	Applications of Fourier Transform in spectral analysis, communication, filtering, and biomedical signal processing.
		5	Feedback Inverted Pendulum.
3	**Digital System**	**1**	Arithmetic Logic Unit (ALU), Scientific calculator, computing engines, industrial control systems, consumer electronics.
		2	Memories, Rolling display boards, Microprocessors, Consumer electronics.
		3	ATM machine, vending machine and traffic lights
		4	High speed computing boards, automotive electronics
		5	Hardware lock and serial port communication.
4	**Object-Oriented Programming**	**1**	Student Grade Management System
		2	Employee Hierarchy System
		3	Handles Exceptions
		4	Background Tasks in Android apps
		5	Collection & Display User Entered Data

Savitribai Phule Pune University
Second Year of Electronics and Communication Engineering- (Advanced Communication Technology)
(2024 Course)

PCC-208-ECA:Digital Communication and Digital Circuits Lab

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

List of Laboratory Experiments

Digital Communication Lab

Group A(Hardware)*Any 4

1.	Generation and Detection of BFSK Signal with spectrum analysis
2.	Generation and detection of BPSK with spectrum analysis.
3	Generation and detection of QPSK with spectrum analysis.
4	Study of DSSS transmitter and receiver using suitable hardware setup/kit
5	Study of FHSS transmitter and receiver using suitable hardware setup/kit.
	Group B (Simulation)*Any 4
6.	Simulation study of various Entropies and mutual information in a communication system.
7.	Simulation Study of Linear Block codes.
8.	Simulation Study of cyclic codes.
9.	Simulation study of Source Coding technique.
10.	Simulation study of random processes. Find various statistical parameters of the random process.

Virtual LAB Links:

1. **Link:** https://www.etti.unibw.de/labalive/index/digitalmodulation/
2. **Link:** https://vlab.amrita.edu/index.php?sub=59&brch=163&sim=262&cnt=970

List of Experiments (Digital Electronics)	
Guidelines for Students Lab Journal	
1	Title of the experiment
2	Problem Statement
3	Logic Design of given problem statement
4	Logic diagram with IC number pin connections
5	Observation table / Truth table
6	Timing diagram
7	Result table
8	Conclusions
9	Mention real life examples concerned with the respective experiments
Guidelines for Laboratory / Term Work Assessment	
1	Continuous assessment of laboratory work based on overall performance and laboratory performance of students.
2	Each laboratory assignment assessment should assign grade/marks based on parameters with appropriate weightage.
3	Suggested parameters include timely completion, performance, efficiency, punctuality, and neatness.
Suggested List of Laboratory Experiments (Any 6)	
1	Design and Implement 8:1 MUX using IC-74153 & Verify its Truth Table. Design & implement the given 4-variable function using IC-74153. Verify its Truth Table.
2	Design and implement full adder and full subtractor function using IC-74138.
3	Design and implement 3-bit Binary to Gray code converter and BCD to Excess-3 code converter using IC-74138.
4	Design and Implement 1-digit BCD adder using IC-7483.
5	Design and Implement 4-bit Binary adder and subtractor with mode control using IC-7483.
6	Design and Implement MOD-N and MOD-NN using IC-7490 and draw Timing diagram.
7	Design & Implement Up/down Counter with mode control using IC-74191 / IC-74193. Draw Timing Diagram.
8	Design and Implement 4-bit right shift and left shift register using D-flip flop IC-7474.
9	Design and Implement Pulse train generator using IC-74194 / IC-7495 (Use right/left Shift).
10	Design and Implement 4-bit Ring Counter / Twisted ring Counter using shift registers IC-74194 / IC-7495.
Note: Additional (min. 2) practicals based on applications are to be performed using Virtual Lab. 1. **Digital Applications Lab:** https://da-iitb.vlabs.ac.in/List%20of%20experiments. html. 2. **Hybrid Electronics Lab:** https://he- coep.vlabs.ac.in/List%20of%20experiments.html	

Note:

1. One practical from the Group should be performed as simulation practical (using any available tool).
2. Additional (min. 2) practicals are to be performed using Virtual Lab.

