

XAVIER INSTITUTE OF ENGINEERING

Mahim, Mumbai 400016

<https://xavier.ac.in/>



(An Autonomous Institute under Mumbai University,
Approved by AICTE and recognized by DTE,
Government of Maharashtra)

Accredited with an "A+" grade by NAAC)

Department of Electronics and Computer Engineering

Curriculum Structure FY to B. Tech.

&

Second Year Syllabus

**Prepared by: Board of Studies for Electronics and Computer
Engineering**

Approved By: Academic Council of Xavier Institute of Engineering

Effective from: 2026-27

B. Tech

Electronics and Computer Engineering

Second Year Undergraduate Curriculum Structure

Effective from

Academic Year 2026–27

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Preamble

Greetings and Congratulations to all stakeholders.

The Xavier Institute of Engineering is pleased to announce that the University Grants Commission, vide letter No. F. 2-10/2023(AC-Policy) dated 30th May 2025, conferred Autonomous Status upon the college for a period of ten years, from the academic year 2025–26 to 2034–35, as per clause 7.5 of the UGC (Conferment of Autonomous Status Upon Colleges and Measures for Maintenance of Standards in Autonomous Colleges) Regulations, 2023.

This milestone is not merely an institutional achievement; it is a meaningful opportunity for the learner. Autonomy provides us with the freedom and responsibility to design a curriculum that is responsive to your aspirations, sensitive to the needs of Indian society, and aligned with the expectations of modern industry. In accordance with the Government of Maharashtra Resolution dated 4th July 2023, and in alignment with the National Education Policy 2020, UGC Regulations, AICTE norms, and the National Credit Framework, this curriculum has been carefully structured to make engineering education more flexible, relevant, skill-oriented, outcome-based, and future-ready.

We are proud to welcome you to the holistic curriculum designed for the Batch of 2025–29, developed on the principles of Outcome-Based Education (OBE) and guided by Bloom's taxonomy. This approach shifts the focus from simply asking "What is taught?" to the more important question: "What will the student be able to do?" Every course, laboratory, project, internship, and learning activity is planned with clear outcomes to ensure that you gradually develop the ability to understand, apply, analyze, evaluate, and create.

As engineering students, you are beginning a transformative journey. This curriculum is designed to help you build strong foundations in science, mathematics, and core engineering, while also giving you opportunities to explore electives, multidisciplinary minors, humanities, management, professional skills, projects, internships, and employable skill-based courses aligned with the National Skill Development Corporation (NSDC). You will also have meaningful academic choices, including pathways toward Honors, Double Minor, or Honors with Research, allowing you to shape your learning journey according to your interests and career goals.

This outcome-based model emphasizes learning by doing. You will learn not only from classrooms and textbooks, but also through discussions, teamwork, experimentation, innovation, problem solving, industry exposure, and research-oriented activities. The aim is to help you become confident, competent, ethical, creative, and socially responsible engineering professionals.

We believe that this curriculum will raise academic standards and make learning more joyful, engaging, and purposeful. However, its success depends on active participation, curiosity, discipline, and ownership of learning. We invite you to embrace this opportunity with enthusiasm and commitment to the cause.

Welcome to a new era in engineering education.

The journey begins with you.

Curriculum Structure and Examination Scheme — Second Year Engineering, Semester III

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credit Assigned				Examination Scheme					
		Theory	Practical	Tutorial	Theory	Tutorial	Practical	Total Credits	In-semester Assessment		End Sem Exam (ESE)	Exam Duration for Theory (in Hrs)		Total
									Continuous Assessment	Mid-Sem Exam		Mid Sem	End Sem	
EC3PCC2	Mathematics for Electronics & Computer Engineering - 3	3	-	-	3	-	-	3	20	30	50	1.5	2	100
EC3PCC3	Analog Electronics Circuits	3	-	-	3	-	-	3	20	30	50	1.5	2	100
EC3PCC4	Electronic Instrumentation and Control Systems	3	-	-	3	-	-	3	20	30	50	1.5	2	100
EC3PCC5	Database Management System	3	-	-	3	-	-	3	20	30	50	1.5	2	100
EC3PCL1	Analog Electronics Circuits Lab	-	2	-	-	-	1	1	25	-	25	-	-	50
EC3PCL2	Database Management System Lab	-	2	-	-	-	1	1	25	-	25	-	-	50
EC3VSEC3	Full Stack Java Programming Lab	-	2*+2	-	-	-	2	2	50	-	25	-	-	75
SY3VEC1	Design Thinking	2	-	-	2	-	-	2	50	-	-	-	-	50
SY3LLC1x	Liberal Learning Course1	2	-	-	2	-	-	2	50	-	-	-	-	50
SY3EEM	Entrepreneurship Development	2	-	-	2	-	-	2	50	-	-	-	-	50
Total		18	8	0	18	0	4	22	330	120	275	6	8	725
<i>* Instructions should be conducted for the entire class</i>														

Liberal Learning Courses	
Course Code	Course Name
SY3LLC11	Digital Solutions for Video Recording and Editing
SY3LLC12	Health and Wellness
SY3LLC13	Personality Development
SY3LLC14	Beginner Level German
SY3LLC15	Beginner Level French

Curriculum Structure and Examination Scheme — Second Year Engineering, Semester IV

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credit Assigned				Examination Scheme					
		Theory	Practical	Tutorial	Theory	Tutorial	Practical	Total Credits	In-semester Assessment		End Sem Exam (ESE)	Exam Duration for Theory (in Hrs)		Total
									Continuous Assessment	Mid-Sem Exam		Mid Sem	End Sem	
EC4PCC6	Basics of VLSI	3	-	-	3	-	-	3	20	30	50	1.5	2	100
EC4PCC7	Microcontrollers	3	-	-	3	-	-	3	20	30	50	1.5	2	100
EC4PCC8	Data Structures and Algorithms	3	-	-	3	-	-	3	20	30	50	1.5	2	100
EC4PEC1x	Program Elective 1	3	-	-	3	-	-	3	20	30	50	1.5	2	100
XX4MDM1Y**	Multidisciplinary Minor 1	3	-	-	3	-	-	3	20	30	50	1.5	2	100
SY4VEC2	Universal Human Values	2	-	-	2	-	-	2	50	-	-	-	-	50
EC4PCL3	Microcontrollers Lab	-	2	-	-	-	1	1	25	-	25	-	-	50
EC4PCL4	Data Structures and Algorithms Lab	-	2	-	-	-	1	1	25	-	25	-	-	50
EC4PEL1x	Program Elective Lab 1	-	2	-	-	-	1	1	25	-	25	-	-	50
Total		17	6	0	17	0	3	20	225	150	325	7.5	10	700

**Four theory courses (3 credits each) and one laboratory course (1 credit) offered by other departments must be taken by Electronics and Computer Engineering students to fulfil the 13-credit MDM requirement.

Program Elective 1			
EC4PEC1X Details		EC4PEL1X Details	
Course Code	Course Name	Course Code	Course Name
EC4PEC11	Analog Communication	EC4PEL11	Analog Communication Laboratory
EC4PEC12	Data Compression and Encryption	EC4PEL12	Data Compression and Encryption Laboratory
EC4PEC13	NoSQL Databases	EC4PEL13	NoSQL Databases Laboratory
EC4PEC14	Linear Integrated Circuits	EC4PEL14	Linear Integrated Circuits Laboratory

Syllabus – Second Year Semester-III

Course Type	Course Code	Course Name			Credits	
PCC	EC3PCC2	Mathematics for Electronics & Computer Engineering - 3			03	
Examination Scheme						
Distribution of Marks				Exam Duration (Hrs.)		Total Marks
In-Semester Assessment		End Semester Assessment (ESE)	MSE	ESE	100	
Continuous Assessment	Mid Semester Exam (MSE)					
20	30		50	1.5		2

Course Objectives:

1. To introduce fundamental mathematical and statistical concepts used in engineering applications.
2. To develop analytical and problem-solving skills for engineering and data-driven problems.
3. To familiarize students with transforms, statistical techniques and sampling theory.
4. To build a foundation for applications in data science, AI, Machine learning.

Course Outcomes:

1. apply Laplace Transform for solving ordinary differential equations.
2. express a given periodic function into Fourier series.
3. apply Z-transform to discrete functions/signals.
4. find eigenvalues and eigenvectors of the matrix, apply Cayley Hamilton theorem, and distinguish diagonalizable matrices.
5. calculate the coefficient of correlation between two variables and interpret given regression lines.
6. to study the concepts of probability distributions and sampling theory.

Detailed Syllabus:

Sr. No.	Name of Module	Course Details	Hours	CO Mapping
I	Laplace Transform	• Laplace Transform & Inverse Laplace Transforms of standard functions like e^{at}, $\sin at$, $\cos at$, $\sinh at$, $\cosh at$ and t^n where $t^n, n \geq 0$ (without proof). • First Shifting theorem, Laplace Transform of derivatives and integrals (Properties without proof) • Inverse Laplace transform using First Shifting Theorem, Partial fractions method. • Applications of Laplace Transforms for Solutions to ODE to electrical & electronics circuit problems. (Only first order differential equations). Self-learning Topics: Heaviside & Dirac Delta function, Applications of Laplace Transforms for Solutions to ODE (Higher order differential equations)	7	CO1
II	Fourier Series	• Fourier series of periodic function with period 2π and $2l$. • Fourier series of even and odd functions in $(-l, l)$, • Complex form of Fourier Series $(-\infty, \infty)$ (No deductions on the basis of Fourier Series) Self-learning Topics: Parseval's Identity, Half-range Cosine/sine Series, Fourier Integral	6	CO2
III	Z-Transform	• Definition and Region of Convergence, Transform of Standard Functions: $\{k^n a^k\}, \{a^k\}, \{\sin(ak + b)\}$. • Properties of Z Transform: Change of Scale, Shifting Property, Convolution theorem. • Inverse Z transform: Partial Fraction • Method. Question related to (ECE engineering) Self-learning Topics: Initial value theorem, Final value theorem, Inverse Using Convolution Theorem	6	CO3

IV	Linear Algebra (Theory of Matrices)	- Characteristic Equation, Eigenvalues and Eigenvectors, and properties of eigenvalues (without proof) - Similarity of matrices, diagonalizable and non-diagonalizable matrices. Self-learning Topics: Cayley-Hamilton Theorem and its usage in reduction of higher degree polynomials Derogatory and non-derogatory matrices, Function of a square Matrix.	6	CO4
V	Statistical Techniques	- Karl Pearson's Coefficient of correlation (r). - Spearman's Rank correlation coefficient (R) (repeated and non-repeated ranks) - Lines of regression. - Fitting of first- and second-degree curves. Self-learning Topics: Covariance, fitting of exponential curve.	6	CO5
VI	Probability Distribution and Sampling Theory	- Probability Distribution: Poisson and Normal distribution (simple problems in finding probability only to be included). - Sampling distribution, Test of Hypothesis, Level of Significance, Critical region, One-tailed, and two- tailed test, Degree of freedom. - Test significance for large samples. Test the significance of mean and Difference between the means of two large samples. - Students' t-distribution (Small sample). Test the significance of mean and Difference between the means of two samples. Self-learning Topics: Estimate parameters of a population., Chi-Square Test: Test of goodness of fit and independence of attributes, Contingency table, Yate's Correction.	8	CO6
Total			39	

Text Books:

- [1] R. K. Jain and S. R. K. Iyengar, *Advanced Engineering Mathematics*, 3rd ed. New Delhi, India: Narosa, 2002.
- [2] A. R. Vashishta and J. N. Sharma, *Linear Algebra*. Meerut, India: Krishna Prakashan, 2004.
- [3] S. C. Gupta and V. K. Kapoor, *Fundamentals of Mathematical Statistics*, 11th ed. New Delhi, India: S. Chand, 2002.

References:

- [1] B. S. Grewal, *Higher Engineering Mathematics*, 45th ed. New Delhi, India: Khanna Publishers, 2018.
- [2] E. Kreyszig, *Advanced Engineering Mathematics*, 9th ed. Hoboken, NJ, USA: John Wiley & Sons, 2006.
- [3] S. Pal and S. C. Bhunia, *Engineering Mathematics*. New Delhi, India: Oxford University Press, 2015.
- [4] H. K. Dass, *Advanced Engineering Mathematics*, 22nd ed. New Delhi, India: S. Chand Publications, 2018.
- [5] B. V. Ramana, *Higher Engineering Mathematics*. New Delhi, India: Tata McGraw-Hill Education, 2007

Online references:

1. "Linear Algebra Course" Swayam, NPTEL, Available: https://swayam.gov.in/search_courses?searchText=linear%20algebra
2. "Mathematics Transform Calculus and its Applications in Differential Equations," Swayam, NPTEL, Available: https://onlinecourses.nptel.ac.in/noc26_ma40/preview
3. "Introduction to Probability Theory and Statistics," Swayam, NPTEL, Course ID: noc26_ma25. Available: https://onlinecourses.nptel.ac.in/noc26_ma25/preview

A. In-Semester Assessment (50 Marks)

1. Continuous Internal Assessment (20 Marks)

- a) 15 Marks = Use any 4 tools from Annexure I (2 tools before MSE and 2 tools after MSE)
- b) 5 Marks = Attendance and Active participation

2. Mid Semester Exam (30 Marks)

Mid semester examination will be based on 40% to 50% syllabus.

B. End Semester Examination (50 Marks)

End Semester Examination will be based on syllabus coverage up to the Mid Semester Examination (MSE) carrying 20% to 30% weightage, and the syllabus covered from MSE to ESE carrying 70% to 80% weightage.

Course Type	Course Code	Course Name			Credits
PCC	EC3PCC3	Analog Electronics Circuits			03
Examination Scheme					
Distribution of Marks			Exam Duration (Hrs.)		Total Marks
In-Semester Assessment		End Semester Assessment (ESE)	MSE	ESE	100
Continuous Assessment	Mid Semester Exam (MSE)				
20	30				
		50	1.5	2	

Prerequisite:

1. Fundamental of Electrical and Electronics System (FEES)

Course Objectives:

1. To understand the fundamentals of semiconductor devices and analyze the characteristics and applications of diodes, BJTs, JFETs, and MOSFETs.
2. To analyze and design biasing circuits and small-signal amplifiers using BJT and MOSFET devices, and evaluate their performance parameters.
3. To study the frequency response of amplifiers and analyze the operation, efficiency, and practical considerations of large-signal (power) amplifiers.
4. To understand the principles, operation, and applications of differential amplifiers, including common-mode and differential-mode analysis.

Course Outcomes:

1. Analyze the characteristics and operation of pn junction diodes, Zener diodes, BJT, JFET, and MOSFET devices.
2. Design and analyze biasing circuits for BJT, JFET, and MOSFET using load line analysis and Q-point stabilization.
3. Evaluate small signal amplifier parameters (gain, input/output impedance) using appropriate models.
4. Analyze the frequency response of amplifiers considering the effects of capacitive elements and determine bandwidth.
5. Compare and analyze power amplifiers (Class A, B, AB) and evaluate their efficiency and thermal performance.
6. Analyze differential amplifier performance including gain, CMRR, and operation under common and differential modes.

Detailed Syllabus:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Introduction of Electronic Devices	Study of pn junction diode characteristics & diode current equation. Application of Zener diode as a voltage regulator. Construction, working and characteristics of BJT, JFET, and E-MOSFET Self-learning Topics: Recent applications of Zener diodes in voltage regulation (e.g. power supplies, protection circuits)	5	CO1
II	Biasing Circuits of BJTs and MOSFETs	Concept of DC load line, Q point and regions of operations, Analysis and design of biasing circuits for BJT (Fixed bias & Voltage divider Bias). DC load line and region of operation for MOSFETs. Analysis and design of biasing circuits for JFET (self-bias and voltage divider- bias), Depletion and Enhancement MOSFET (Drain to Gate bias & voltage divider bias). Self-Learning Topic: Simulation of biasing circuits using software like LTspice / Multisim	8	CO2
III	Small Signal Amplifiers	Concept of AC load line and Amplification, Small signal analysis (Z_i , Z_o , A_v and A_i) of CE amplifier using hybrid pi model. Small signal analysis (Z_i , Z_o , A_v) of CS (for E-MOSFET) amplifiers. Introduction to multistage amplifiers (Concept, advantages & disadvantages). Self-Learning Topic: Comparison of CE and CS amplifiers in real-world circuits.	6	CO3

IV	Frequency response of Small Signal Amplifiers	Effects of coupling, bypass capacitors and parasitic capacitors on frequency response of single stage amplifier, Miller effect and Miller capacitance. High and low frequency analysis of CE amplifier. High and low frequency analysis of CS (E-MOSFET) amplifier Self-Learning Topic: Bandwidth improvement techniques in amplifiers	8	CO4
V	Large Signal Amplifiers	Difference between small signal & large signal amplifiers. Classification and working of Power amplifier. Analysis of Class A power amplifier (Series fed and transformer coupled). Transformer less Amplifier: Class B power amplifier. Class AB output stage with diode biasing. Thermal considerations and heat sinks. Self-Learning Topic: Working of audio power amplifiers in home theater systems	6	CO5
VI	Introduction to Differential Amplifiers	E-MOSFET Differential Amplifier, DC transfer characteristics, operation with common mode signal and differential mode signal. Differential and common mode gain, CMRR, differential and common mode Input impedance. Two transistor (E-MOSFET) constant current source. Self-Learning Topic: Role of differential amplifiers in noise reduction and signal processing	6	CO6
Total			39	

Text Books:

- [1] D. A. Neamen, *Electronic Circuit Analysis and Design*, 2nd ed. New York, NY, USA: Tata McGraw Hill, 2009.
- [2] A. S. Sedra, K. C. Smith, and A. N. Chandorkar, *Microelectronic Circuits Theory and Applications*, 6th ed. New York, NY, USA: Oxford University Press, 2014.
- [3] S. Franco, *Design with Operational Amplifiers and Analog Integrated Circuits*, vol. 1988. New York, NY, USA: McGraw-Hill, 2002.

Reference Books:

- [1] R. L. Boylestad and L. Nashelsky, *Electronic Devices and Circuit Theory*, 11th ed. Upper Saddle River, NJ, USA: Pearson Education, 2012.
- [2] A. K. Maini, *Electronic Devices and Circuits*. Hoboken, NJ, USA: Wiley, 2009.
- [3] T. L. Floyd, *Electronic Devices*, 9th ed. Upper Saddle River, NJ, USA: Prentice Hall, 2012.
- [4] S. Salivahanan and N. S. Kumar, *Electronic Devices and Circuits*, 3rd ed. New York, NY, USA: Tata McGraw Hill, 2012.
- [5] D. A. Bell, *Electronic Devices and Circuits*. Upper Saddle River, NJ, USA: Prentice-Hall of India, 1999.

Online References:

1. S. Chatterjee, "Analog Electronic Circuit," Swayam, IIT Delhi, Course ID: noc20_ee89.
Available: https://swayam.gov.in/nd1_noc20_ee89/preview
2. J. Mukherjee, "Analog Circuits," Swayam, NPTEL, IIT Bombay, Course ID: noc25_ee04.
Available: https://onlinecourses.nptel.ac.in/e-learning/preview/noc25_ee04
3. S. Chatterjee, "Analog Electronic Circuit," Swayam, NPTEL, IIT Delhi, Course ID: noc25_ee103.
Available: https://onlinecourses.nptel.ac.in/e-learning/preview/noc25_ee103

Assessment:

A. In-Semester Assessment (50 Marks)

1. Continuous Internal Assessment (20 Marks)

- a) 15 Marks = Use any 4 tools from Annexure I (2 tools before MSE and 2 tools after MSE)
- b) 5 Marks = Attendance and Active participation

2. Mid Semester Exam (30 Marks)

Mid semester examination will be based on 40% to 50% syllabus.

B. End Semester Examination (50 Marks)

End Semester Examination will be based on syllabus coverage up to the Mid Semester Examination (MSE) carrying 20% to 30% weightage, and the syllabus covered from MSE to ESE carrying 70% to 80% weightage.

Course Type	Course Code	Course Name			Credits
PCC	EC3PCC4	Electronic Instrumentation and Control Systems			03
Examination Scheme					
Distribution of Marks			Exam Duration (Hrs.)		Total Marks
In-Semester Assessment		End Semester Assessment (ESE)	MSE	ESE	100
Continuous Assessment	Mid Semester Exam (MSE)				
20	30				
		50	1.5	2	

Prerequisite:

1. Basic Electrical Engineering

Course Objectives:

1. Explain the fundamentals of sensors and transducers.
2. Apply mathematical modeling techniques to control systems.
3. Analyze the time and frequency response of control systems.
4. Analyze the stability of control systems using appropriate stability criteria.

Course Outcomes:

1. Identify various sensors and transducers and describe their basic performance specifications.
2. Explain the working principles of transducers used for measuring temperature, displacement, level, and pressure, and their industrial applications.
3. Develop mathematical models of physical systems suitable for analysis and design of control systems.
4. Determine the transfer function of a given control system.
5. Analyze control system performance in the time domain and frequency domain.
6. Analyze the stability of a given control system using appropriate stability criteria.

Detailed Syllabus:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Principle of Measurement, Testing and Measuring instruments	Components of a generalized measurement system, accuracy, precision, linearity, sensitivity, resolution, hysteresis, and calibration. Measurement of Resistance – Kelvin's Double Bridge, Wheatstone Bridge, and Mega Ohm Bridge, Measurement of Inductance – Maxwell Bridge and Hay Bridge, Measurement of Capacitance – Schering Bridge. Self-learning Topics: Industrial Applications of AC and DC Bridges in Electrical Measurements.	4	CO1
II	Sensors and Transducers	Basics of Sensors and Transducers – Active and Passive Transducers, Characteristics of Transducers, and Selection Criteria of Transducers, Displacement and Pressure Measurement – Potentiometers, Pressure Gauges, Linear Variable Differential Transformer (LVDT) for measurement of displacement and pressure, and Strain Gauges, Temperature Transducers – Resistance Temperature Detectors (RTD), Thermistors, and Thermocouples, including their operating ranges and applications. Self-learning Topics: Case Study on Selection and Application of Transducers in Industrial Measurement Systems.	5	CO2
III	Introduction to control system Analysis	Introduction to Control Systems – Open-loop and Closed-loop Systems with examples of control systems, Transfer Function Model, Block Diagram Reduction	7	CO3

		Techniques and Signal Flow Graph. Self-learning Topics: Open-Loop and Closed-Loop Control Systems in real life applications.		
IV	Response of control system	Dynamic Response – Standard test signals, transient and steady state behavior of first and second order systems, steady state errors in feedback control systems and their types, Concept of lag and lead compensator. Self-learning Topics: Simulation of first and second order system responses using standard test signals to evaluate rise time, settling time, and overshoot using MATLAB/ Python.	7	CO4
V	Stability Analysis in Time Domain	Concept of stability – Routh and Hurwitz stability criterion, Root locus Analysis – Root locus concept, general rules for constructing root-locus, root locus analysis of control system. Self-learning Topics: Simulation for stability analysis of control systems using the Routh–Hurwitz criterion and Root Locus technique using MATLAB/Python.	8	CO5
VI	Stability Analysis in Frequency Domain	Frequency domain specification, Relationship between time and frequency domain specification of system, stability margins, Bode Plot – Magnitude and phase plot, Method of plotting Bode plot, Stability margins and analysis using bode plot, Nyquist Criterion – Concept of Polar plot and Nyquist plot. Self-learning Topics: Simulation for frequency domain analysis of control systems using Bode plot to study stability margins in MATLAB/Python.	8	CO6
Total			39	

Text Books:

- [1] A. K. Sawhney, *Electrical & Electronic Measurement & Instrumentation*, 4th ed. New Delhi, India: Dhanpat Rai & Co., 1991.
- [2] B. C. Nakra and K. K. Chaudhry, *Instrumentation Measurement and Analysis*, 3rd ed. New Delhi, India: Tata McGraw-Hill, 2012.
- [3] I. J. Nagrath and M. Gopal, *Control System Engineering*, 4th ed. New Delhi, India: New Age International, 2006.
- [4] K. Ogata, *Modern Control Engineering*, 3rd ed. Upper Saddle River, NJ, USA: Pearson Education, 1996.

Reference Books:

- [1] A. D. Helfrick and W. D. Cooper, *Modern Electronic Instrumentation and Measurement Techniques*. New Delhi, India: PHI Learning, 1996.
- [2] M. M. S. Anand, *Electronic Instruments and Instrumentation Technology*. New Delhi, India: PHI Learning, 2010.
- [3] M. Gopal, *Control Systems: Principles and Design*. New Delhi, India: Tata McGraw-Hill Publishing Co., 1998.
- [4] N. S. Nise, *Control Systems Engineering*, 3rd ed. New York, NY, USA: John Wiley & Sons, 2000.

Online References:

1. "Electrical Measurement and Electronic instruments," *NPTEL*, IIT Madras, Course ID: noc24_ee117.
Available: https://onlinecourses.nptel.ac.in/noc24_ee117/preview
2. "Industrial Instrumentation," *NPTEL*, IIT Kharagpur, Course ID: 108105064, Jul. 2017.
Available: <https://nptel.ac.in/courses/108105064>
3. S. MA, "Control Systems Engineering from Scratch," *Udemy*, Feb. 2022. Available: <https://www.udemy.com/course/control-systems-engineering-from-scratch/>
4. "Control Systems Analysis: Modeling of Dynamic Systems," *Coursera*, University of Colorado Boulder.
Available: <https://www.coursera.org/learn/modeling-feedback-systems>
5. S. Chatterjee, "Analog Electronic Circuit," *Swayam*, IIT Delhi, Course ID: noc20_ee89.
Available: https://swayam.gov.in/nd1_noc20_ee89/preview

Assessment:

A. In-Semester Assessment (50 Marks)

1. Continuous Internal Assessment (20 Marks)

- a) 15 Marks = Use any 4 tools from Annexure I (2 tools before MSE and 2 tools after MSE)
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2. Mid Semester Exam (30 Marks)

Mid semester examination will be based on 40% to 50% syllabus.

B. End Semester Examination (50 Marks)

End Semester Examination will be based on syllabus coverage up to the Mid Semester Examination (MSE) carrying 20% to 30% weightage, and the syllabus covered from MSE to ESE carrying 70% to 80% weightage.

Course Type	Course Code	Course Name			Credits
PCC	EC3PCC5	Database Management System			03
Examination Scheme					
Distribution of Marks			Exam Duration (Hrs.)		Total Marks
In-Semester Assessment		End Semester Assessment (ESE)	MSE	ESE	100
Continuous Assessment	Mid Semester Exam (MSE)				
20	30				
		50	1.5	2	

Prerequisite:

1. C and Python Programming

Course Objectives:

1. To understand the fundamentals of Database Management System.
2. To design and implement relational databases using SQL.
3. To apply normalization and transaction management techniques.
4. To explore NoSQL databases and their applications.

Course Outcomes:

1. Identify the need for a Database Management System (DBMS).
2. Construct a conceptual and relational model for real-world applications.
3. Formulate queries using SQL commands.
4. Apply the concept of normalization to relational database design.
5. Demonstrate the concepts of transaction and concurrency techniques.
6. Explore NoSQL databases.

Detailed Syllabus:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Introduction to Database	Introduction, Characteristics of Databases, File System v/s Database System, Data Abstraction and Data Independence, DBMS System Architecture, Users of DBMS, Role of Database Administrator (DBA). Self-learning Topics: Identify the types of Databases.	5	CO1
II	The Entity-Relationship and Relational Model	The Entity-Relationship (ER) Model: Entity types: Weak and strong entity sets, entity sets, types of attributes; Relationship constraints: Cardinality and participation; Extended Entity-Relationship (EER) Model: Generalization, specialization, and Aggregation. Introduction to the relational model, relational schema, and concept of keys. Mapping ER and EER Model to the Relational Model, relational algebra operators (selection (σ), projection (π), union (Selection(σ), Projection(π), Union ($\cup$), Difference ($-$), Cartesian Product ($\times$), Join ($\bowtie$), Intersection ($\cap$), Rename (ρ)) Self-learning Topics: Design an ER model for any real-time case study. Practice relational algebra queries.	10	CO2
III	Structured Query Language (SQL)	Overview of SQL, Data Definition Commands, Integrity constraints: key constraints, Domain Constraints, Referential integrity, check constraints, data manipulation commands, data control commands, and transaction control commands. aggregate functions—group by, having, order by, joins, Nested and complex queries, Views in SQL, Set and string operations, Triggers, Function and	9	CO3

		procedures in SQL Self-learning Topics: LeetCode (SQL practice problems), HackerRank (SQL challenges)		
IV	Database Normalization	Design guidelines for relational schema, concept of normalization, functional dependencies, 1NF, 2NF, 3NF, BCNF, Lossless Decomposition. Self-learning Topics: Study and explore higher normal forms such as 4NF, 5NF and 6NF.	5	CO4
V	Transaction Management and Concurrency Control	Transaction concept, Transaction states, ACID properties, Concurrent Executions, Serializability-Conflict and View, Concurrency Control: Lock-based, Introduction to Deadlock handling, Timestamp-based protocols. Self-learning Topics: Study of various deadlock situations that may occur for a database design.	6	CO5
VI	Introduction of NoSQL	Overview of NoSQL: Definition, Features, Types, Differences between SQL and NoSQL, CRUD operations in MongoDB, Real-world applications of NoSQL Self-Learning Activity: Case Study on NoSQL database type	4	CO5
Total			39	

Text Books:

- [1] A. Silberschatz, H. F. Korth, and S. Sudarshan, *Database System Concepts*, 6th ed. New York, NY, USA: McGraw-Hill, 2010.
- [2] R. Elmasri and S. Navathe, *Fundamentals of Database Systems*, 6th ed. Harlow, Essex, England: Pearson, 2014.
- [3] R. Ramakrishnan and J. Gehrke, *Database Management Systems*, 3rd ed. Boston, MA, USA: McGraw-Hill, 2003.

Reference Books:

- [1] C. Coronel, S. Morris, and P. Rob, *Database Systems: Design, Implementation, and Management*, 7th ed. New Delhi, India: Cengage Learning India, 2007.
- [2] P. S. Deshpande, *SQL & PL/SQL for Oracle 11g Black Book*. New Delhi, India: Dreamtech Press, 2013.
- [3] G. K. Gupta, *Database Management Systems*. New Delhi, India: Tata McGraw Hill, 2011

Online References:

1. P. P. Das and S. Chattopadhyay, "Data Base Management System," *NPTEL*, IIT Kharagpur, Course ID: noc25_cs145, Jul. 2025. Available: https://onlinecourses.nptel.ac.in/noc25_cs145/preview
2. "Data Base Management System," *Swayam*, CEC, Course ID: cec26_cs08. Available: https://onlinecourses.swayam2.ac.in/e-learning/preview/cec26_cs08
3. "Database Management," *MOOC List*. Available: <https://www.mooc-list.com/tags/database-management>
4. "SQL Tutorial," *W3Schools*, 2026. Available: <https://www.w3schools.com/sql/>
5. A. Petrov, *Database Internals*. Sebastopol, CA, USA: O'Reilly Media, 2019. Available: <https://www.oreilly.com/library/view/database-internals/9781492040330/>

Assessment:

A. In-Semester Assessment (50 Marks)

1. Continuous Internal Assessment (20 Marks)

- a) 15 Marks = Use any 4 tools from Annexure I (2 tools before MSE and 2 tools after MSE)
- b) 5 Marks = Attendance and Active participation

2. Mid Semester Exam (30 Marks)

Mid semester examination will be based on 40% to 50% syllabus.

B. End Semester Examination (50 Marks)

End Semester Examination will be based on syllabus coverage up to the Mid Semester Examination (MSE) carrying 20% to 30% weightage, and the syllabus covered from MSE to ESE carrying 70% to 80% weightage.

Course Type	Course Code	Course Name	Credits
PCL	EC3PCL1	Analog Electronics Circuits Lab	01
Examination Scheme			
Continuous Assessment		Practical/ Oral	Total Marks
25		25	50

Prerequisite:

1. Digital System Design

Lab Objectives:

1. To Understand the characteristics and applications of diodes, BJTs, JFETs, and MOSFETs.
2. To Analyze and design biasing circuits using load line and Q-point concepts.
3. To Evaluate the performance and frequency response of small signal amplifiers.
4. To Explain the operation of power amplifiers and differential amplifiers.

Lab Outcomes:

At the end of the course, students will be able to:

1. Perform and analyze the characteristics of semiconductor devices such as diodes, BJTs, JFETs, and MOSFETs.
2. Design and test biasing circuits and small signal amplifiers using transistor devices.
3. Evaluate amplifier performance parameters including gain, impedance, frequency response, and bandwidth.
4. Analyze the operation of power amplifiers and differential amplifiers using practical and simulation techniques.

List of Suggested Experiments:

(A minimum of 10 experiments covering the entire syllabus must be conducted in batches.)

Sr No.	Name of the Experiment	Hours	LO Mapping
I	Module 1: Introduction of Electronic Devices This module introduces semiconductor devices such as PN junction diode, Zener diode, BJT, JFET, and E-MOSFET. Students will study device characteristics, operating principles, and applications in electronic circuits. Suggested Experiments: 1. Study of V-I characteristics of PN junction diode and verification of diode current equation. 2. Study of Zener diode characteristics and application as voltage regulator. 3. Study of input and output characteristics of BJT in CE configuration. 4. Study of drain and transfer characteristics of JFET and E-MOSFET. 5. Simulation of diode and transistor characteristics using LTspice/ Multisim.	4	LO1
II	Module 2: Biasing Circuits of BJTs and MOSFETs This module focuses on DC load line analysis, Q-point determination, and biasing techniques for BJT, JFET, and MOSFET amplifiers. Students will analyze and design stable biasing circuits for transistor operation. Suggested Experiments: 1. Design and analysis of fixed bias and voltage divider bias circuits for BJT. 2. Determination of DC load line and Q-point for BJT amplifier. 3. Study of self-bias and voltage divider bias circuits for JFET. 4. Study of drain-to-gate bias and voltage divider bias for E-MOSFET. 5. Simulation of transistor biasing circuits using LTspice/ Multisim.	4	LO2

III	Module 3: Small Signal Amplifiers This module introduces AC load line concepts and small signal analysis of transistor amplifiers. Students will evaluate gain, input impedance, and output impedance of CE and CS amplifiers along with multistage amplifier concepts. Suggested Experiments: 1. Study of CE amplifier and determination of voltage gain, current gain, input impedance, and output impedance. 2. Study of CS amplifier using E-MOSFET and determination of amplifier parameters. 3. Frequency response analysis of CE amplifier. 4. Frequency response analysis of CS amplifier.	4	LO2 LO3
IV	Module 4: Frequency Response of Small Signal Amplifiers This module explains the effects of coupling, bypass, and parasitic capacitances on amplifier performance. Students will analyze low-frequency and high-frequency response of transistor amplifiers and study Miller effect. Suggested Experiments: 1. Study of low-frequency response of CE amplifier using coupling and bypass capacitors. 2. Study of low-frequency response of CE amplifier using coupling and bypass capacitors using LTspice/ Multisim. 3. Study of high-frequency response and Miller effect in CE amplifier.	4	LO3
V	Module 5: Large Signal Amplifiers This module introduces power amplifiers, their classifications, efficiency, and thermal considerations. Students will study Class A, Class B, and Class AB power amplifiers used in practical audio systems. Suggested Experiments: 1. Study and analysis of Class A power amplifier. 2. Study of Class B push-pull amplifier using LTspice/ Multisim.	2	LO4
VI	Module 6: Differential Amplifiers This module introduces E-MOSFET differential amplifiers and constant current sources. Students will study common mode and differential mode operation, gain parameters, input impedance, and CMRR. Suggested Experiments: 1. Study of E-MOSFET differential amplifier characteristics. 2. Simulation of differential amplifier for noise reduction applications using LTspice/ Multisim. 3. Study of two transistor E-MOSFET constant current source.	2	LO4

Text Books:

- [1] D. A. Neamen, Electronic Circuit Analysis and Design, 2nd ed. New York, NY, USA: Tata McGraw Hill, 2009.
- [2] A. S. Sedra, K. C. Smith, and A. N. Chandorkar, Microelectronic Circuits Theory and Applications, 6th ed. New York, NY, USA: Oxford University Press, 2014.
- [3] S. Franco, Design with Operational Amplifiers and Analog Integrated Circuits, vol. 1988. New York, NY, USA: McGraw-Hill, 2002.

Reference Books:

- [1] R. L. Boylestad and L. Nashelsky, Electronic Devices and Circuit Theory, 11th ed. Upper Saddle River, NJ, USA: Pearson Education, 2012.
- [2] A. K. Maini, Electronic Devices and Circuits. Hoboken, NJ, USA: Wiley, 2009.
- [3] T. L. Floyd, Electronic Devices, 9th ed. Upper Saddle River, NJ, USA: Prentice Hall, 2012.
- [4] S. Salivahanan and N. S. Kumar, Electronic Devices and Circuits, 3rd ed. New York, NY, USA: Tata McGraw Hill, 2012.
- [5] D. A. Bell, Electronic Devices and Circuits. Upper Saddle River, NJ, USA: Prentice-Hall of India, 1999.

Online References:

1. S. Chatterjee, "Analog Electronic Circuit," Swayam, IIT Delhi, Course ID: noc20_ee89. [Online]. Available: https://swayam.gov.in/nd1_noc20_ee89/preview
2. J. Mukherjee, "Analog Circuits," Swayam, NPTEL, IIT Bombay, Course ID: noc25_ee04. [Online]. Available: https://onlinecourses.nptel.ac.in/e-learning/preview/noc25_ee04
3. S. Chatterjee, "Analog Electronic Circuit," Swayam, NPTEL, IIT Delhi, Course ID: noc25_ee103. [Online]. Available: https://onlinecourses.nptel.ac.in/e-learning/preview/noc25_ee103

Assessment:**A. In-Semester Assessment (25 Marks)****1. Continuous Internal Evaluation (CIA)**

- a) 10 Marks – Laboratory work / Experiments
- b) 10 Marks - Use any 2 lab tools from Annexure I (one tool before MSE and one tool after MSE)
- c) 05 Marks – Attendance and Active participation

B. End-Semester Assessment (25 Marks)**1. Practical/ Oral Examination**

Practical/ Oral exams to be conducted based on the content of the syllabus.