Savitribai Phule Pune University
Second Year of Electronics and Communication Engineering- (Advanced Communication Technology)
(2024 Course)

MDM-232-ECA: Multidisciplinary Minor - Object-Oriented Programming

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

Prerequisite Courses: Basic Object Oriented Programming concept using C++

Course Objectives:

1. To understand the fundamentals of object-oriented programming using C++.
2. To develop Java programs using classes, objects, inheritance, polymorphism, and exception handling.
3. To work with built-in Java libraries, packages and multithreading.
4. To foster problem-solving and logical thinking through real-world examples and programming practices.

Course Outcomes:

On completion of the course, learner will be able to:

CO1: Explain concepts of Object-Oriented Programming using C++.

CO2: Implement classes, objects, constructors, and destructor concepts in JAVA to build modular programs.

CO3: Analyze and design JAVA codes using abstract classes, inheritance and polymorphism.

CO4: Evaluate the concept of interfaces & packages.

CO5: Design and implement JAVA based mini project.

Course Contents

Unit I	Introduction to OOP Concepts	(09Hours)

Introduction to procedural programming, Limitations of procedural programming, Need of object-oriented programming, Fundamentals of object-oriented programming: Class, Object, Encapsulation, Abstraction, Inheritance, Polymorphism, Basics of C++ programming, Functions, Inline functions, Default arguments, Reference variables, Dynamic initialization of variables, memory management operators, Member dereferencing operators, operator precedence, typecast operators, Scope resolution operators. Creating Classes and Objects, Access Specifiers.

Mapping of Course Outcomes for Unit I

CO1: Explain concepts of Object-Oriented Programming using C++.

Unit II	Introduction to Core Java	(09 Hours)
Evolution of Java, Features of Java, Java Virtual Machine (JVM), Java Runtime Environment (JRE), Java Development Kit (JDK), Structure of a Java Program, Compilation and Execution Process. Java Syntax: Data Types, Variables, Operators, Control Statements and Loops. Creating Classes and Objects using JAVA. Constructors, method overloading, Static members and Methods, this pointer, Garbage collection, finalize methods, final variables and methods, final class.		
Mapping of Course Outcomes for Unit II CO2: Implement classes, objects, constructors, and destructor concepts in JAVA to build modular programs.		
Unit III	**Inheritance and Polymorphism**	**(09 Hours)**
Types of Inheritance in Java (Single, Multilevel, Hierarchical), Method Overriding, Dynamic Method Dispatch, Use of super and final keywords, Abstract Methods and classes, One dimensional and two dimensional arrays , wrapper classes.		
Mapping of Course Outcomes for Unit III CO3: Analyze and design JAVA codes using abstract classes, inheritance and polymorphism.		
Unit IV	**Interfaces and Packages**	**(09Hours)**
Interfaces: Introduction to Interfaces, Multiple Inheritance using Interfaces, Using static method in interface, Functional Interfaces and Lambda Expressions. **Packages:** Java API Packages, Using System Packages, Creating accessing and using a package, Importing packages, Adding a class to a Package, Hiding classes.		
Mapping of Course Outcomes for Unit IV CO4: Evaluate the concept of interfaces & packages.		
Unit V	**Multithreading and Exception Handling**	**(09 Hours)**
Introduction to multithreading: Introduction, creating thread and extending thread class. Concept of Exception handling: Introduction, Types of errors, Exception handling syntax, Multiple catch statements, Creating Custom Exceptions. Mini Project: Real world application using JAVA.		
Mapping of Course Outcomes for Unit V CO5: Design and implement JAVA based mini project		

Learning Resources

Textbooks:

1. E Balagurusamy, "Programming with C++", Tata McGraw Hill, 3rd Edition.
2. E Balagurusamy, Programming with JAVA , Tata McGraw Hill, 6th Edition.
3. Herbert Schildt, Java: The complete reference, Tata McGraw Hill, 7th Edition

Reference Books:

1. T. Budd, Understanding OOP with Java, Pearson Education
2. Y. Daniel Liang (2010), Introduction to Java programming, 7th edition, Pearson education, India.
3. Cay Horstmann , Core Java Volume 1 ,Kindle , 11 edition M.T. Savaliya, "Advanced Java Technology", Dreamtec

MOOC / NPTEL Courses:

1. NPTEL Course **"Programming in C++":**

   https://nptel.ac.in/courses/106/105/106105151/

2. NPTEL Course **" Programming in Java":**

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

Savitribai Phule Pune University
Second Year of Electronics and Communication Engineering- (Advanced Communication Technology)
(2024 Course)

PCC-209-ECA: Signals & Systems and Object-Oriented Programming Lab

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

Guidelines for Student's Lab Journal (Signals & Systems)

The students Lab Journal should contain following related to every experiment

1. Title of the experiment
2. Objective
3. Brief theory related to the experiment.
4. Connection diagram / circuit diagram.
5. Observation table
6. Sample calculations for one/two reading.
7. Result table
8. Graph and Conclusions.

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

Group A (Any 6 experiments to be performed)

1. Generate and plot the following signals in time domain and also sketch its amplitude and phase spectrum. Verify the result:
   Impulse
   Unit Step
   Exponential
   Unit ramp
   Sinc
   Rectangular

2. Write the codes to plot the following signals also simulate the signals:
(a) $\sin(200\pi t)$,
(b) $\sin(200\pi t+\pi/6)$,
(c) $\sin(200\pi t-\pi/6)$,
(d) $\cos(200\pi t)$,
(e) $\sin(200\pi t+\pi/4)$,
(f) $\cos(200\pi t- \pi/4)$

3. Develop codes to simulate, and plot the results for an exponential signal: $x(t) = k e^{-at}u(t)$ for the cases: (a) k = 1 and a = 0.35 (b) k =1.5 and a= -0.45
4. Sampling & Aliasing: Consider various human voice / speech (probably your voice both male and female) or music signals. Try different sampling rates and observe the effect of aliasing.
5. Find the convolution integral of Unit step and exponential signals and write a program to sketch the out response of the system. Also verify the commutative property of convolution integral.
6. Take any one periodic signal and find its Fourier series coefficients using exponential or trigono-metric FS method. Write a program to find its Fourier series coefficients. Also using FS coefficients, reconstruct the signal. Observe the effect of Gibbs phenomenon.
7. Real time speech signal and Spectral analysis The speech signal has frequency components in the audio frequency range 300 Hz to 3400 Hz of the electromagnetic spectrum. Record the male and female voice speech Signal. Write a program to record the speech signals and sketch it in time domain, its amplitude spectrum and phase spectrum.
8. The music signal has frequency components in the audio frequency range 20 Hz to 20000 Hz of the electromagnetic spectrum. 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.

Object-Oriented Programming Lab	
List of Laboratory Experiments (Any 9 and Mini Project compulsory)	
1.	**Class and Objects:** Write a program in C++ to perform following operations on complex numbers Add, Subtract, Multiply, Divide, Complex conjugate. Design the class for complex number representation and the operations to be performed. G
2.	**Java Basics**: Write a program in Java to find all the roots of a quadratic equation
3.	**Methods:** Write a program in Java using methods i) To find factorial of a given number. ii) To display first 50 prime numbers. iii) iii) To find sum and average of N numbers.
4.	**Constructor:** Create a Bank Account class with deposit, withdraw, and balance check functionalities.
5.	**Arrays & Strings**: Write a program in Java to sort i) List of Integers ii) List of Names
6.	**Two dimensional Arrays:** Write a Program in Java to add two matrices.
7.	**Inheritance:** Create a base class Employee and derived classes Manager, Developer with overridden salary computation.
8.	**Interface:** Implement a program using interfaces such as Vehicle with classes Car, Bike.
9.	**Abstract Class**: Demonstrate an example where both abstract class and interface are used in a payment gateway

	context.
10.	**Exception:** i) Write a program in JAVA using try and catch for exception handling. ii) Create a program to validate voter age using user-defined exceptions.
11.	**Threads:** Write a program to create multiple threads and demonstrate how two threads communicate with each other.
12.	Mini Project Compulsory (Group of 3)

Note: Practical No. 12 is Compulsory.