Course Type	Course Code	Course Name	Credits
PCL	EC3PCL2	Database Management System Lab	01
Examination Scheme			
Continuous Assessment		Practical/ Oral	Total Marks
25		25	50

Prerequisite:

1. C and Python Programming

Lab Objectives:

1. To develop skills in database modeling and design.
2. To build relational databases using SQL.
3. To understand and apply advanced database techniques.
4. To explore NoSQL databases for efficient data management.

Lab Outcomes:

1. Design conceptual and relational database models for real-world problems.
2. Develop and implement RDBMS databases using SQL.
3. Apply advanced database concepts in practical applications.
4. Formulate NoSQL queries for handling data.

List of Suggested Experiments:

(A minimum of 10 experiments covering the entire syllabus must be conducted in batches.)

Sr. No	Detailed Content	Hours	LO Mapping
I	Topic: Entity Relationship and Relational Model 1.1 Design of Entity Relationship (ER) and Extended ER (EER) Diagrams for real-world problem statement 1.2 Conversion of E-R model to relational model	4	LO1
II	Topic: Structured Query Language (SQL) 2.1 Database Creation using DDL Commands and Integrity Constraints 2.2 Database Manipulation using DML Commands 2.3 Implementation of Aggregate Functions, GROUP BY, HAVING, and Set Operations 2.4 Implementation of SQL Joins, Nested Queries, and Complex Queries 2.5 Implementation of Views, Stored Procedures, Functions, and Triggers 2.6 Demonstration of DCL using GRANT, REVOKE	10	LO2
III	Topic: Transaction Management and Concurrency Control and Recovery 3.1 Implementation of Concurrency Control using Locking Mechanisms, and Deadlock Handling 3.2 Demonstration of TCL Commands using COMMIT, ROLLBACK, and SAVEPOINT 3.3 Demonstration of Database Connectivity	6	LO3
IV	Topic: Introduction of NoSQL 4.1 Study on NoSQL 4.2 Installation and Configuration of MongoDB Environment 4.3 Implementation of CRUD Operations in MongoDB	2	LO4

Text Books:

- [1] A. Silberschatz, H. F. Korth, and S. Sudarshan, *Database System Concepts*, 6th ed. New York, NY, USA: McGraw-Hill, 2010.
- [2] R. Elmasri and S. Navathe, *Fundamentals of Database Systems*, 6th ed. Harlow, Essex, England: Pearson, 2014.
- [3] R. Ramakrishnan and J. Gehrke, *Database Management Systems*, 3rd ed. Boston, MA, USA: McGraw-Hill, 2003.

Reference Books:

- [1] C. Coronel, S. Morris, and P. Rob, *Database Systems: Design, Implementation, and Management*, 7th ed. New Delhi, India: Cengage Learning India, 2007.
- [2] P. S. Deshpande, *SQL & PL/SQL for Oracle 11g Black Book*. New Delhi, India: Dreamtech Press, 2013.
- [3] G. K. Gupta, *Database Management Systems*. New Delhi, India: Tata McGraw Hill, 2011

Online References:

- 1. P. P. Das and S. Chattopadhyay, "Data Base Management System," *NPTEL*, IIT Kharagpur, Course ID: noc25_cs145, Jul. 2025. Available: https://onlinecourses.nptel.ac.in/noc25_cs145/preview
- 2. "Data Base Management System," *Swayam*, CEC, Course ID: cec26_cs08. Available: https://onlinecourses.swayam2.ac.in/e-learning/preview/cec26_cs08
- 3. "Database Management," *MOOC List*. Available: <https://www.mooc-list.com/tags/database-management>
- 4. "SQL Tutorial," *W3Schools*, 2026. Available: <https://www.w3schools.com/sql/>
- 5. A. Petrov, *Database Internals*. Sebastopol, CA, USA: O'Reilly Media, 2019. Available: <https://www.oreilly.com/library/view/database-internals/9781492040330/>

Assessment:**A. In-Semester Assessment (25 Marks)****1. Continuous Internal Evaluation (CIA)**

- a) 10 Marks – Laboratory work / Experiments
- b) 10 Marks - Use any 2 lab tools from Annexure I (one tool before MSE and one tool after MSE)
- c) 05 Marks – Attendance and Active participation

B. End-Semester Assessment (25 Marks)**1. Practical/ Oral Examination**

Practical/ Oral exams to be conducted based on the content of the syllabus.

Course Type	Course Code	Course Name	Credits
VSEC	EC3VSEC3	Full Stack Java Programming Lab	02
Examination Scheme			
Continuous Assessment		Practical/ Oral	Total Marks
50		25	75

Prerequisite:

1. C Programming

Lab Objectives:

1. To understand the basic concepts of Java programming, Java development environment, and program structure.
2. To learn and apply object-oriented programming concepts such as classes, objects, inheritance and exception handling in Java.
3. To develop GUI-based applications using Swing and connect Java applications with databases using JDBC.
4. To understand and develop client-side web applications using HTML, CSS and JavaScript.

Lab Outcomes:

1. Describe the basic concepts of Java programming, JVM, JRE, and program structure.
2. Develop programs using object-oriented programming concepts such as inheritance, multithreading, and exception handling.
3. Design GUI applications and database-driven programs using Swing and JDBC.
4. Develop interactive web pages using HTML, CSS, and JavaScript with form validation and DOM manipulation.

Detailed Laboratory Syllabus:

Sr. No.	Name of Module	Detailed Content	Hours	LO Mapping
I	Introduction	Introduction: History and Features of Java, JVM, JRE, JDK, Java Program Structure, Object-oriented programming concepts. Basic programming constructs: Input and output functions in Java: scanner class, Data Types, Variables, Operators, Control Statements. Classes & Objects: Class, object, data members, member functions, Types of Constructors, Constructor Overloading, static members and functions, Method Overloading. Array, Strings, String Buffer. Self-Learning Topics: Buffered reader class	6	LO1
II	Inheritance & Packages	Inheritance: Introduction to Inheritance, Types of Inheritance, Super Keyword, Method Overriding, final Keyword, dynamic method dispatch, abstract method, abstract classes, Interfaces Packages: User defined packages, Access specifiers Self-Learning Topics: Inheritance among interfaces	4	LO2
III	Exception Handling & Multithreading	Exception Handling: Introduction to Exception Handling, Types of Exceptions, try, catch, finally, throw, throws, user defined exception Multithreading: Thread Life Cycle, Runnable interface, thread class, Creating a Thread Self-learning Topics: thread synchronization	3	LO2
IV	Java Collections Framework	Java Collections Framework: Introduction to Java Collections Framework, Vectors, List, Set, Queue, and Map interfaces using Array List, LinkedList, HashSet, Linked HashSet, Tree Set, HashMap, and Tree Map. Concepts of Iterator, Comparable, and Comparator interfaces. Self-Learning Topics: Basics of TypeScript and Dart programming languages.	3	LO2

V	Swing and JDBC	Swing and JDBC Introduction to Swing and GUI programming including AWT vs Swing, components, containers, labels, buttons, checkboxes, radio buttons, lists, tables, menus, toolbars, and scroll panes, Adapter classes and event handling in Swing. JDBC: architecture, drivers, database connectivity, Statement, Prepared Statement, Result Set, and CRUD operations using JDBC Self-Learning Topics: JavaFx features	5	LO3
VI	Client-Side Programming (HTML, CSS, JavaScript)	Client-Side Programming (HTML, CSS, JavaScript) Basics of client-side web development including HTML tags and forms, CSS selectors and styling, and JavaScript concepts such as variables, operators, control statements, functions, events, form validation, and DOM manipulation. Self-Learning Topics: Responsive web design	5	LO4
Total			26	

Suggested List of Experiments:

(A minimum of 10 experiments covering the entire syllabus must be conducted in batches.)

Sr. No	Detailed Content	Hours	LO Mapping
1	Topic: Basic programming constructs: data types, variables, operators, and expressions, control structure 1.1 Develop a Student Grade Calculator application to demonstrate Java data types, variables, operators, and expressions for calculating total marks, percentage, and grade. 1.2 Develop a Bank ATM Simulation program using if-else, switch case, and looping statements to perform operations such as balance enquiry, withdrawal, deposit, and exit. 1.3 Use nested loops to generate a triangle number pattern, applying conditional checks.	4	LO1
2	Topic: Classes, objects, constructors, and method overloading 2.1 Develop a Library Management System to demonstrate classes, objects, constructors for managing book details and issue records. 2.2 Develop a program that calculates the area of shapes like Circle, Rectangle, Square, Triangle and the volume of shapes like Sphere, Cuboid, Cube using method overloading. 2.3 Create a Product class to demonstrate constructor overloading. Create employee objects using different initialization formats and include members like ID, name, cost, category.	4	LO1
3	Topic: Arrays and string handling 3.1 Develop a program to store numbers in an array and find minimum, maximum, average of elements, sum of elements. 3.2 Create a two-dimensional array to store matrices. Perform matrix addition and transpose operations. 3.3 Develop a program that demonstrates the use of various methods available in String class. 3.4 Develop a program that demonstrates the use of various methods available in String Buffer class	2	LO1
4	Topic: Inheritance, use of super keyword, and method overriding 4.1 Develop a College Management System demonstrating inheritance, method overriding, and use of super keyword for student, faculty, and staff details. 4.2 Create a Java program that demonstrates the concept of user-defined packages and the use of all four access specifiers through appropriate class and method structures.	2	LO2
5	Topic: Abstract classes and interfaces 5.1 Develop a Vehicle Service Application using abstract classes and interfaces to demonstrate common vehicle operations and service functionalities.	2	LO2

6	Topic: Exception handling using try, catch, finally, throw, and throws 6.1 Develop a program to demonstrate different in-built exceptions using try, catch, finally, throw, and throws 6.2 Develop an Online Banking Application to create user defined exception for invalid transactions, insufficient balance, and incorrect account details.	2	LO2
7	Topic: Thread class and Runnable interface 7.1 Develop a program to demonstrate different methods of Thread class 7.2 Develop a Railway Ticket Booking System using multithreading concepts to handle multiple users booking tickets simultaneously through Thread class and Runnable interface.	2	LO2
8	Topic: Collection classes (Any Two) 8.1 Develop a program to demonstrate the use of Java Collections Framework using Array List, HashSet, HashMap, and Tree Map. 8.2 Develop an E-Commerce Product Management System using Java Collections Framework such as Vector, Array List, HashSet, HashMap, and Tree Map for storing product and customer details. 8.3 Write a Java program to demonstrate Iterator, Comparable, and Comparator interfaces. 8.4 Develop a Student Ranking System using Iterator, Comparable, and Comparator interfaces to sort students based on marks, name, and roll number.	2	LO2
9	Topic: GUI application 9.1 Develop a Student Information GUI Application using Swing components such as JButton, JLabel, JTextField, JCheckBox, and JTable for managing student records. 9.2 Develop a Calculator or Login Form GUI Application using Swing event handling concepts such as ActionListener, Mouse Listener, and keyboard events.	2	LO3
10	Topic: Client-side web application using HTML, CSS, and JavaScript 10.1 Design a Student Registration Web Application using HTML, CSS, and JavaScript with form validation, events, and DOM manipulation for handling user inputs dynamically.	2	LO4
11	Topic: Mini Project Build a complete GUI-based application integrating event handling and database connectivity.	4	LO2, LO3, LO4

Text Books:

- [1] H. Schildt, *Java: The Complete Reference*, McGraw Hill Education (India) Pvt. Ltd., New Delhi, India, 2024, ISBN: 978-1265058432.
- [2] E. Balagurusamy, *Programming with Java*, 6th ed. New Delhi, India: McGraw Hill Education, 2019.
- [3] A. S. Godbole and A. Kahate, *Web Technologies: HTML, JavaScript, PHP, Java, JSP, XML and AJAX*, McGraw Hill Education (India) Pvt. Ltd., New Delhi, India, 2017, ISBN: 978-1259028670.

Reference Books:

- [1] C. S. Horstmann, *Core Java Volume I – Fundamentals*, Pearson India Education Services Pvt. Ltd., Noida, India, 2021, ISBN: 978-0135166307.
- [2] C. Northwood, *The Full Stack Developer: Your Essential Guide to the Everyday Skills Expected of a Modern Full Stack Web Developer*, Apress Media, Springer.

Online References:

1. Oracle, "Java SE Documentation." Available: <https://docs.oracle.com/javase/>
2. Javatpoint, "Java Tutorial." Available: <https://www.javatpoint.com/java-tutorial>
3. GeeksforGeeks, "Java Programming Language." Available: <https://www.geeksforgeeks.org/java/>
4. NPTEL, "Programming in Java (Course 106105191)." Available: <https://nptel.ac.in/courses/106105191>

Assessment:

A. In-Semester Assessment

1. Continuous Internal Evaluation (CIA): (50 Marks)

- a) 15 Marks – Laboratory work / Experiments

- b) 10 Marks - Use any 2 lab tools from Annexure I (one tool before MSE and one tool after MSE)
- c) 20 Marks - Mini Project
- d) 05 Marks – Attendance and Active participation

B. End-Semester Assessment

1. Practical/ Oral Examination: (25 Marks)

Practical/ Oral exams to be conducted based on the content of the syllabus.

Course Type	Course Code	Course Name			Credits
VEC	SY3VEC1	Design Thinking			02
Examination Scheme					
Distribution of Marks			Exam Duration (Hrs.)		Total Marks
In-semester Assessment		End Semester Assessment (ESE)			
Continuous Assessment	Mid-Semester Exam (MSE)		End Semester Assessment (ESE)	MSE	ESE
50	-	-		-	-

Course Objectives

1. To enable learners to understand the principles, stages, and importance of Design Thinking in solving human-centered problems.
2. To develop the ability to investigate real user needs through empathy-driven methods such as observation, interviews, stakeholder analysis, and journey mapping.
3. To train learners to synthesize user insights and define focused, human-centered problem statements using personas, Point-Of-View (POV) statements, and "How Might We" questions.
4. To cultivate creative confidence through structured ideation techniques for generating, organizing, and selecting solution alternatives, and to provide hands-on experience in creating and communicating low-fidelity and high-fidelity prototypes using sketches, storyboards, wireframes, service blueprints, and role-play.
5. To enable learners to test, evaluate, and iteratively refine proposed solutions based on user feedback, usability observations, and practical constraints.
6. To encourage learners to reflect on the feasibility of transforming a validated design solution into a socially relevant startup or innovation opportunity.

Course Outcomes:

1. Recall the fundamental principles, terminology, stages, and key tenets of Design Thinking, and identify differences between Design Thinking and traditional problem-solving approaches.
2. Explain the purpose of empathy in human-centred design and describe the use of tools such as empathy maps, stakeholder maps, customer journey maps, user interviews, and personas.
3. Apply empathy and problem-framing tools to a real-world problem in order to develop user insights, construct personas, and formulate user-centred "How Might We" statements.
4. Analyze user observations, interview findings, and clustered ideas to distinguish patterns, prioritize pain points, and frame a focused problem statement without assuming a solution.
5. Evaluate alternative ideas and prototype concepts using user feedback, usability observations, and the criteria of desirability, feasibility, and viability, and justify improvements made during iteration.
6. Create low- and high-fidelity prototypes using methods such as paper prototyping, storyboarding, wireframing, and role-play, and develop an improved design solution through testing and iterative refinement.

Detailed Syllabus:

Sr. No.	Topic	Detailed Contents	Hours	CO Mapping
I	Introduction to Design Thinking	• Definition and significance of Design Thinking; comparison with traditional problem-solving approaches; key principles of human-centred design • Five stages of Design Thinking: Empathize, Define, Ideate, Prototype, Test • Design Thinking in engineering, services, social systems, and startups • Overview of semester-long project-based workflow Self-learning Topics: Examples of successful design thinking applications in engineering, healthcare, education, and startups.	4	CO1
II	Empathy and User Research	• Meaning and importance of empathy; user observation and contextual inquiry • Stakeholder mapping • User interviews: planning, questioning, ethics • Empathy maps	6	CO2

		• Customer journey mapping / day-in-the-life mapping • Recording user needs, pain points, emotions, and behaviours Self-learning Topics: Preparing interview guides and observing users ethically in real-world contexts.		
III	Define – Problem Framing	• Synthesizing user research; identifying patterns, themes, and pain points • Prioritizing insights; distinguishing a problem statement from a solution statement • Personas and point-of-view statements • Framing the problem in user-centred language • “How Might We” statements Self-learning Topics: Writing effective personas, point-of-view statements, and “How Might We” questions from user insights.	5	CO3
IV	Ideation and Concept Development	• Purpose of ideation; divergent and convergent thinking • Brainstorming, brainwriting, mind mapping • Affinity diagramming; idea clustering and prioritization • Selecting concepts based on desirability, feasibility, and viability • Idea rejection and concept justification Self-learning Topics: Using creative ideation tools for idea generation.	5	CO4
V	Prototyping	• Purpose of prototyping; low-fidelity vs high-fidelity prototypes • Paper prototyping; storyboards and scenario prototypes • Service blueprints; wireframes for digital solutions; role-play and experience prototyping • Communicating ideas through tangible representations Self-learning Topics: Exploring digital wireframing tools and low-cost prototyping methods for product and service ideas.	4	CO6
VI	Testing, Iteration, Reflection, and Design-to-Startup Extension	• Principles of usability testing; collecting and documenting user feedback • Desirability, feasibility, and viability; feedback loops and iterative improvement • Reflection on limitations and learning • Converting a Design Thinking solution into a startup concept: value proposition, target users, business model, and implementation considerations Self-learning Topics: Basics of value proposition canvas, lean startup approach, and preparing a simple pitch for a design solution.	4	CO5, CO6
Total			28	

Textbooks

- [1] P. Soni, *Design Your Thinking: The Mindsets, Toolsets and Skill Sets for Creative Problem-Solving*. New Delhi, India: Penguin Random House India, 2022.
- [2] E. Yayici, *Design Thinking Methodology Book*. Boca Raton, FL, USA: CRC Press, 2016.
- [3] C. Mueller-Roterberg, *Handbook of Design Thinking*. Singapore: World Scientific, 2018.

Reference Books

- [1] T. Brown, *Change by Design*. New York, NY, USA: Harper Business, 2009.
- [2] I. Mootee, *Design Thinking for Strategic Innovation*. Hoboken, NJ, USA: Wiley, 2013.
- [3] J. Liedtka, A. King, and K. Bennett, *Solving Problems with Design Thinking*. New York, NY, USA: Columbia University Press, 2013.
- [4] D. A. Norman, *The Design of Everyday Things*, Revised and Expanded ed. New York, NY, USA: Basic Books, 2013.
- [5] T. Kelley and D. Kelley, *Creative Confidence*. New York, NY, USA: Crown Business, 2013.

Online Resources

1. **Stanford d.school Toolkits**
<https://dschool.stanford.edu/innovate/tools>
2. **IDEO Design Kit (Human-Centered Design Resources)**
<https://www.designkit.org/>

3. **Interaction Design Foundation – Empathy Mapping**
<https://ixdf.org/literature/topics/empathy-mapping>
4. **Interaction Design Foundation – Usability Testing**
<https://ixdf.org/literature/topics/usability-testing>
5. **SWAYAM Course: Design Thinking and Innovation**
https://onlinecourses.swayam2.ac.in/e-learning/preview/aic23_ge17
6. **NPTel Course: Product Engineering and Design Thinking**
https://onlinecourses.nptel.ac.in/noc23_me52/preview
7. **UXPressia Templates (Personas, Journey Maps)**
<https://uxpressia.com/templates>
8. **Miro Templates (Persona, Empathy Maps, Ideation Tools)**
<https://miro.com/persona/>

List of Experiments

Each group shall work on a single approved real-world problem statement throughout the semester.

Sr. No.	List of Design Tasks	Module	COs
1	Problem Context and Stakeholder Mapping: Select a real-world problem statement, identify primary and secondary stakeholders, and define the user context.	I / II	CO2, CO3
2	Empathy Research Planning and User Interaction: Plan and conduct interviews / observation with real users related to the selected problem. Record key findings ethically and systematically.	II	CO2
3	Empathy Mapping and User Insights: Prepare an empathy map based on field interaction and identify key emotions, behaviours, frustrations, and needs.	II	CO2
4	Customer Journey / Day-in-the-Life Mapping: Visualize the user journey and identify pain points, breakdowns, and opportunity areas.	II	CO2
5	Persona Development and Problem Framing: Develop one or more user personas and frame the problem using POV and “How Might We” statements.	III	CO3
6	Ideation Workshop: Generate multiple solution ideas using brainstorming, mind mapping, or brainwriting. Document all ideas.	IV	CO4
7	Affinity Diagramming and Concept Selection: Cluster generated ideas, identify themes, shortlist concepts, and justify the selected solution direction.	IV	CO4
8	Low-Fidelity Prototyping: Create a paper prototype, storyboard, service flow, or physical mock-up of the selected solution.	V	CO6
9	Wireframing / Service Blueprint / Role-play Prototype: Build a more detailed representation of the proposed solution using wireframes, service blueprinting, or role-play scenarios.	V	CO6
10	Usability Testing, Feedback, and Iteration: Test the prototype with users or peers, document feedback, refine the design, and record what changed and why.	VI	CO5, CO6

Assignments

Sr. No.	List of Assignments (Any three)	COs
1	Empathy Map Assignment: Create an empathy map for the selected target user group using actual interview or observation findings.	CO3
2	Persona Assignment: Develop a detailed persona including user context, motivations, goals, behaviours, and pain points.	CO3
3	Good Design vs Bad Design Analysis: Analyze three real-life products/services and justify why they represent good or poor design from a user-centred perspective.	CO4
4	Design Thinking Tool Review: Study any one open-source or widely used Design Thinking tool/platform/template and submit a brief review of its features and applications.	CO2, CO4
5	Startup Extension Note: Write a short concept note explaining how the proposed DT solution could be developed into a startup, service, or social innovation.	CO5, CO6

Assessment:

A. In-Semester Assessment (50 Marks)

1. Continuous Assessment

- a) 15 Marks = Assignments
- b) 15 Marks = Case Study and Presentation
- c) 10 Marks = Any two tools from Annexure I
- d) 10 Marks = Attendance and Active participation

Course Type	Course Code	Course Name			Credits
LLC	SY3LLC11	Digital Solutions for Video Recording and Editing			02
Examination Scheme					
Distribution of Marks			Exam Duration (Hrs.)		Total Marks
In-semester Assessment		End Semester Assessment (ESE)			
Continuous Assessment	Mid-Semester Exam (MSE)		50		
50	-	-		-	

Course Objectives:

1. Introduce fundamentals of digital video production and recording techniques.
2. Provide hands-on experience with video editing tools and workflows.
3. Develop storytelling and technical communication skills.
4. Familiarize students with AI-based video technologies.
5. Enable students to publish and optimize digital video content.

Course Outcomes:

At the end of the course, students will be able to:

1. Understand the fundamentals of video production and its components.
2. Apply camera, framing, and lighting techniques for quality video recording.
3. Apply basic video editing techniques using digital tools.
4. Create enhanced videos using color grading, chroma key, and motion graphics.
5. Create and publish optimized video content ethically and effectively.
6. Utilize AI tools and emerging technologies for video production.

Detailed Syllabus:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Introduction to Video Production	Basics of video production, Types of videos (educational, technical, promotional), Video components: resolution, frame rate, aspect ratio, Digital formats and compression, Recording devices (camera, smartphone, webcam) Self-learning Topics: Evolution of video technology	5	CO1
II	Video Recording Techniques	Camera handling and framing techniques, Shot types, angles, and composition rules, Lighting techniques (natural & artificial), Audio recording fundamentals, Practical shooting techniques Self-learning Topics: Advanced lighting setups	5	CO2
III	Fundamentals of Video Editing	Introduction to editing software, Basic editing operations (cut, trim, merge), Transitions and visual effects, Audio synchronization, Editing workflow Self-learning Topics: Editing styles for different platforms.	4	CO3
IV	Advanced Editing & Motion Graphics	Color correction and grading, Titles, subtitles, and overlays, Green screen (chroma key), Motion graphics basics, Introduction to VFX. Self-learning Topics: Advanced VFX techniques	4	CO4
V	Content Creation,	Script writing and storyboarding, Visual storytelling techniques, Technical video creation for engineering applications, Audience engagement	5	CO5

	Publishing & Analytics	strategies, Ethical considerations, Exporting formats and compression, Uploading videos on digital platforms, SEO for video content, Video analytics tools, Copyright and licensing Self-learning Topics: Digital branding and content strategy		
VI	AI Tools & Emerging Video Technologies	AI-based video editing (auto-cut, highlights), Auto captions and subtitle generation, AI- based color correction and enhancement, Noise removal and audio enhancement, Text- to-video and image-to-video generation, AI avatars and voice generation, Cloud-based editing and collaboration, AR/VR and 360° video production, Interactive and personalized video content, Ethical issues in AI-generated media Self-learning Topics: Deepfake detection and future trends	5	CO6
Total			28	

Text Books:

- [1] J. Owens, Video Production Handbook, 7th ed. Abingdon, Oxon, UK: Routledge, 2023.
 [2] Adobe Creative Team, Adobe Premiere Pro Classroom in a Book 2025 Release. Berkeley, CA, USA: Adobe Press/ Peachpit, 2025.

Reference Books:

- [1] M. Rabiger and M. Hurbis-Cherrier, Directing: Film Techniques and Aesthetics, 6th ed. Abingdon, Oxon, UK: Routledge, 2020.
 [2] H. Zettl, Television Production Handbook, 11th ed. New Delhi, India: Cengage Learning, 2011. ISBN: 9781133169871.

Online References:

1. Coursera <https://www.coursera.org>
2. NPTEL <https://nptel.ac.in>
3. YouTube <https://www.youtube.com>
4. Adobe <https://www.adobe.com>

Assessment:

A. In-Semester Assessment (50 Marks)

1. Continuous Assessment

- a) 15 Marks = Assignments
- b) 15 Marks = Mini-Project / Presentation
- c) 10 Marks = Any two tools from Annexure I
- d) 5 Marks = Attendance and Active participation

Course Type	Course Code	Course Name			Credits
LLC	SY3LLC12	Health and Wellness			02
Examination Scheme					
Distribution of Marks			Exam Duration (Hrs.)		Total Marks
In-semester Assessment		End Semester Assessment (ESE)			
Continuous Assessment	Mid-Semester Exam (MSE)			MSE	ESE
50	-	-	-	-	

Prerequisite:

1. Willingness to participate in physical activities and surveys related to fitness and community wellness.

Course Objectives:

1. To understand the fundamental concepts of health, fitness, and wellness and their interrelationship.
2. To develop awareness about components of physical fitness and dimensions of overall wellness.
3. To analyze behaviour patterns and apply techniques for positive behaviour modification.
4. To promote healthy lifestyle practices and prevent lifestyle-related diseases.
5. To design and implement a balanced daily routine for improving quality of life.
6. To evaluate physical and physiological fitness using standard assessment and testing methods.

Course Outcomes:

1. Explain the concepts of health, fitness, and wellness along with their influencing factors.
2. Classify components of fitness and dimensions of wellness and relate them to personal health.
3. Apply behaviour change models and SMART goal-setting techniques to improve lifestyle habits.
4. Develop a structured daily routine incorporating diet, exercise, and time management.
5. Perform and interpret basic fitness and physiological tests for health assessment.
6. Conduct community-based wellness surveys and propose strategies to enhance public health awareness.

Detailed Syllabus:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Fitness and Wellness	Concept, meaning, and definition of health, fitness, and wellness Components of fitness: Health-related fitness, Skill-related fitness Dimensions of wellness: Physical, mental, social, emotional Factors affecting health and wellness Relationship between wellness and lifestyle Self-learning Topics: Prepare a self- evaluation of your physical, mental, social, and emotional wellness.	4	CO1
II	Behavior Modification	Meaning and importance of behavior change Barriers to behavior change Stages of behavior change model SMART goal setting technique Healthy lifestyle practices, Prevention and management of lifestyle diseases Self-learning Topics: Common Barriers in Adopting Healthy Habits: Identify personal, social, and environmental barriers and suggest ways to overcome them.	4	CO2
III	Daily Schedule for Quality	Planning daily routine based on age, gender, and occupation Time management for: Sleep Diet Physical Activity Recreation	5	CO3

	Life	Principles of healthy living: Positive attitude, Regular exercise, Balanced diet, Hygiene practices, Role of lifestyle in improving quality of life Self-learning Topics: Designing a Personalized Daily Routine: Create a daily schedule based on your age, gender, and academic/professional needs.		
IV	Fitness Assessment	Fitness components: Cardiovascular endurance, Muscular strength, Flexibility, Body composition Methods and tests for measuring fitness components Interpretation of fitness test results Importance of regular fitness assessment Self-learning Topics: Designing a Personal Fitness Assessment Plan: Create a plan including tests, frequency, and improvement goals.	5	CO4
V	Physiological Testing	Measurement of physiological parameters: Blood pressure, Pulse rate, VO ₂ max, Vital capacity Importance of physiological testing in health assessment Normal and abnormal values of health indicators Role of physiological data in fitness planning Self-learning Topics: Impact of Lifestyle on Physiological Parameters: Analyze how diet, exercise, stress, and sleep influence body functions.	5	CO5
VI	Community Wellness and Project	Concept of community health and wellness Conducting fitness and wellness survey Data collection and analysis Identification of community health issues Preparation of survey report, Strategies for promoting health and wellness awareness Self-learning Topics: Designing a Fitness and Wellness Survey Learn how to prepare questionnaires covering lifestyle, diet, and physical activity.	5	CO6
Total			28	

Text Books:

- [1] C. Bouchard, S. N. Blair, and W. L. Haskell, Physical Activity and Health. Philadelphia, PA, USA: Lippincott Williams & Wilkins, 2000.
- [2] A. Snelling, Introduction to Health Promotion. Chichester, UK: Wiley-Blackwell, 2010.
- [3] P. Paul, Health & Wellness. New Delhi, India: Prakash Books India, 2018.

Reference Books:

- [1] A. Carr, Positive Psychology: The Science of Happiness, 2nd ed. Chichester, UK: Wiley-Blackwell, 2011.
- [2] J. Stea, Mind the Science: Saving Your Mental Health from the Wellness Industry. Berkeley, CA, USA: North Atlantic Books, 2023.
- [3] A. Clow and S. Edmunds, Physical Activity and Mental Health. Boca Raton, FL, USA: CRC Press, 2005.

Online References:

1. WHO, World Health Organization. Available: <https://www.who.int>
2. ICMR, Indian Council of Medical Research. Available: <https://www.icmr.gov.in>
3. SWAYAM - Free Online Education. Available: <https://swayam.gov.in>
4. NPTEL - National Programme on Technology Enhanced Learning. Available: <https://nptel.ac.in>
5. AYUSH, Ministry of Ayush, Government of India. Available: <https://ayush.gov.in>

Assessment:

A. In-Semester Assessment (50 Marks)

1. Continuous Assessment (50 Marks)

- a) 15 Marks = Assignments
- b) 15 Marks = Case Study and Presentation
- c) 10 Marks = Any two tools from Annexure I
- d) 10 Marks = Attendance and Active participation

Course Type	Course Code	Course Name			Credits	
LLC	SY3LLC13	Personality Development			02	
Examination Scheme						
Distribution of Marks				Exam Duration (Hrs.)		Total Marks
In-semester Assessment		End Semester Assessment (ESE)				
Continuous Assessment	Mid-Semester Exam (MSE)			MSE	ESE	50
50	-	-	-	-		

Course Objectives:

1. To develop interpersonal skills and be an effective goal-oriented team player.
2. To develop professionals with idealistic, practical and moral values.
3. To develop communication and problem-solving skills.
4. To re-engineer attitude and understand its influence on behaviour.

Course Outcomes:

1. To help students understand themselves and set clear goals.
2. To enable students to manage their behaviour and communicate assertively
3. To build teamwork, leadership, and basic negotiation skills.
4. To improve communication, emotional control, and stress-handling abilities.
5. To develop professional etiquette and prepare students for GDs and interviews.

Detailed Syllabus:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Personality, Self Awareness, SWOT and Goal setting.	Meaning - Personality Traits - Importance of Personality Development. Benefits of Self-Awareness Developing Self- Awareness Use of simple Personality Assessment Tools. SWOT Analysis: Meaning - Application. Goal Setting: Meaning - SMART goals, Time Management.	6	CO1
II	Self-Monitoring, Perception, Attitude & Assertiveness	Who am I, Attributes, Importance of Self Confidence, Self Esteem. Factors influencing Attitude, Challenges and lessons from Attitude. Simple Assertiveness Techniques.	6	CO2
III	Team Building, Leadership, Negotiation & Conflict Management	Importance of Team Building - Simple activities. Leadership: Meaning - Basic Leadership Styles. Negotiation Skills: Meaning - Common Mistakes in Negotiation. Conflict Management: Meaning Basic types of Conflict	5	CO3
IV	Communication, Emotional Intelligence & Stress Management	Process of Communication - Barriers in Communication - Digital Communication Etiquette (Email, Video Calls, Chat Platforms). Emotional Intelligence: Meaning -How to improve EQ. Stress Management: Meaning - Sources of Stress - Symptoms of Stress - Consequences of Stress - Simple management techniques.	5	CO4
V	Social Graces, Group Discussion, and Interview Skills	Social Graces: meaning - workplace etiquette. Table Manners: Meaning - Do's and Don'ts of Table Etiquettes. Dress Code: Meaning - Dress Code for an Interview - grooming basics. Group Discussion: Meaning - Essential skills. Interview: Meaning - Interview Process - Common Q&A.	6	CO5
Total			28	

Reference Books:

- [1] B. K. Mitra, Personality Development and Soft Skills. New Delhi, India: Oxford University Press, 2011.
- [2] S. N. Rajan et al., Personality Development. Tirunelveli, India: Publication Division, Manonmaniam Sundaranar University, 2010.
- [3] K. K. Ramachandran and K. K. Karthick, From Campus to Corporate. New Delhi, India: Macmillan Publishers India, 2010.
- [4] S. Verma, Development of Life Skills and Professional Practice. New Delhi, India: Sultan Chand & Sons, 2016.
- [5] M. S. Rao, Soft Skills: Enhancing Employability and Career Growth. New Delhi, India: I.K. International Publishing House, 2011.

Assessment:**A. In-Semester Assessment (50 Marks)****1. Continuous Assessment (50 Marks)**

- a) 15 Marks = Assignments
- b) 15 Marks = Case Study and Presentation
- c) 10 Marks = Any two tools from Annexure I
- d) 10 Marks = Attendance and Active participation

Course Type	Course Code	Course Name			Credits	
LLC	SY3LLC14	Beginner Level German			02	
Examination Scheme						
Distribution of Marks				Exam Duration (Hrs.)		Total Marks
In-semester Assessment		End Semester Assessment (ESE)				
Continuous Assessment	Mid-Semester Exam (MSE)			MSE	ESE	50
50	-	-	-	-		

Prerequisite:

1. Students need not have prior knowledge and understanding of German.

Course Objectives:

1. Establish fundamental communication skills in German, enabling students to navigate professional, academic, and social environments.
2. Introduce technical and workplace-specific vocabulary relevant to the engineering field, including professional titles, office technology, and dimensions.
3. Develop a solid foundation in German grammar, focusing on sentence structure, the case system, and modal verbs necessary for giving instructions and reporting data.
4. Equip students with practical literacy skills to complete professional forms, read technical signage, and draft short workplace communications like emails.

Course Outcomes:

1. Personal & Professional Interaction
 - **Greet and bid farewell** in both formal and informal settings, and **introduce themselves and others** using appropriate professional titles (e.g., *Ingenieur/in*).
 - **Exchange essential personal data**, including spelling names via the German alphabet, stating origins, and providing contact information like email addresses and phone numbers.
2. Workplace & Technical Communication
 - **Identify and quantify technical items** using German numbers (1–1000+) and standard units of measurement such as *Kilometer*, *Gramm*, and *Prozent*.
 - **Describe the engineering workplace**, including naming common tools (*Drucker*, *Computer*), office equipment, and laboratory locations.
 - **Formulate and respond to requests** and instructions in a lab or office context using the **imperative** form.
3. Daily Routine & Logistics
 - **Manage scheduling and time**, including telling time in official/unofficial formats, naming weekdays, and using temporal prepositions (*am*, *um*, *im*) to set deadlines.
 - **Navigate logistical situations**, such as ordering food at a canteen, describing a daily commute using various modes of transport, and giving simple directions.
4. Grammatical Proficiency
 - **Correctly apply the German article system** (definite, indefinite, and "null" articles) and assign the proper **grammatical gender** to technical nouns.
 - **Use the case system (Nominative, Accusative, and Dative)** to identify subjects, direct objects, and indirect objects in technical reports and sentences.
 - **Express ability, necessity, and permission** using modal verbs like *können*, *müssen*, and *dürfen*.
 - **Describe completed tasks** using the present perfect tense (*Perfekt*) with the correct "sentence bracket" (*Satzklammer*) structure.