Virtual LAB Links:

1. Object Oriented Programming with C++:

Link of the Virtual Lab : https://cse02-iiith.vlabs.ac.in

2. Core Java Programming

Link of the Virtual Lab: https://java-iitd.vlabs.ac.in/

Savitribai Phule Pune University
Second Year of Electronics and Communication Engineering- (Advanced Communication Technology)
(2024 Course)

VSE-270-ECA: Electronics Skill Development Lab

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

Prerequisite Courses: Basics of Electronics Engineering, Fundamentals of programming

Companion Course: Universal Human Values (Practical)

Course Objectives:

1. To impart knowledge about electronics system development
2. To make aware various tools and techniques for testing, simulation and PCB design
3. To acquaint industry standards for product development

Course Outcomes:

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

CO1: Build application specific electronic circuit/system.
CO2: Use various measuring, debugging and EDA tools effectively.
CO3: Exercise prototype towards product development.

Tutorial shall be covered based on the following within 15 hrs per semister	
A: Electronic circuit/system Basics	
1.	Introduction and Identification of active and passive components with circuit connections using breadboard.
2.	Basic programming example with open source and proprietary microcontroller platforms.
3.	Sensor and actuator interfacing with microcontroller.
4.	Integrating communication capability (Wired and wireless) with microcontroller.
5.	Estimation of power budget and subsequent selection of power source/battery for the application.
B: Simulation, Testing and PCB Design	
6.	Simulation of above designed electronics circuit/system with simulation software and PCB lay outing using appropriate EDA tool.
7.	Soldering of component on the fabricated PCB.
8.	Testing and debugging of built circuit/system with an appropriate measuring and debugging tools. e.g. EMI/EMC
C: Prototype to Product Conversion	
9.	Design considerations for the enclosure
10.	Case study of prototype system to product conversion.
11.	Report and manual preparation for the system developed.

Text Books

1. Simulation Softwares Help Manual (Examples. Multisim, Proteus, Altium Design).
2. Principles of Measurement Systems by John P. Bently (Pearson).
3. PCB Design and Layout Fundamentals for EMC, by Roger Hu
4. https://www.eitkw.com/wpcontent/uploads/2020/03/Arduino_Projects_Book.pdf?srsltid=AfmBOoraDaL3Q5_vDUB0CY6D_gLik6-53lYuwvXktbJlgzVk8z5T7ZoD
5. Electronic Instrumentation; by H. S. Kalsi; McGraw-Hill Education India Pvt. Ltd.
6. Modern Electronic Instrumentation and measurement Techniques; by A.D. Helfrich and W.D. Cooper, PHI publication
7. Printed Circuit Boards: Design and Technology; Walter C Bosshart; McGraw Hill Education

Reference Books

1. Electrical and Electronic Measurements and Instrumentation by A. K. Sawhney; Dhanpati Rai & Co.
2. Printed Circuits Handbook, Seventh Edition: 50th Anniversary Edition (ELECTRONICS), Clyde Coombs, Happy Holden, McGraw-Hill Education India Pvt. Ltd.
3. Instrumentation measurement and Analysis by B.C. Nakra, K.K. Chaudhary D. Roy Choudhury and Shail B. Jain, Linear integrated Circuits, 5th Edition, New Age International Publishers
4. R S Khandpur, Printed Circuit Boards: Design - Fabrication and Assembly, Tata McGraw Hill
5. Simon Monk Hacking Electronics, McGraw Hill

Web Resources

1. https://github.com/arduino/Arduino
2. https://spoken-tutorial.org/tutorialsearch/?search_foss=Arduino&search_language=English
3. https://worldskillsindia.co.in/worldskill/file/2019/Electronics.pdf

Savitribai Phule Pune University Second Year of Electronics and Communication Engineering- (Advanced Communication Technology) (2024 Course)		
AEC-281- ECA: Modern Indian Language (Marathi)		
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:

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.