Detailed Syllabus:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Module 1: Foundations of Communication	Class 1: Hello, I am an Engineer ● Goal: Learn formal and informal greetings and introductions. ● Outcome: Students can introduce themselves and ask others for their names and wellbeing using <i>sein</i> and <i>heißen</i>. Class 2: The Technical Alphabet & Spelling ● Goal: Master the German alphabet and pronunciation of vowels. ● Outcome: Students can spell their names and technical terms (e.g., <i>Ingenieur</i>, <i>Software</i>) correctly. Class 3: Origin and Internationality ● Goal: Discuss countries, languages, and international German words. ● Outcome: Students can state where they are from and which languages they speak (e.g., <i>Ich spreche Englisch</i>). Class 4: Numbers and Global Data ● Goal: Learn numbers 1–20 and naming contact information. ● Outcome: Students can exchange phone numbers and email addresses in a professional context. Class 5: Hobbies and Motivation ● Goal: Express personal interests and free-time activities. ● Outcome: Students can describe what they like to do (e.g., <i>Ich lerne gern Deutsch</i>) using basic verbs. Class 6: Scheduling the Week ● Goal: Learn weekdays and make simple appointments. ● Outcome: Students can schedule a meeting using "Ja/Nein" questions (e.g., <i>Gehen wir am Montag?</i>).	7	CO1
II	Module 2: The Engineering Workplace	Class 7: Dimensions and Measurements ● Goal: Master large numbers (20– 1000+) and units of measurement. ● Outcome: Students can quantify technical data using units like <i>Kilometer</i>, <i>Gramm</i>, and <i>Prozent</i>. Class 8: Professional Titles and Roles ● Goal: Identify engineering-related professions and workplace roles. ● Outcome: Students can use gender- neutral and gender-specific job titles (e.g., <i>Ingenieur/in</i>, <i>Informatiker/in</i>). Class 9: Tools and Office Technology ● Goal: Vocabulary for computers and office equipment. ● Outcome: Students can identify essential technical tools such as <i>Drucker</i>, <i>Laptop</i>, and <i>Maus</i>. Class 10: Gender and Nouns in the Lab ● Goal: Understand the definite article system (<i>der</i>, <i>die</i>, <i>das</i>). ● Outcome: Students can correctly categorize technical nouns by gender and use color-coding (blue/green/red) to memorize them. Class 11: Plurals of Technical Terms ● Goal: Form plural nouns correctly. ● Outcome: Students can use plural forms for common office items (e.g., <i>Seminare</i>, <i>Bücher</i>, <i>Stunden</i>). Class 12: Describing Objects and Quality ● Goal: Use adjectives to describe technical properties. ● Outcome: Students can describe items as <i>groß</i>, <i>schwer</i>, <i>leicht</i>, or <i>teuer</i>.	7	CO2
III	Module 3: Daily Routine and Logistics	Class 13: Lunch at the Canteen (Mensa) ● Goal: Vocabulary for food, drinks, and meals. ● Outcome: Students can order food and drinks (e.g., <i>Wasser</i>, <i>Kaffee</i>) and understand common menu items. Class 14: Professional Needs (Accusative Case) ● Goal: Introduce the accusative case for direct objects.	7	CO3

		● Outcome: Students can express needs using <i>haben</i> or <i>brauchen</i> (e.g., <i>Ich brauche einen Stift</i>). Class 15: Time Management ● Goal: Tell time in both official and unofficial formats. ● Outcome: Students can state the exact time for classes or deadlines (e.g., <i>Viertel nach sechs</i>). Class 16: Navigation in the City/University ● Goal: Give and follow simple directions. ● Outcome: Students can navigate a campus using terms like <i>geradeaus</i>, <i>links</i>, and <i>rechts</i>. Class 17: Commuting and Transport ● Goal: Learn modes of transport and the dative case with "mit". ● Outcome: Students can describe how they get to work/university (e.g., <i>Ich fahre mit der U-Bahn</i>). Class 18: Scheduling with Prepositions ● Goal: Use temporal prepositions (<i>am</i>, <i>um</i>, <i>im</i>). ● Outcome: Students can state when events occur (e.g., <i>am Montag, um 10 Uhr, im Sommer</i>).		
IV	Module 4: Advanced Professional Communication	Class 19: Work Routine (Separable Verben) ● Goal: Master separable verbs for daily actions. ● Outcome: Students can describe their day using verbs like <i>anfangen</i>, <i>aufstehen</i>, and <i>anrufen</i>. Class 20: Giving Instructions (Imperative) ● Goal: Formulate requests and commands politely. ● Outcome: Students can give clear instructions for lab tasks or office needs (e.g., <i>Machen Sie bitte das Fenster auf!</i>). Class 21: Describing the Past (Perfekt) ● Goal: Introduce the present perfect tense to report completed work. ● Outcome: Students can describe what they did (e.g., <i>Ich habe die Präsentation geplant</i>) using the "Satzklammer" structure. Class 22: Ability and Necessity (Modal Verbs) ● Goal: Use modal verbs <i>können</i> and <i>müssen</i>. ● Outcome: Students can express skills (possibility) and requirements (obligation) in an engineering context. Class 23: Problem Solving and Emails ● Goal: Write formal emails and report technical issues. Outcome: Students can draft a simple professional email to colleagues regarding a project or absence. Class 24: Final Project: The Engineering Brief ● Goal: Synthesize all learned skills in a workplace simulation. ● Outcome: Students can participate in a role-play discussing a project's timeline, team roles, and required tools.	7	CO4
Total			28	

Text Books:

[1] S. Dengler, P. Rusch, H. Schmitz, and T. Sieber, Netzwerk neu A1, Kursbuch. Stuttgart, Germany: Ernst Klett Sprachen, 2024.

Reference Books:

- [1] A. Billina, *Fit in Grammatik A1/A2*, 1st ed. Ismaning, Germany: Hueber Verlag, 2010.
- [2] J. Gerbes, *Fit fürs Goethe-Zertifikat A1: Start Deutsch 1*. Ismaning, Germany: Hueber Verlag, 2007.
- [3] R. Bruseke, Deutsch Grammatik Leicht A1. Ismaning, Germany: Hueber Verlag, 2018.
- [4] B. Holdrich, Lesen & Schreiben A1, 1st ed. Ismaning, Germany: Hueber Verlag, 2010.
- [5] H. J. Hantschel, V. Klotz, and P. Krieger, Mit Erfolg zu Start Deutsch A1: Übungsbuch, 1st ed. Stuttgart, Germany: Klett Sprachen, 2010.
- [6] H. J. Hantschel, V. Klotz, and P. Krieger, Prüfungstraining Start Deutsch A1. Stuttgart, Germany: Klett Sprachen.
- [7] C. Lemcke and L. Rohrmann, Deutsch Intensiv Wortschatz A1. Berlin, Germany: Langenscheidt, 2008.

Online References:

1. Deutsche Welle, "Learn German online for free | A1-C1," DW. <https://learngerman.dw.com/en/learn-german/s-9528>

Assessment:**A. In-Semester Assessment (50 Marks)****1. Continuous Assessment (50 Marks)**

- a) 15 Marks = Assignments
- b) 15 Marks = Case Study and Presentation
- c) 10 Marks = Any two tools from Annexure I
- d) 10 Marks = Attendance and Active participation

Course Type	Course Code	Course Name			Credits
LLC	SY3LLC15	Beginner Level French			02
Examination Scheme					
Distribution of Marks			Exam Duration (Hrs.)		Total Marks
In-semester Assessment		End Semester Assessment (ESE)			
Continuous Assessment	Mid-Semester Exam (MSE)			MSE	ESE
50	-	-	-	-	

Prerequisite:

1. Students need not have prior knowledge and understanding of French

Course Objectives:

1. To read and understand simple short texts in French
2. To get acquainted with some socio-cultural aspects of France
3. To comprehend spoken French at a very basic level
4. To write letters/short texts using simple vocabulary such as on oneself, one's family in French
5. To speak on everyday topics, ask and respond to questions in French

Course Outcomes:

1. Know basic vocabulary related to the different parts of speech, nouns, verbs, pronouns, conjunctions at A1 level
2. Read and understand short text passages involving basic grammar and vocabulary 3. Write simple sentences in French as part of comprehension exercises or writing skills
3. Comprehend basic conversations on everyday topics spoken by native/non-native speakers
4. Apply the knowledge of vocabulary and syntax to speak on everyday topics such as using appropriate greetings, asking basic questions like name, age, nationality, etc.

Detailed Syllabus:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Leçon 0 (Introduction)	Alphabets, basic spellings, basic classroom phrases, general pronunciation rules, numbers, days of the week, months of the year, subject pronouns.	5	CO1, CO2, CO3, CO4, CO5
II	Bienvenue en classe! (Welcome to the Class!)	Basic greetings, gender, time, indefinite articles & definite articles, time, prepositions, être (Verb). Self-Study: Nationalities, colours.	5	CO2, CO3, CO5.
III	Dans la bonne direction! (To the right direction!)	Présenter un ami/la famille et moi-même (To present a friend/ one's family), basic directions, negation, interrogation, plural of some nouns, the expression, "il y a", "voici/viola", demonstrative pronouns "c'est/ce sont", the verb 'avoir'.	6	CO3, CO4, CO5.
IV	Quel temps fait-il? (How is the weather?)	Adjectives, weather, present tense (regular verbs), asking simple questions & giving answers, listening to conversations, some more pronouns. Self-study: Conjugations of some regular verbs.	6	CO2, CO3, CO5
V	Écrivez avec plaisir! (Write with pleasure!)	Some irregular verbs, imperative tense, letter writing, short essay writing, reading. Self-study: Conjugations of some irregular verbs as given in class.	6	CO1, CO4
Total			28	

Text Books:

- [1] A. Gondil, R. Abhyankar, and P. Dole, *Le Français, c'est fun!*. Pune, India: Maharashtra State Bureau of Textbook Production and Curriculum Research, 2022.

Reference Books:

- [1] A. Berthet, C. Hugot, E. Daill, and M. Waendendries, *Alter Ego 1: Méthode de français*, Niveau A1. Paris, France: Hachette, 2017.
[2] M.-N. Cocton, É. Heu, C. Houssa, É. Kasazian, D. Duplex, and D. Ripaud, *Saison: Méthode de français*, Niveaux A1-A2. Paris, France: Didier, 2014.
[3] Y. Loiseau and R. Mérieux, *Connexions: Cahier d'exercices*, Niveau 1. Paris, France: Didier, 2004.
[4] G. Mauger, *Cours de Langue et de Civilisation Françaises*, 1er degré. Paris, France: Hachette, 2015.

Online References:

1. TV5MONDE, "Learn French," TV5MONDE EDU. Available: <https://apprendre.tv5monde.com>
2. "Français Facile," FrançaisFacile.com. Available: <https://www.francaisfacile.com>
3. "Easy French," YouTube. Available: <https://www.youtube.com/@EasyFrench>

Assessment:**A. In-Semester Assessment (50 MARKS)****1. Continuous Assessment (50 Marks)**

- a) 15 Marks = Assignments
- b) 15 Marks = Case Study and Presentation
- c) 10 Marks = Any two tools from Annexure I
- d) 10 Marks = Attendance and Active participation

Course Type	Course Code	Course Name			Credits
EEM	SY3EEM	Entrepreneurship Development			02
Examination Scheme					
Distribution of Marks			Exam Duration (Hrs.)		Total Marks
In-semester Assessment		End Semester Assessment (ESE)			
Continuous Assessment	Mid-Semester Exam (MSE)			MSE	ESE
50	-	-	-	-	

Course Objectives:

1. To introduce students to entrepreneurship concepts and startup development.
2. To develop business idea generation, validation, and business model preparation.
3. To provide hands-on experience in market research, financial planning, and business pitching.
4. To enhance problem-solving and decision-making skills in entrepreneurial ventures.
5. To familiarize students with government schemes and support systems for entrepreneurs.
6. To develop communication and presentation skills required for business pitching.

Course Outcomes:

1. Understand the fundamental concepts of entrepreneurship and business models.
2. Conduct market research and develop business plans.
3. Utilize financial planning and cost analysis for startups.
4. Apply entrepreneurial skills to identify and solve business challenges.
5. Develop prototypes using open-source software for business operations.
6. Pitch business ideas effectively with structured presentations.

Detailed Syllabus:

Sr. No.	Topic	Detailed Contents	Hours	CO Mapping
0	Prerequisite	Fundamentals of communication and leadership skills.	2	--
I	Introduction to Entrepreneurship	Definition, Characteristics, and Types of Entrepreneurs. Entrepreneurial Motivation and Traits. Start-up Ecosystem in India. Self-Learning Topic: Challenges in Entrepreneurship	3	CO1
II	Business Idea Generation & Validation	Ideation Techniques: Design Thinking, Brainstorming, Mind Mapping. Business Model Canvas (BMC). Market Research & Customer Validation. Self-Learning Topic: Minimum Viable Product (MVP) Concept	3	CO2
III	Business Planning & Strategy	Writing a Business Plan. SWOT Analysis and Competitive Analysis. Financial Planning and Budgeting. Self-Learning Topic: Risk Assessment and Management	5	CO3
IV	Funding and Legal Framework	Sources of Funding: Bootstrapping, Angel Investors, Venture Capital Government Schemes & Start-up India Initiatives. Business Registration & Legal Formalities. Self-Learning Topic: Intellectual Property Rights (IPR) & Patents	5	CO4
V	Marketing & Digital Presence	Branding and Digital Marketing. Social Media Marketing & SEO. Customer Relationship Management (CRM). Self-Learning Topic: E-commerce & Online Business Models	5	CO5

VI	Business Pitching & Prototype Development	Pitch Deck Preparation & Presentation Techniques. Prototyping with Open-source Tools. Elevator Pitch & Investor Pitch. Self-Learning Topic: Case Studies of Successful Start-ups	5	CO6
Total			28	

Text Books:

- [1] P. M. Charantimath, Entrepreneurship Development and Small Business Enterprises, 3rd ed. New Delhi, India: Pearson, 2021.
- [2] P. F. Drucker, Innovation and Entrepreneurship, Reprint ed. New York, NY, USA: Harper Business, 2019.
- [3] R. Roy, Startup and Entrepreneurship: A Practical Guide. New Delhi, India: Oxford University Press, 2022.
- [4] N. Scarborough, Essentials of Entrepreneurship and Small Business Management, 9th ed. New York, NY, USA: Pearson, 2021.
- [5] E. Ries, The Lean Startup. New York, NY, USA: Crown Publishing, 2018.

References:

- [1] B. Aulet, Disciplined Entrepreneurship: 24 Steps to a Successful Startup. Cambridge, MA, USA: MIT Press, 2017.
- [2] P. Thiel, Zero to One: Notes on Startups, or How to Build the Future. New York, NY, USA: Crown Business, 2014.
- [3] C. Guillebeau, The \$100 Startup. New York, NY, USA: Crown Business, 2019.
- [4] A. Osterwalder and Y. Pigneur, Business Model Generation. Hoboken, NJ, USA: Wiley, 2020.
- [5] W. C. Kim and R. Mauborgne, Blue Ocean Strategy. Boston, MA, USA: Harvard Business Review Press, 2019.

Online Resources:

1. Startup India, Startup India Portal. Available: <https://www.startupindia.gov.in>
2. MIT OpenCourseWare, "Entrepreneurship," MIT OCW.
Available: <https://ocw.mit.edu/search/?d=Sloan%20School%20of%20Management>
3. University of Maryland, "Entrepreneurship Specialization," Coursera.
Available: <https://www.coursera.org/specializations/entrepreneurship>
4. Harvard Business Review, "Entrepreneurship," HBR. Available: <https://hbr.org/topic/entrepreneurship>
5. Udemy, "Entrepreneurship & Business Courses," Udemy. Available: <https://www.udemy.com/courses/business/entrepreneurship/>

A. In-Semester Assessment (50 Marks)

1. Continuous Assessment (50 Marks)

- a) 20 Marks = Surprise Test / Open Book Test - Written test covering up to 50% syllabus
- b) 10 Marks = Assignment - Group assignment based on remaining 50% syllabus not covered in test
- c) 10 Marks = Presentation / Seminar - Presentation on entrepreneurial case study based on remaining 50% syllabus not covered in test
- d) 5 Marks = Viva / Quiz - Oral viva or short quizzes
- e) 5 Marks = Attendance / Participation - Regular class attendance

Syllabus – Second Year Semester-IV

Course Type	Course Code	Course Name			Credits
PCC	EC4PCC6	Basics of VLSI			03
Examination Scheme					
Distribution of Marks			Exam Duration (Hrs.)		Total Marks
In-Semester Assessment		End Semester Assessment (ESE)	MSE	ESE	100
Continuous Assessment	Mid Semester Exam (MSE)				
20	30		50	1.5	

Prerequisite:

1. Digital System Design, Analog Electric circuits

Course Objectives:

1. To introduce the process flow of VLSI Design and understand MOSFET operation from a VLSI design perspective.
2. To learn VLSI design performance metric and various tradeoffs.
3. To design, implement and verify combinational and sequential logic circuits using various MOS design styles.
4. To provide an exposure to RTL design and HDL programming.

Course Outcomes:

1. Tell various tools and processes used in VLSI Design.
2. Derive expressions for performance parameters of CMOS and develop understanding of combinational and sequential logic.
3. Explain working and of various CMOS combinational and sequential circuits and design them using various VLSI Design tools.
4. Explain Semiconductor Memories.
5. Select suitable circuit and design style for given application and debug various pipelining issues.
6. Design Applications using RTL design

Detailed Syllabus:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Review of MOSFET Operation and Fabrication	Overview of VLSI Design Flow, Review of MOSFET operation, MOSFET Capacitances, MOSFET scaling, Short Channel effects Fabrication process flow of NMOS and CMOS Self-Learning Topic: Novel MOSFET Architectures FinFET, GAA-FET, CNTFET	7	CO1
II	Combinational and Sequential CMOS Logic Circuits	CMOS inverter operation and layout, Voltage Transfer characteristics (VTC), Noise Margins, Propagation Delay, Power Dissipation, Design of CMOS Inverter, Realization of CMOS NAND gate, NOR gate Realization of SR and JK CMOS design Self-Learning Topic: Layout of CMOS NAND, NOR and complex CMOS circuits	7	CO2
III	MOS Design Logic Styles	Static CMOS, Pass Transistor Logic, Transmission Gate, Pseudo NMOS, Dynamic Logic, SR Latch, MS –JK Flip Flop and realization using design styles Realization of Shift Register, MUX, Decoder using above design styles, 1-bit full Adder Self-Learning Topics: Dynamic, Domino, C2MOS design styles	7	CO3

IV	Semiconductor Memories	ROM array, 6T-SRAM (operation, design strategy, sense amplifier) Operation of 1T and 3T DRAM Cell, NAND and NOR flash memory Self-Learning Topics: layout of SRAM	6	CO4
V	Data Path and System Design Issues	Ripple carry adder, CLA adder, carry save adder, carry select adder, carry skip adder, Array Multiplier On chip clock generation and distribution, pipelining and pipelining hazards Self-Learning Topics: datapath for read/write operation and its data flow.	5	CO5
VI	RTL Design	High Level state machines, RTL design process RTL modelling and Verilog (behavioural, dataflow, structural model) RTL design of Soda dispenser machine. Self-Learning Topics: Design a 4-bit overlapping sequence detector	7	CO6
Total			39	

Text Books:

- [1] S. Kang and Y. Leblebici, CMOS Digital Integrated Circuits: Analysis and Design, 3rd ed. New Delhi, India: Tata McGraw Hill, 2012.
- [2] J. M. Rabaey, A. Chandrakasan, and B. Nikolic, Digital Integrated Circuits: A Design Perspective, 2nd ed. New Delhi, India: Pearson Education, 2016.
- [3] F. Vahid, Digital Design with RTL Design, VHDL, and Verilog, 2nd ed. Hoboken, NJ, USA: John Wiley & Sons, 2011.

Reference Books:

- [1] N. H. E. Weste, D. Harris, and A. Banerjee, CMOS VLSI Design: A Circuits and Systems Perspective, 3rd ed. New Delhi, India: Pearson Education, 2005.
- [2] J. P. Uyemura, Introduction to VLSI Circuits and Systems, Student ed. New Delhi, India: Wiley, 2013.
- [3] R. J. Baker, CMOS Circuit Design, Layout, and Simulation, 2nd ed. Hoboken, NJ, USA: Wiley, 2013.

Online References:

1. NPTEL, "CMOS Digital VLSI Design," NPTEL. Available: <https://nptel.ac.in/courses/117/101/117101058/>
2. NPTEL, "VLSI Circuits," NPTEL. Available: <https://nptel.ac.in/courses/108/107/108107129/>

Assessment:

A. In-Semester Assessment (50 Marks)

1. Continuous Internal Assessment (20 Marks)

- a) 15 Marks = Use any 4 tools from Annexure I (2 tools before MSE and 2 tools after MSE)
- b) 5 Marks = Attendance and Active participation

2. Mid Semester Exam (30 Marks)

Mid semester examination will be based on 40% to 50% syllabus.

B. End Semester Examination (50 Marks)

End Semester Examination will be based on syllabus coverage up to the Mid Semester Examination (MSE) carrying 20% to 30% weightage, and the syllabus covered from MSE to ESE carrying 70% to 80% weightage.

Course Type	Course Code	Course Name			Credits
PCC	EC4PCC7	Microcontrollers			03
Examination Scheme					
Distribution of Marks			Exam Duration (Hrs.)		Total Marks
In-Semester Assessment		End Semester Assessment (ESE)	MSE	ESE	100
Continuous Assessment	Mid Semester Exam (MSE)				
20	30		50	1.5	

Prerequisite:

1. Digital System Design

Course Objectives:

1. To acquire a comprehensive understanding of the architecture, components, and memory systems of microcomputers.
2. To understand the architecture, instruction set, and programming of the 8051 microcontroller, including I/O ports, timers, counters, interrupts, and serial communication.
3. To develop the ability to write and implement programs using the 8051 microcontroller for embedded applications.
4. To understand the concepts of advanced microcontrollers (ARM7), embedded systems, and recent developments in microcontroller technology.

Course Outcomes:

1. Explain the fundamental components and systems integral to microcomputers
2. Explain the memory systems to optimize system performance.
3. Explain the architecture and instructions of 8051 microcontrollers
4. Apply the concepts of I/O ports, Timer, Counter, Interrupts, serial port for 8051 microcontroller programming.
5. Explain ARM7 microcontroller architecture and its suitability for embedded systems and real-time applications.
6. Apply the concept of embedded systems and recent advancements in microcontroller technologies and explore their impact on modern applications.

Detailed Syllabus:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Overview of Microprocessor based System	Overview of Components and Systems of Microcomputers, Introduction to the basic components of microcomputers, Significance of signal lines of memory, Concept of RISC & CISC Architecture, Harvard & Von Neumann Architecture, Concept of embedded system vs general-purpose system Self-learning Topics: Comparative study of different microprocessors	5	CO1
II	The Memory Systems	Concepts of primary memory and secondary memory, Need of Secondary memory, Types of Semiconductor Memory, Features of SRAM and DRAM, Cache Memory and its need, Flash vs SRAM in microcontrollers, Memory-mapped I/O, Stack vs Heap Self-Learning Topic: Comparative study of memory hierarchy and memory organization in microprocessors and microcontrollers	4	CO2
III	8051 Microcontroller & Assembly Language Programming	Comparison between Microprocessor and Microcontroller, Features, architecture and pin configuration, CPU timing and machine cycle, Memory organization, Addressing modes, Instruction set, Need of Assembler & Compiler, Assembler Directives, Programs related to: arithmetic, logical operations Self-Learning Topic: Study of stack operations and subroutine handling	9	CO3

		in 8051.		
IV	8051 I/O Ports, Timer/Counters, Interrupts, Serial Port communication & Interfacing	8051 Input / Output ports and Port structure, 8051 Timer/Counter, Timer modes, 8051 Interrupt, 8051 serial communication & modes, Assembly language program related to: delay subroutine, input & output port, timer, counter, serial port and Interrupt, Interfacing LEDs, Relay, Sensors and switches. Self-Learning Topic: Detailed study of interrupt handling and real-time applications of 8051.	9	CO4
V	ARM7	Concept of cortex A, cortex R and Cortex M, Basic ARM architecture idea, Programmers model, Introduction and Features of ARM Cortex M (M0/M3/M4 overview), NVIC (Interrupt controller), registers and execution flow, basic pipeline structure. Self-Learning Topic: Comparative study of ARM7 and Cortex-M architecture	8	CO5
VI	Study 8-bit microcontroller Applications	Definition of Embedded System, Embedded Systems Vs General Computing Systems, Factors to be Considered in Selecting a Microcontroller for an Application, Understanding features of MSP 430 and STM32, ESP32 Microcontrollers, Case Study on microcontroller based real time applications (Wearables, IoT Devices, Motor Control) Self-Learning Topic: Comparative study of ATmega328, LPC2148, MSP430 and STM32 microcontrollers based on architecture, power, and application domains	4	CO6
Total			39	

Text Books:

- [1] M. A. Mazidi, J. G. Mazidi, and R. D. McKinlay, The 8051 Microcontroller and Embedded Systems, 2nd ed. Noida, India: Pearson Education, 2008.
- [2] K. J. Ayala and D. V. Gadre, The 8051 Microcontroller and Embedded Systems: Using Assembly and C. Delhi, India: Cengage Learning, 2010.
- [3] R. Kamal, Microcontrollers: Architecture, Programming, Interfacing and System Design, 2nd ed. Noida, India: Pearson Education India, 2011.
- [4] N. S. Kumar, M. S. P. S. Kumar, and S. A. Kumar, Microprocessors and Microcontrollers, 2nd ed. New Delhi, India: Oxford University Press, 2014.
- [5] S. MacKenzie and R. C. W. Phan, The 8051 Microcontroller, 4th ed. London, UK: Pearson Education International, 2008.
- [6] S. Furber, ARM System-on-Chip Architecture, 2nd ed. London, UK: Pearson Education, 2000.

Reference Books:

- [1] Intel Corporation, MCS® 51 Microcontroller Family User's Manual. Santa Clara, CA, USA: Intel, 1994.
- [2] Microchip Technology, *ATmega328P: 8-bit AVR Microcontroller with 32K Bytes In-System Programmable Flash*. Chandler, AZ, USA: Microchip Technology, 2020.
- [3] J. A. Langbridge, Professional Embedded ARM Development. Indianapolis, IN, USA: Wrox/John Wiley & Sons, 2014.
- [4] A. N. Sloss, D. Symes, and C. Wright, ARM System Developer's Guide: Designing and Optimizing System Software. Burlington, MA, USA: Elsevier Morgan Kaufmann, 2004.
- [5] M. K. Patel, The 8051 Microcontroller and Embedded Systems. New Delhi, India: McGraw Hill Education, 2014.

Online References:

1. S. Chattopadhyay, "Microprocessors and Microcontrollers," SWAYAM, IIT Kharagpur, Course ID: noc20_ee42. Available: https://swayam.gov.in/nd1_noc20_ee42/preview
2. R. Thakur, "PLC and Microcontroller," SWAYAM, NITTTR Chandigarh, Course ID: ntr25_ed25. Available: https://onlinecourses.swayam2.ac.in/ntr25_ed25/preview

Assessment:

A. In-Semester Assessment (50 Marks)

1. Continuous Internal Assessment (20 Marks)

- a) 15 Marks = Use any 4 tools from Annexure I (2 tools before MSE and 2 tools after MSE)
- b) 5 Marks = Attendance and Active participation

2. Mid Semester Exam (30 Marks)

Mid semester examination will be based on 40% to 50% syllabus.

B. End Semester Examination (50 Marks)

End Semester Examination will be based on syllabus coverage up to the Mid Semester Examination (MSE) carrying 20% to 30% weightage, and the syllabus covered from MSE to ESE carrying 70% to 80% weightage.

Course Type	Course Code	Course Name			Credits
PCC	EC4PCC8	Data Structures and Algorithm			03
Examination Scheme					
Distribution of Marks			Exam Duration (Hrs.)		Total Marks
In-Semester Assessment		End Semester Assessment (ESE)	MSE	ESE	100
Continuous Assessment	Mid Semester Exam (MSE)				
20	30		50	1.5	

Prerequisite:

1. C programming

Course Objectives:

1. To understand the importance of data structures in computer science and their role in designing efficient solutions to computational problems.
2. To study and explore various linear and non-linear data structures along with fundamental searching and sorting techniques.
3. To explore various algorithm design strategies and develop effective problem-solving skills by selecting and applying appropriate algorithmic techniques.

Course Outcomes:

1. Apply fundamental operations such as insertion, deletion, and traversal on stack and queue data structures.
2. Perform various operations such as insertion, deletion, and traversal operations on linked list data structures.
3. Utilize tree and graph data structures to solve real-world computational problems across various domains.
4. Select and apply appropriate searching and sorting algorithms to efficiently solve computational problems
5. Demonstrate understanding of divide and conquer and greedy algorithmic strategies.
6. Apply dynamic programming techniques to solve optimization problems

Detailed Syllabus:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Introduction, Stack and Queue	Introduction: Data Structures, Concept of ADT, Classification of Data Structure Stack: ADT, Representation, Operations, Applications of Stack: Infix to postfix conversion, postfix expression evaluation, balanced parentheses Queue: ADT, Representation, Operations on Queue, Circular Queue, Priority Queue, Double Ended Queue, Self-Learning: Applications of Stack and Queue	7	CO1
II	Linked List	ADT, Representation, Array vs Linked list, Types of Linked list Singly linked list: Representation, Operations Doubly linked list: Representation, Operations Stack using linked list, Queue using linked list, Applications of Linked list Self-Learning: Circular linked list Operations	6	CO2
III	Tree and Graph	Tree: ADT, Tree Terminology, Binary Tree, Traversal of Binary Tree Binary Search Tree: Operations: Insertion, Deletion, Traversal Self-balancing Trees: AVL trees, Operations: Rotations, Insertion Graph: ADT, Graph Terminologies, Representation of Graph Graph Traversal Technique: BFS, DFS Self-Learning: Applications: Expression Tree, Huffman Encoding	7	CO3
IV	Searching and Sorting	Selection Sort, Insertion Sort Hashing: Hash Tables, Hash Functions. Collision Resolution Techniques: Linear Probing, Quadratic Probing,	4	CO4

		Double Hashing Self-Learning: Separate Chaining		
V	Divide and Conquer Approach and Greedy Approach	Introduction to Algorithms: Performance analysis: space, and time complexity, Asymptotic Notations: O , Θ , Ω notations, Master Method Divide and Conquer Approach: General Method, Merge sort, Quick sort, Binary search Greedy Approach: General Method, Single source shortest path: Dijkstra Algorithm, Fractional Knapsack problem, Minimum cost spanning trees: Kruskal and Prim's algorithms Self-Learning: Job sequencing with deadlines	9	CO5
VI	Dynamic Programming	General Method, All pair shortest path, Floyd Warshall Algorithm, 0/1 knapsack Problem, Longest common subsequence, Travelling Salesman Problem Self-Learning: Single source shortest path: Bellman Ford Algorithm	6	CO6
		Total	39	

Text Books:

- [1] R. Thareja, *Data Structures Using C*. New Delhi, India: Oxford University Press, 2014.
- [2] A. M. Tenenbaum, Y. Langsam, and M. J. Augenstein, *Data Structures Using C*. Noida, India: Pearson Education, 2009.
- [3] T. H. Cormen, C. E. Leiserson, R. L. Rivest, and C. Stein, *Introduction to Algorithms*, 2nd ed. New Delhi, India: PHI Learning, 2005.
- [4] H. Bhasin, *Design and Analysis of Algorithms*. New Delhi, India: Oxford University Press, 2015.
- [5] E. Horowitz and S. Sahni, *Fundamentals of Computer Algorithms*. New York, NY, USA: Computer Science Press, 2008.

Reference Books:

- [1] E. Balagurusamy, *Data Structures Using C*. New Delhi, India: Tata McGraw-Hill Education, 2011.
- [2] R. L. Kruse, C. L. Tondo, and B. P. Leung, *Data Structures and Program Design in C*, 2nd ed. Noida, India: Pearson Education, 1997.
- [3] S. Dasgupta, C. H. Papadimitriou, and U. V. Vazirani, *Algorithms*. New Delhi, India: Tata McGraw-Hill, 2008.
- [4] S. K. Basu, *Design Methods and Analysis of Algorithms*. New Delhi, India: PHI Learning, 2013.

Online References:

1. NPTEL, "Programming, Data Structures and Algorithms in Python," NPTEL. Available: <https://nptel.ac.in/courses/106/106/106106131/>
2. NPTEL, "Design and Analysis of Algorithms," SWAYAM, IIT Madras, Course ID: noc19_cs47. Available: https://swayam.gov.in/nd1_noc19_cs47/preview
3. T. Roughgarden, "Algorithms Specialization," Coursera, Stanford University. Available: <https://www.coursera.org/specializations/algorithms>
4. "Algorithms," MOOC List. Available: <https://www.mooc-list.com/tags/algorithms>

Assessment:

A. In-Semester Assessment (50 Marks)

1. Continuous Internal Assessment (20 Marks)

- a) 15 Marks = Use any 4 tools from Annexure I (2 tools before MSE and 2 tools after MSE)
- b) 5 Marks = Attendance and Active participation

2. Mid Semester Exam (30 Marks)

Mid semester examination will be based on 40% to 50% syllabus.

B. End Semester Examination (50 Marks)

End Semester Examination will be based on syllabus coverage up to the Mid Semester Examination (MSE) carrying 20% to 30% weightage, and the syllabus covered from MSE to ESE carrying 70% to 80% weightage.

Course Type	Course Code	Course Name			Credits
PCE	EC4PEC11	Analog Communication			03
Examination Scheme					
Distribution of Marks			Exam Duration (Hrs.)		Total Marks
In-Semester Assessment		End Semester Assessment (ESE)	MSE	ESE	100
Continuous Assessment	Mid Semester Exam (MSE)				
20	30		50	1.5	

Prerequisite:

1. Mathematics for Electronics & Computer Engineering-III
2. Analog Electronics Circuits

Course Objectives:

1. To illustrate the fundamentals of basic communication system.
2. To understand various analog modulation and demodulation techniques.
3. To focus on applications of analog modulation and demodulation techniques.
4. To explain the key concepts of analog and digital pulse modulation and demodulation techniques.

Course Outcomes:

1. Explain the basic elements and working of communication systems
2. Analyze amplitude modulation techniques and their generation and detection.
3. Understand frequency modulation and phase modulation systems
4. Describe the working of transmitters and receivers used in communication systems.
5. Evaluate the effect of noise on communication systems.
6. Explain sampling and different pulse modulation techniques.

Detailed Syllabus:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Basics of Communication System	Basic elements of communication system: Information source, transmitter, communication channel, receiver, and destination. Types of communication systems: Analog and digital communication systems. Baseband and passband transmission. Need for modulation in communication systems. Classification of modulation techniques: Amplitude modulation, frequency modulation, and phase modulation. Self-Learning Topic: Types of Noise and Electromagnetic Spectrum,	6	CO1
II	Amplitude Modulation and Demodulation	Concept and principle of amplitude modulation. Mathematical representation of AM signals. Modulation index and percentage modulation. Frequency spectrum of AM signal. Power relations in AM (carrier power, sideband power, total transmitted power). Generation of AM signals: Square law modulator and switching modulator. Demodulation of AM signals: Envelope detector and practical considerations. Self-Learning Topics: Low level and High-level Transmitters.	8	CO2
III	Angle Modulation	Concept of angle modulation. Frequency modulation (FM) and phase modulation (PM). Mathematical analysis of FM signals. Frequency deviation and modulation index. Narrowband FM and wideband FM. Bandwidth of FM signal using Carson's rule. Generation of FM	9	CO3

		signals: Direct method and Armstrong method. Demodulation of FM signals: Slope detector, and Foster–Seeley discriminator. Self-Learning Topics: Demodulation of FM signals using Ratio Detector.		
IV	Transmitters and Receivers	Block diagram and working of AM transmitter. Block diagram and working of FM transmitter. Tuned Radio Frequency receiver. Superheterodyne receiver. Intermediate frequency concept. Image frequency and its rejection. Receiver characteristics: Sensitivity, selectivity, and fidelity. Self-learning Topics: Use of AM and FM in Modern Communication Technology. Challenges faced by radio broadcasting industry.	6	CO4
V	Noise in Analog Communication	Introduction to noise and its sources. Types of noise: External noise and internal noise. Thermal noise and shot noise. Signal-to-noise ratio (SNR). Noise performance in AM systems. Noise performance in FM systems. Methods to improve SNR in FM systems. Self-Learning Topics: Types of Noise affect in real life communication systems.	5	CO5
VI	Pulse Modulation Techniques	Sampling theorem and Nyquist rate. Natural sampling and flat-top sampling. Pulse Amplitude Modulation (PAM). Pulse Width Modulation (PWM). Pulse Position Modulation (PPM). Comparison of pulse modulation techniques. Self-Learning Topics: Types of Multiplexing and Applications of Multiplexing.	5	CO6
Total			39	

Text Books:

- [1] S. Haykin, M. Moher, A. S. Raghuvanshi, and S. Shah, Communication Systems: An Indian Adaptation, 5th ed. New Delhi, India: Wiley India, 2022.
- [2] B. P. Lathi and Z. Ding, Modern Digital and Analog Communication Systems, 5th ed. New York, NY, USA: Oxford University Press, 2018.
- [3] G. Kennedy, B. Davis, and S. R. M. Prasanna, Kennedy's Electronic Communication Systems, 5th ed. New Delhi, India: McGraw Hill Education, 2021

Reference Books:

- [1] H. Taub, D. L. Schilling, and G. Saha, Taub's Principles of Communication Systems, 4th ed. Chennai, India: McGraw Hill Education, 2017.
- [2] J. G. Proakis and M. Salehi, Communication Systems Engineering, 3rd ed. Englewood Cliffs, NJ, USA: Prentice-Hall, 2004.
- [3] L. E. Frenzel, Principles of Electronic Communication Systems, 4th ed. Chennai, India: McGraw Hill Education, 2019.

Online References:

1. NPTEL, "Principles of Communication Systems - I," NPTEL, IIT Delhi. [Online]. Available: <https://nptel.ac.in/courses/108/104/108104093/> [Accessed: Jun. 15, 2026].
2. NPTEL, "Principles of Communication Systems - II," NPTEL, IIT Delhi. [Online]. Available: <https://nptel.ac.in/courses/108/104/108104094/> [Accessed: Jun. 15, 2026].
3. S. L. Maskara, "Communication Engineering," SWAYAM, IIT Kharagpur, Course ID: noc20_ee70. [Online]. Available: https://onlinecourses.nptel.ac.in/noc20_ee70/preview

Assessment:

A. In-Semester Assessment (50 Marks)

1. Continuous Internal Assessment (20 Marks)

a) 15 Marks = Use any 4 tools from Annexure I (2 tools before MSE and 2 tools after MSE)

b) 5 Marks = Attendance and Active participation

2. Mid Semester Exam (30 Marks)

Mid semester examination will be based on 40% to 50% syllabus.