Course Contents

Unit I & II - (07 & 08 Hours)

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

Case Study:

Unit III & IV - (07 & 08 Hours)

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

Text Books:

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 Communication Engineering- (Advanced Communication Technology) (2024 Course)		
AEC-281- ECA: Modern Indian Language (Hindi)		
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:

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।

Course Contents

Unit I & II - (07 & 08 Hours)

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।

Case Study:

Unit III & IV - (07 & 08 Hours)

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

Text Books:

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 and Communication Engineering- (Advanced Communication Technology) (2024 Course)		
EEM-241- ECA : 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' batch wise.

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 entrepreneur- ship. Brainstorming: Rules of effective brainstorming. Individual vs. group brainstorming. Mind Mapping: Visual idea structuring using central themes and branches. Tools (manual and digital) for mind mapping.

Understanding Customer Needs and Pain Points: Customer pain points and their identification, Problem-solution fit: Linking pain points to possible solutions. Observational techniques, user 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 of- fers. Addressing customer pain points. Customer Segments: Identifying target customers. Creating customer personas Revenue Models: Direct sales, subscriptions, freemium, licensing, etc.

Basic Market Research for Validation: Importance of market research in early-stage business 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. Position- ing 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 con- tent 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/

You Tube Links:

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

List of Assignments to be performed 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 Communication Engineering- (Advanced Communication Technology) (2024 Course)		
VEC-251- ECA - Environment Awareness		
Teaching Scheme	**Credits**	**Examination Scheme**
Theory : 02 Hours/Week	02	**CCE** : 15 Marks **End-Semester** : 35 Marks

Course Objectives: The course aims to:

1. To introduce the multidisciplinary nature and scope of environmental studies.
2. To understand ecosystem structures, biodiversity, and ecological balance through hands-on observation 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: Upon successful completion of this 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

Unit I - Environment and its Issues (07 Hours)

a) Environment Meaning of Environment, Types of Environment, Components of Environment
b) Man- Environment relationship, importance of environment
c) Need for Public Awareness
d) Ecosystem-Meaning, Major Components of Ecosystem
e) Case studies of Forest Ecosystem, Grassland Ecosystem, Desert Ecosystem, Aquatic Ecosystem
f) Stability of Ecosystem in Sustainable Environment

Unit II - Environment Pollution (07 Hours)

a) Definition of Pollution, Types of Pollution
b) Air Pollution-Meaning, Sources, effects of air pollution, Air Pollution Act
c) Water Pollution Meaning, Sources, Effects of Water pollution, Water Pollution Act
d) Noise Pollution Meaning, Sources, Effect of Noise Pollution
e) Solid Waste Pollution Meaning, sources, Effect of Waste Pollution

Unit III - e-Waste Managements and Acts (08 Hours)

e-waste; composition and generation. Global context in e-waste; e-waste pollutants, e-waste hazardous properties, Effects of pollutant (e-waste)on human health and surrounding environment, domestic e-waste disposal, Basic principles of e-waste management, Technologies for recovery of resources from electronic waste, resource recovery potential of e-waste, steps in recycling and recov- ery of materials - mechanical processing, technologies for recovery of materials, occupational and environmental health perspectives of recycling e-waste in India.

Unit IV - e-Waste Control and Measures (07 Hours)

Need for stringent health safeguards and environmental protection laws in India, Extended Producers Responsibility (EPR), Import of e-waste permissions, Producer-Public-Government cooperation, Administrative Controls & Engineering controls, monitoring of compliance of Rules, Effective regula tory mechanisms strengthened by manpower and technical expertise, Reduction of waste at source in India.

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

Text Books:

1. Odum, Eugene P. “Fundaentals 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 Links:

1. https://www.environment.gov.in
2. https://www.unep.org
3. https://news.mit.edu/2013/ewaste-mit

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