B. End Semester Examination (50 Marks)

End Semester Examination will be based on syllabus coverage up to the Mid Semester Examination (MSE) carrying 20% to 30% weightage, and the syllabus covered from MSE to ESE carrying 70% to 80% weightage.

Course Type	Course Code	Course Name			Credits
PEC	EC4PEC12	Data Compression and Encryption			03
Examination Scheme					
Distribution of Marks			Exam Duration (Hrs.)		Total Marks
In-Semester Assessment		End Semester Assessment (ESE)	MSE	ESE	100
Continuous Assessment	Mid Semester Exam (MSE)				
20	30		50	1.5	

Prerequisite:

1. Mathematics for Electronics & Computer Engineering - 3

Course Objectives:

1. To understand the fundamentals of multimedia data compression techniques.
2. To analyze lossless and lossy compression algorithms and evaluate multimedia compression standards.
3. To apply cryptographic algorithms and number theory concepts for data security.
4. To understand system security mechanisms and secure communication techniques.

Course Outcomes:

1. Explain and compare various lossless and lossy data compression techniques.
2. Analyze different audio and video compression standards
3. Apply symmetric key cryptographic algorithms for data security.
4. Apply number theory concepts to solve the cryptographic problems.
5. Analyze different public key cryptography algorithms and also describe methods that provide the goals for integrity, confidentiality and authentication.
6. Describe various system security mechanisms and secure transaction techniques.

Detailed Syllabus:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Introduction to Data Compression	Data compression, modelling and coding, Lossless and Lossy Compression, Arithmetic Coding – Decoding, Dictionary Based Compression, Sliding Window Compression: LZ-77, LZ-78, LZW. Image Compression DCT, JPEG, JPEG – LS, Differential Lossless Compression, DPCM, JPEG – 2000 Standards. Self-Learning Topic: Applications of data compression in cloud storage.	6	CO1
II	Video and Audio Compression	Video compression: Motion compensation, temporal and spatial prediction, MPEG-4, H.264 encoder and decoder. Sound, Digital Audio, μ -Law and A-Law Companding, MPEG –4 Audio Layer, Advanced Audio Coding (AAC) standard. Self-Learning Topics: H.265 (HEVC), AV1 video codec.	6	CO2
III	Data Security	Security Goals, Cryptographic Attacks and Techniques. Symmetric Key: Substitution Cipher, Transposition Cipher, Stream and Block Cipher. DES, double DES and triple DES, AES Self-Learning Topics: Modern cryptographic attacks, Lightweight cryptography for IoT.	10	CO3

IV	Number Theory	Prime Numbers, Fermat's and Euler's Theorem. Chinese Remainder Theorem. Self-learning Topics: Modular arithmetic applications, Elliptic Curve Cryptography (ECC)	4	CO4
V	Asymmetric Key Cryptography	Principles of Public Key Crypto System, RSA, Key Management, Diffie-Hellman Key Exchange. Message Integrity, Message Authentication and Hash Functions, SHA, HMAC, Digital Signature Standards. Self-Learning Topics: PGP (Pretty Good Privacy), Secure Socket Layer (SSL), Email authentication mechanisms.	9	CO5
VI	System Security	Intrusion Detection System, Secure Electronic Transactions. Firewall Design, Digital Immune systems, Biometric Authentication, Ethical Hacking. Self-Learning Topics: Network security tools, Security in IoT devices, Mobile device security.	4	CO6
Total			39	

Text Books:

- [1] K. Sayood, Introduction to Data Compression, 3rd ed. San Francisco, CA, USA: Morgan Kaufmann, 2006.
- [2] M. Nelson and J.-L. Gailly, The Data Compression Book, 2nd ed. New York, NY, USA: M&T Books, 1995.
- [3] W. Stallings, Cryptography and Network Security: Principles and Practice, 5th ed. New Delhi, India: Pearson Education, 2011.
- [4] B. A. Forouzan, Cryptography and Network Security. New Delhi, India: Tata McGraw-Hill, 2010.

Reference Books:

- [1] D. Salomon, Data Compression: The Complete Reference, 4th ed. London, UK: Springer, 2007.
- [2] M. Bishop, Computer Security: Art and Science. Boston, MA, USA: Addison-Wesley, 2003.
- [3] B. Meneses, Network Security and Cryptography, 7th ed. Boston, MA, USA: Cengage Learning, 2019.

Online References:

1. D. Mukhopadhyay, "Cryptography and Network Security," NPTEL, IIT Kharagpur.
Available: <https://nptel.ac.in/courses/106105031>.
2. S. Gangopadhyay, "Introduction to Cryptology," NPTEL, IIT Roorkee, Course ID: noc17_cs36.
Available: https://onlinecourses-archive.nptel.ac.in/noc17_cs36/preview.
3. NPTEL, "Information Security," SWAYAM, Course ID: noc22_cs90.
Available: https://onlinecourses.nptel.ac.in/noc22_cs90/preview.

Assessment:

A. In-Semester Assessment (50 Marks)

1. **Continuous Internal Assessment (20 Marks)**
 - a) 15 Marks = Use any 4 tools from Annexure I (2 tools before MSE and 2 tools after MSE)
 - b) 5 Marks = Attendance and Active participation
2. **Mid Semester Exam (30 Marks)**
Mid semester examination will be based on 40% to 50% syllabus.

B. End Semester Examination (50 Marks)

End Semester Examination will be based on syllabus coverage up to the Mid Semester Examination (MSE) carrying 20% to 30% weightage, and the syllabus covered from MSE to ESE carrying 70% to 80% weightage.

Course Type	Course Code	Course Name			Credits
PEC	EC4PEC13	NoSQL Databases			03
Examination Scheme					
Distribution of Marks			Exam Duration (Hrs.)		Total Marks
In-Semester Assessment		End Semester Assessment (ESE)	MSE	ESE	100
Continuous Assessment	Mid Semester Exam (MSE)				
20	30				
		50	1.5	2	

Prerequisite:

1. Python Programming
2. Data Structures,
3. Database Management System,

Course Objectives:

1. To understand the limitations of RDBMS and the need for NoSQL databases.
2. To learn the four main types of NoSQL databases: Key-Value, Document, Column-family, and Graph.
3. To master data modeling techniques in a non-relational environment.
4. To understand the CAP theorem and its implications on distributed consistency.

Course Outcomes:

1. Identify the fundamental characteristics of NoSQL databases and the trade-offs described by the CAP theorem.
2. Perform CRUD operations and partitioning strategies in Key-Value databases like Redis.
3. Construct document-based schemas and perform complex data analysis using the MongoDB Aggregation Framework.
4. Formulate queries and design columnar data models using Cassandra Query Language (CQL).
5. Apply graph theory principles to model complex relationships and perform traversals using Cypher in Neo4j.
6. Demonstrate the concepts of data distribution, consistency models, and the implementation of polyglot persistence in hybrid architectures.

Detailed Syllabus:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Introduction to NoSQL	Introduction to NoSQL, Characteristics, SQL vs NoSQL, Data Modeling, Aggregate Models, CAP Theorem (Consistency, Availability, Partition Tolerance), Base Properties. Self-learning Topics: Evolution from 1st Gen to 3rd Gen Databases; The "NewSQL" movement.	5	CO1
II	Key-Value Databases	Key-Value Store Features, Scalability, Introduction to Redis/Riak: Data types, CRUD operations, Partitioning and use cases. Self-learning Topics: Use of Redis as a Message Broker (Pub/Sub); Setting up Redis Clusters.	6	CO2
III	Document Databases	Introduction to Document Stores, Features of MongoDB, MongoDB Architecture, Data Modeling (Embedding vs. Referencing), CRUD Operations, Indexing, and Aggregation Framework, Sharding. Self-learning Topics: MongoDB Atlas (Cloud) management; Change Streams and Triggers.	8	CO3
IV	Column-Family Stores	Architecture of Columnar Databases, Introduction to Apache Cassandra: Data Model, CQL (Cassandra Query Language), Keyspaces, Tables, and Clusters.	7	CO4

		Self-learning Topics: Difference between Hbase and Cassandra; Time-series data modeling.		
V	Graph Databases	Introduction to Graph Theory in DBs, Graph Model, Introduction to Neo4j: Nodes, Relationships, Properties, and Cypher Query Language, Graph Algorithms. Self-learning Topics: Real-world Fraud Detection patterns; Graph Data Science (GDS) library basics.	6	CO5
VI	Distributed Systems & Polyglot Persistence	Distributed Systems: Introduction to Distributed Databases; Data Distribution Models: Replication (Master-Slave, Peer-to-Peer) and Sharding; Consistency Models: Eventual Consistency vs. Strong Consistency; Quorum-based protocols. Polyglot Persistence: Concept of Polyglot Persistence; Choosing the right database for specific use cases; Hybrid data architectures; Challenges in cross-database consistency. Self-learning Topics: Study of various deadlock situations in distributed designs; Case studies on Netflix's use of Cassandra or Amazon's DynamoDB for polyglot architectures.	7	CO6
Total			39	

Text Books:

- [1] P. J. Sadalage and M. Fowler, *NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence*. New Delhi, India: Pearson India Education Services Pvt. Ltd., 2013.
- [2] J. Carpenter and E. Hewitt, *Cassandra: The Definitive Guide: Distributed Data at Web Scale*, 3rd ed. Sebastopol, CA, USA: O'Reilly Media, 2022.
- [3] G. Harrison, *Next Generation Databases: NoSQL, NewSQL, and Big Data*, 1st ed. New York, NY, USA: Apress, 2016.
- [4] S. Bradshaw, E. Brazil, and K. Chodorow, *MongoDB: The Definitive Guide: Powerful and Scalable Data Storage*, 3rd ed. Sebastopol, CA, USA: O'Reilly Media, 2019.
- [5] S. Tiwari, *Professional NoSQL*. Hoboken, NJ, USA: Wiley, 2011.

Reference Books:

- [1] D. Sullivan, *NoSQL for Mere Mortals*. New Delhi, India: Pearson India Education Services Pvt. Ltd., 2015.
- [2] E. Redmond and J. R. Wilson, *Seven Databases in Seven Weeks*. Raleigh, NC, USA: Pragmatic Bookshelf, 2012.
- [3] J. L. Carlson, *Redis in Action*. Shelter Island, NY, USA: Manning Publications, 2013.
- [4] S. Acharya and S. Chellappan, *Big Data and Analytics*. New Delhi, India: Wiley India, 2015.
- [5] D. McCreary and A. Kelly, *Making Sense of NoSQL*. Shelter Island, NY, USA: Manning Publications, 2013.

Online References:

1. NPTEL, "Big Data Computing," SWAYAM, IIT Patna, Course ID: noc25_cs131. Available: https://onlinecourses.nptel.ac.in/noc25_cs131/preview
2. A. Bhattacharya, "Fundamentals of Database Systems," NPTEL, IIT Kanpur, 2021. Available: https://archive.nptel.ac.in/content/syllabus_pdf/106104135.pdf
3. P. P. Das and S. Chattopadhyay, "Data Base Management System," SWAYAM, NPTEL, IIT Kharagpur, Course ID: noc25_cs145. Available: https://onlinecourses.nptel.ac.in/noc25_cs145/preview

Assessment:

A. In-Semester Assessment (50 Marks)

1. Continuous Internal Assessment (20 Marks)

- a) 15 Marks = Use any 4 tools from Annexure I (2 tools before MSE and 2 tools after MSE)
- b) 5 Marks = Attendance and Active participation

2. Mid Semester Exam (30 Marks)

Mid semester examination will be based on 40% to 50% syllabus.

B. End Semester Examination (50 Marks)

End Semester Examination will be based on syllabus coverage up to the Mid Semester Examination (MSE) carrying 20% to 30% weightage, and the syllabus covered from MSE to ESE carrying 70% to 80% weightage.

Course Type	Course Code	Course Name			Credits
PEC	EC4PEC14	Linear Integrated Circuits			03
Examination Scheme					
Distribution of Marks			Exam Duration (Hrs.)		Total Marks
In-Semester Assessment		End Semester Assessment (ESE)	MSE	ESE	100
Continuous Assessment	Mid Semester Exam (MSE)				
20	30		50	1.5	

Prerequisite:

1. FE1ESC2 Fundamentals of Electrical and Electronic Systems
2. EC3PCC3 Analog Electronics Circuits

Course Objectives:

1. To understand the concepts, working principles and key applications of linear integrated circuits.
2. To perform analysis of circuits based on linear integrated circuits.
3. To design circuits and systems for particular applications using linear integrated circuits.

Course Outcomes:

1. Explain op-amp basics, characteristics, and configurations.
2. Analyze linear applications of OPAMP.
3. Analyze non-linear applications of OPAMP.
4. Analyze and design different application of IC 555.
5. Analyze and design different types of voltage regulator.
6. Explain working of VCO and PLL ICs with application

Detailed Syllabus:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Introduction	Block diagram of op-amp., Ideal and practical characteristics of op-amp, Configurations of op-amp: Open loop and closed loop configurations of op-amp, Inverting and Non-inverting configuration of op-amp and buffer, summing amplifier, difference amplifiers and Instrumentation amplifier using op-amp. Self-learning Topics: History and development of op-amp, IC 741 Op-Amp pin configuration	7	CO1
II	Linear Applications of Operational Amplifier	Integrator & differentiator (ideal & practical), Active Filters: First and Second order active low pass, high pass, band pass, band reject and Notch filters. Positive feedback, Barkhausen's criteria, Sine Wave Oscillators: RC phase shift oscillator, Wien bridge oscillator. Self-learning Topics: Design a low pass audio filter, Design a high pass filter for noise removal	8	CO2
III	Non-Linear Applications of Operational Amplifier	Comparators: Inverting comparator, non-inverting comparator, zero crossing detectors, window detector. Schmitt Triggers: Inverting Schmitt trigger, non-inverting Schmitt trigger. Waveform Generators: Square wave generator and triangular wave generator. Basics of Precision Rectifiers: Half wave and full wave precision rectifiers. Peak detector. Self-learning Topics: Design an inverting comparator circuit, implement a zero-crossing detector, Build a window detector circuit	7	CO3

IV	Timer IC 555 and its applications	Functional block diagram and working of IC 555 Design of a stable and Monostable multivibrator using IC 555 Applications of a stable and Monostable multivibrator as Pulse width modulator and Pulse Position Modulator. Self-learning Topics: LED flasher using a stable multivibrator, Automatic timer using monostable multivibrator	7	CO4
V	Voltage Regulators	Functional block diagram, working and design of three terminal fixed voltage regulators (78XX, 79XX series). Functional block diagram, working and design of general-purpose IC 723 (HVLC and HVHC). Introduction and block diagram of switching regulator, Introduction of LM 317. Self-learning Topics: difference between HVLC and HVHC configuration, Heat Sink	6	CO5
VI	Special Purpose Integrated Circuits	The Naïve string-matching algorithm, The Rabin Karp algorithm, The Knuth-Morris-Pratt algorithm Self-learning Topics: Real life applications of all algorithms	4	CO6
Total			39	

Text Books:

- [1] R. A. Gayakwad, Op-Amps and Linear Integrated Circuits, 4th ed. New Delhi, India: Pearson Prentice Hall, 2010.
- [2] D. R. Choudhury and S. B. Jain, Linear Integrated Circuits, 4th ed. New Delhi, India: New Age International Publishers, 2011.

Reference Books:

- [1] K. R. Botkar, Integrated Circuits. New Delhi, India: Khanna Publishers, 2004.
- [2] S. Franco, Design with Operational Amplifiers and Analog Integrated Circuits, 3rd ed. New Delhi, India: Tata McGraw-Hill, 2004.
- [3] D. A. Bell, Operational Amplifiers and Linear Integrated Circuits, Indian ed. New Delhi, India: Oxford University Press, 2011.
- [4] R. F. Coughlin and F. F. Driscoll, Operational Amplifiers and Linear Integrated Circuits, 6th ed. Upper Saddle River, NJ, USA: Prentice Hall, 2003.
- [5] J. Millman, C. Halkias, and S. K. Mohapatra, Millman's Electronic Devices and Circuits, 3rd ed. New Delhi, India: McGraw-Hill Education, 2010.

Online References:

1. H. J. Pandya, "Integrated Circuits MOSFETs OP-Amps and their Applications," SWAYAM, IISc Bangalore, Course ID: noc20_ee13. Available: https://swayam.gov.in/nd1_noc20_ee13/preview.
2. NPTEL, "Op-Amp & Linear ICs," SWAYAM, Course ID: ntr25_ed139. Available: https://onlinecourses.swayam2.ac.in/elearning/preview/ntr25_ed139.
3. IIT Kharagpur, "Basic Electronics Virtual Laboratory," Virtual Labs. Available: <https://be-iitkgp.vlabs.ac.in/List%20of%20experiments.html>.

Assessment:

A. In-Semester Assessment (50 Marks)

1. Continuous Internal Assessment (20 Marks)

- a) 15 Marks = Use any 4 tools from Annexure I (2 tools before MSE and 2 tools after MSE)
- b) 5 Marks = Attendance and Active participation

2. Mid Semester Exam (30 Marks)

Mid semester examination will be based on 40% to 50% syllabus.

B. End Semester Examination (50 Marks)

End Semester Examination will be based on syllabus coverage up to the Mid Semester Examination (MSE) carrying 20% to 30% weightage, and the syllabus covered from MSE to ESE carrying 70% to 80% weightage.

Course Type	Course Code	Course Name			Credits
VEC	SY4VEC2	Universal Human Values			02
Examination Scheme					
Distribution of Marks				Exam Duration (Hrs.)	Total Marks
In-Semester Assessment		End Semester Assessment (ESE)	MSE	ESE	50
Continuous Assessment	Mid Semester Exam (MSE)				
50	--	--	--	--	

Course Objectives:

1. To develop an understanding of Universal Human Values (UHV) and enable students to engage in self-exploration for achieving clarity about happiness, prosperity, and life goals.
2. To help students build personal, academic, and professional competence through goal setting, self-discipline, emotional management, and continuous self-improvement.
3. To enable students to understand and apply ethical values, harmony in relationships, social responsibility, sustainability, and constitutional principles in personal and professional life.

Course Outcomes:

1. Understand the concept of Universal Human Values (UHV), self-exploration, and basic human aspirations such as happiness and prosperity.
2. Apply goal-setting techniques, time management, and self-development strategies to improve personal, academic, and career growth.
3. Analyze the harmony between self and body, and demonstrate values like trust, respect, and responsibility in relationships.
4. Evaluate the importance of social harmony, sustainability, and environmental responsibility in building a balanced society.
5. Develop ethical decision-making abilities by applying moral principles, constitutional values, and corporate ethics in real-life situations.

Detailed Syllabus:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Introduction to Universal Human Values & Self-Exploration	Purpose and motivation for the course; getting to know each other meaning, need, and importance of Universal Human Values (UHV) Self-exploration: meaning, process, and guidelines, Right understanding vs assumptions, Basic human aspirations: Happiness (Sukh) & Prosperity (Samriddhi), Relationship between values, skills, and life goals Self-Learning: Reading: The Power of Self-Awareness in Success Video: The Importance of Knowing Yourself Activity: Personal introduction	6	CO1
II	Basic Human Aspirations, Goals & Personal Development	Personal, academic, and career dimensions, Expectations from family, peers, society, and nation, Goal setting (short-term & long-term), Self-confidence and personality development, Managing peer pressure, time, anger, and stress, continuous self-improvement. Self-Learning: Goal sheet preparation Reading: How to Align Personal and Career Goals Time management worksheet TED Ed video on peer pressure	6	CO2
III	Harmony in Human Being (Self & Body) and Relationships	Human being as co-existence of Self (I) and Body, Needs of Self vs Body, Activities of Self: Desire, Thought, Expectation, Harmony of Self with Body (Sanyam & Swasthya), Self-regulation, discipline, and holistic health, Family as the basic unit of interaction, Values in relationships: Trust, Respect, Affection, Care, Guidance, Gratitude, dignity, love; peer interactions (ragging, cooperation) Self-Learning: Reflection on habits Food journal tracking Sleep awareness Self-improvement plan.	5	CO3

IV	Harmony in Society, Nature & Sustainability	Role of relationships in society and workplace • Conflict resolution and social responsibility, Vision of Universal Human Order (Sarvabhaum Vyavastha), Interconnectedness in nature, Four orders: Material, Plant, Animal, Human, Co-existence and mutual fulfillment, Sustainable living and environmental responsibility. Self-Learning: Case study on sustainability Activity: Track environmental impact habits.	5	CO4
V	Ethical Decision-Making, Constitution & Corporate Ethics	Ethical values, moral reasoning, and frameworks, Case studies on ethical dilemmas, Corporate ethics and professional conduct, Ethical leadership and engineering ethics, Fundamental Rights and Duties, Directive Principles of State Policy, Structure of governance and constitutional amendments, Landmark case laws, Corporate laws and governance, Corporate Social Responsibility (CSR) and regulatory impact. Self-Learning: Case analysis (ethics /CSR /constitution) Reflection on ethical challenges.	6	CO1
Total			28	

Text Books:

- [1] K. R. Dasari, Universal Human Values & Professional Ethics. Chennai, India: Notion Press, 2020.
[2] K. S. Sharma and S. K. Sachdeva, Universal Human Values. Canada: Booksclic Publishing, 2023

Online References:

1. UHV Foundation, "Videos," *UHV Foundation*.
Available: <https://uhv.org.in/videos>
2. UHV Foundation, "Universal Human Values," *YouTube*.
Available: <https://www.youtube.com/c/UniversalHumanValues>.
3. "UHV Unit-1 Complete One-Shot," *YouTube*, uploaded by BunkToBrains.
Available: <https://www.youtube.com/watch?v=Qc5ft5fL-LI>.

Assessment:

A. In-Semester Assessment (50 Marks)

1. Continuous Internal Assessment (50 Marks)

- a) 15 Marks = Assignment/s
- b) 15 Marks = Case study and Presentation
- c) 10 Marks = Use any 2 tools from Annexure I (1 tool before MSE and 1 tool after MSE)
- d) 10 Marks = Attendance and Active participation

Course Type	Course Code	Course Name	Credits
PCL	EC4PCL3	Microcontrollers Lab	01
Examination Scheme			
Continuous Assessment		Practical/ Oral	Total Marks
25		25	50

Prerequisite:

1. Digital System Design

Lab Objectives:

1. To evaluate and integrate development tools for effective system design and implementation for microcontroller-based system.
2. To study the addressing modes of 8051 and write the program to apply the same.
3. To interface I/O devices to 8051 and write the program apply the same.
4. To develop microcontroller-based applications.

Lab Outcomes:

1. Use microcontroller development tools to design, simulate, debug, and troubleshoot microcontroller-based systems.
2. Develop assembly language programs for arithmetic, logical, data transfer, and code conversion operations.
3. Implement assembly language programs for general-purpose I/O, timers, interrupts, and interfacing with input/output devices.
4. Design and develop microcontroller-based embedded system applications by integrating hardware and software concepts.

List of Suggested Experiments:

(A minimum of 10 experiments covering the entire syllabus must be conducted in batches.)

Sr. No.	Name of the Experiment	Hours	LO Mapping
I	Module 1: 8051 and ARM Assembly Language Programming Fundamentals This module introduces the fundamentals of assembly language programs for the 8051 microcontroller to perform arithmetic, logical, and data conversion operations. Students will Understand the use of 8051 instruction sets, registers, and memory organization while implementing fundamental programming tasks which will strengthen their problem-solving and embedded programming skills. Suggested Experiments: 1. Write Assembly Program in assembly language for 8051 to perform arithmetic operations such as: a) Addition b) Subtraction c) Multiplication d) Division 2. Write Assembly Program in assembly language for 8051 to perform multiple byte decimal addition 3. Write Assembly Program in assembly language for 8051 to Conversion of codes (Any One): a) Binary to BCD b) Binary to Gray 4. Write Assembly Program to perform Logical Operations such as : a) AND b)OR c)XOR 5. Write Assembly Program to perform arithmetic operations using ARM such as: a) Addition b) Subtraction c) Multiplication d) Division	06	LO1
II	Module 2: Data Handling and Memory Manipulation using 8051 Assembly Language This module focuses on the memory management tasks such as block data transfer and sorting of data stored in memory. Students will understand looping, addressing modes, and comparison instructions to implement efficient data manipulation algorithms on the 8051 microcontrollers. Suggested Experiments: 1. Write Assembly Program in assembly language for 8051 to moving block of data from one memory location to another. 2. Write Assembly Program to arrange numbers in Ascending order or descending order 3. Write Assembly Program in assembly language for 8051 to search for a given element in an array (Linear Search). 4. Write Assembly Program in assembly language for 8051 to find the largest/Smallest number in an array.	06	LO2

III	Module 3: Interfacing and Peripheral Programming using 8051 This module provides knowledge of Interfacing and programming peripheral devices such as LEDs, seven-segment displays, LCDs, stepper motors, and serial communication modules using the 8051 microcontrollers. Students will develop assembly language programs utilizing timers, interrupts, and I/O ports to generate waveforms and implement real-time embedded applications. Suggested Experiments: 1. Write Assembly Program in assembly language for 8051 to generate: a) Square Wave b) Triangular Wave 2. Write Assembly Program in assembly language for 8051 to blink an LED: a) Using Timer and Interrupt b) Using Delay Subroutine 3. Interfacing and programming of a Seven-Segment Display with the 8051 microcontrollers. 4. Interfacing and programming of a 16 × 2 LCD display with the 8051 microcontrollers. 5. Study and interfacing of a Stepper Motor with the 8051 microcontrollers: a) Continuous Mode b) Step Mode (180° Clockwise and Anticlockwise Rotation) 6. Write Assembly Programme for 8051 serial communications to transmit a string of characters through the UART.	08	LO3
IV	Module 4: Design and Implementation of a Microcontroller-Based Embedded System This module will help students Design, simulate, and demonstrate a real-world embedded application using the 8051 microcontrollers on simulation platforms such as Keil µVision and Proteus. Students may choose any one application from the suggested list or propose an equivalent project. Suggested list: 1. Traffic Light Controller 2. Touchless Doorbell (IR Sensor Based) 3. Automatic Street Light Controller 4. Digital Visitor Counter 5. Temperature Monitoring System 6. Electronic Voting Machine (EVM) 7. Digital Stopwatch/Timer	04	LO4

Text Books:

- [1] M. A. Mazidi, J. G. Mazidi, and R. D. McKinlay, The 8051 Microcontroller and Embedded Systems, 2nd ed. Noida, India: Pearson Education, 2008.
- [2] K. J. Ayala and D. V. Gadre, The 8051 Microcontroller and Embedded Systems: Using Assembly and C. Delhi, India: Cengage Learning, 2010.
- [3] R. Kamal, Microcontrollers: Architecture, Programming, Interfacing and System Design, 2nd ed. Noida, India: Pearson Education India, 2011.
- [4] N. S. Kumar, M. S. P. S. Kumar, and S. A. Kumar, Microprocessors and Microcontrollers, 2nd ed. New Delhi, India: Oxford University Press, 2014.
- [5] S. MacKenzie and R. C. W. Phan, The 8051 Microcontroller, 4th ed. London, UK: Pearson Education International, 2008.
- [6] S. Furber, ARM System-on-Chip Architecture, 2nd ed. London, UK: Pearson Education, 2000.

Reference Books:

- [1] Intel Corporation, MCS® 51 Microcontroller Family User's Manual. Santa Clara, CA, USA: Intel, 1994.
- [2] Microchip Technology, *ATmega328P: 8-bit AVR Microcontroller with 32K Bytes In-System Programmable Flash*. Chandler, AZ, USA: Microchip Technology, 2020.
- [3] J. A. Langbridge, Professional Embedded ARM Development. Indianapolis, IN, USA: Wrox/John Wiley & Sons, 2014.
- [4] A. N. Sloss, D. Symes, and C. Wright, ARM System Developer's Guide: Designing and Optimizing System Software. Burlington, MA, USA: Elsevier Morgan Kaufmann, 2004.
- [5] M. K. Patel, The 8051 Microcontroller and Embedded Systems. New Delhi, India: McGraw Hill Education, 2014.

Online References:

1. S. Chattopadhyay, "Microprocessors and Microcontrollers," SWAYAM, IIT Kharagpur, Course ID: noc20_ee42.
Available: https://swayam.gov.in/nd1_noc20_ee42/preview
2. R. Thakur, "PLC and Microcontroller," SWAYAM, NITTTR Chandigarh, Course ID: ntr25_ed25.
Available: https://onlinecourses.swayam2.ac.in/ntr25_ed25/preview

Assessment:

A. In-Semester Assessment (25 Marks)

1. Continuous Internal Evaluation (CIA)

- a) 10 Marks – Laboratory work / Experiments
- b) 10 Marks - Use any 2 lab tools from Annexure I (one tool before MSE and one tool after MSE)
- c) 05 Marks – Attendance and Active participation

B. End-Semester Assessment (25 Marks)

1. Practical/ Oral Examination

Practical/ Oral exams to be conducted based on the content of the syllabus.

Course Type	Course Code	Course Name	Credits
PCL	EC4PCL4	Data Structures and Algorithms Lab	01
Examination Scheme			
Continuous Assessment		Practical/ Oral	Total Marks
25		25	50

Prerequisite:

1. C programming

Lab Objectives:

1. To implement basic data structures such as linked lists, stacks, and queues for efficient data management.
2. To implement fundamental algorithmic techniques with an understanding of their structural design principles and practical applications.
3. To develop the ability to analyze and compare algorithms based on time and space complexity in order to select appropriate solutions for computational problems.

Lab Outcomes:

1. Implement and manage linear data structures using various memory allocation techniques.
2. Design and implement non-linear data structures and hierarchical models for complex data representation.
3. Apply fundamental algorithmic paradigms to solve search and sort computational problems.
4. Develop optimized solutions for complex problems using advanced algorithmic strategies.

List of Suggested Experiments:

(A minimum of 10 experiments covering the entire syllabus must be conducted in batches.)

Sr. No.	Details	Hours	LO Mapping
1	Linear Data Structures and Applications Suggested Experiments: Implement a menu-driven program for array operations: creation, display, insertion, and deletion. Implement a Stack using arrays and check for balanced parentheses. Implement a menu-driven program for Circular Queue using arrays. Implement a menu-driven program for a Singly Linked List.	6	LO1
2	Non-Linear Data Structures: Trees and Graphs Suggested Experiments: Implement a menu-driven program for a Binary Search Tree (BST) with insertion and deletion. Implement a program for Breadth-First Search (BFS) for a given graph. Implement a program for Depth-First Search (DFS) for a given graph. Implement Dijkstra's algorithm to find the shortest path in a weighted graph.	6	LO2
3	Searching, Sorting, and Divide-and-Conquer Suggested Experiments: Implement the Binary Search algorithm. Implement the Merge Sort algorithm. Implement the Quick Sort algorithm. Implement Infix to Postfix conversion and Postfix Expression Evaluation.	6	LO3
4	Advanced Algorithms: Greedy and Dynamic Programming Suggested Experiments:	4	LO4

	Implement the 0/1 Knapsack algorithm using dynamic programming. Implement Greedy-based shortest path evaluation (via Dijkstra's). Analyze time and space complexity for various sorting algorithms. Develop recursive solutions for optimization problems.		
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Text Books:

- [1] T. H. Cormen, C. E. Leiserson, R. L. Rivest, and C. Stein, *Introduction to Algorithms*, 2nd ed. New Delhi, India: PHI Learning, 2005.
- [2] H. Bhasin, *Design and Analysis of Algorithms*. New Delhi, India: Oxford University Press, 2015.
- [3] E. Horowitz and S. Sahni, *Fundamentals of Computer Algorithms*. New York, NY, USA: Computer Science Press, 2008.

Reference Books:

- [1] S. Dasgupta, C. H. Papadimitriou, and U. V. Vazirani, *Algorithms*. New Delhi, India: Tata McGraw-Hill, 2008.
- [2] S. K. Basu, *Design Methods and Analysis of Algorithms*. New Delhi, India: PHI Learning, 2013.

Online References:

1. NPTEL, "Programming, Data Structures and Algorithms in Python," NPTEL.
Available: <https://nptel.ac.in/courses/106/106/106106131/>
2. NPTEL, "Design and Analysis of Algorithms," SWAYAM, IIT Madras, Course ID: noc19_cs47.
Available: https://swayam.gov.in/nd1_noc19_cs47/preview
3. T. Roughgarden, "Algorithms Specialization," Coursera, Stanford University.
Available: <https://www.coursera.org/specializations/algorithms>
4. "Algorithms," MOOC List.
Available: <https://www.mooc-list.com/tags/algorithms>

Assessment:

A. In-Semester Assessment (25 Marks)

1. Continuous Internal Evaluation (CIA)

- a) 10 Marks – Laboratory work / Experiments
- b) 10 Marks - Use any 2 lab tools from Annexure I (one tool before MSE and one tool after MSE)
- c) 05 Marks – Attendance and Active participation

B. End-Semester Assessment (25 Marks)

1. Practical/ Oral Examination

Practical/ Oral exams to be conducted based on the content of the syllabus.

Course Type	Course Code	Course Name	Credits
PEL	EC4PEL11	Analog Communication Lab	01
Examination Scheme			
Continuous Assessment		Practical/ Oral	Total Marks
25		25	50

Prerequisite:

1. Mathematics for Electronics and Computer Engineering-3
2. Analog Electronics Circuits

Lab Objectives:

1. To understand the basic principles of analog modulation and demodulation techniques.
2. To perform experiments on AM and FM communication systems and analyze the characteristics of modulated signals.
3. To use communication laboratory instruments such as the CRO and function generator for communication experiments.
4. To study and analyze the effect of noise on communication systems.

Lab Outcomes:

1. To understand practical implementation of analog communication systems.
2. To perform experiments on AM and FM modulation and demodulation.
3. To analyze characteristics of communication signals using laboratory instruments.
4. To study the effect of noise and pulse modulation techniques in communication systems

List of Suggested Experiments:

(A minimum of 10 experiments covering the entire syllabus must be conducted in batches.)

Sr. No.	Name of the Experiment	Hours	LO Mapping
1	Module 1: Amplitude Modulation and Demodulation This module introduces the fundamentals of analog modulation techniques used in communication systems. Students will study the generation, transmission, and recovery of AM signals along with modulation parameters and practical circuit implementation. Suggested Experiments: 1. Study of Amplitude Modulation (AM) and determination of modulation index. 2. Generation of AM signal using square law modulator. 3. AM Demodulation using envelope detector and analysis of recovered signal. 4. Generation of DSBSC signal using balanced modulator. 5. Simulation of AM and DSBSC modulation using GNU Radio, Python, or Scilab. 6. Simulation-based analysis of modulation index variation and its effect on AM waveform and spectrum using open-source software.	6	LO1 LO2
2	Module 2: Frequency Modulation and Demodulation Techniques This module focuses on the principles of frequency modulation and demodulation techniques. Students will understand FM signal generation, frequency deviation, and practical FM detection methods. Suggested Experiments: 1. Study of Frequency Modulation (FM) generation and measurement of frequency deviation 2. FM demodulation using slope detector 3. Measurement of bandwidth of FM signals using Carson's Rule. 4. Simulation of FM generation and demodulation using Octave, Python, or Scilab. 5. Simulation-based analysis of frequency deviation and bandwidth variation in FM systems using open-source software.	4	LO1 LO2

3	Module 3: Communication Receiver and Signal Analysis This module provides knowledge of radio receiver operation and signal analysis techniques used in communication systems. Students will study receiver performance parameters and frequency spectrum analysis of communication signals. Suggested Experiments: 1. Study of Superheterodyne receiver characteristics (sensitivity, selectivity, fidelity) 2. Observation of signal spectrum of AM/FM signals using CRO or spectrum analyzer. 3. Simulation-based spectrum analysis of AM and FM signals in time and frequency domain using Python/Scilab.	4	LO1 LO3
4	Module 4: Noise in Communication Systems This module introduces the concept of noise in communication systems and its effect on signal quality. Students will learn methods for measuring and analyzing Signal-to-Noise Ratio (SNR). Suggested Experiments: 1. Study of noise in communication systems and SNR measurement. 2. Verification of Friis Formula for Noise Figure in Cascaded Communication Systems. 3. Simulation-based verification of Friis Noise Formula using Python/Scilab	4	LO3 LO4
5	Module 5: Pulse Modulation Techniques This module introduces pulse modulation methods used in modern communication systems. Students will study the generation and analysis of different pulse modulation techniques and their waveform characteristics. Suggested Experiments: 1. Study of sampling theorem using pulse modulation techniques. 2. Generation and analysis of Pulse Amplitude Modulation (PAM) 3. Generation and analysis of Pulse Width Modulation (PWM) 4. Generation and analysis of Pulse Position Modulation (PPM) 5. Simulation of PAM, PWM, and PPM techniques using Octave, Python, or Scilab. 6. Simulation-based verification of sampling theorem and aliasing effect using open-source software	4	LO1 LO4

Text Books:

- [1] S. Haykin, *Communication Systems*, 5th ed., Indian adaptation. New Delhi, India: Wiley India, 2021.wileyindia
- [2] B. P. Lathi and Z. Ding, *Modern Digital and Analog Communication Systems*, 4th ed. New York, NY, USA: Oxford University Press, 2009.
- [3] G. Kennedy and B. Davis, *Electronic Communication Systems*, 4th ed. New Delhi, India: McGraw Hill Education, 1999.

Reference Books:

- [1] H. Taub and D. Schilling, *Principles of Communication Systems*, 3rd ed. New York, NY, USA: McGraw Hill, 2008.
- [2] J. G. Proakis and M. Salehi, *Communication Systems Engineering*, 2nd ed. Noida, India: Pearson Education, 2002.
- [3] L. E. Frenzel, *Principles of Electronic Communication Systems*, 3rd ed. New York, NY, USA: McGraw Hill, 2008.

Online References:

1. NPTEL, "Principles of Communication Systems - I," NPTEL/SWAYAM.
Available: https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_ee36.
2. NPTEL, "Principles of Communication Systems - II," NPTEL/SWAYAM. [Online].
Available: https://onlinecourses.nptel.ac.in/noc22_ee73/preview.
3. NPTEL, "NOC: Principles of Communication Systems - II, IIT Kanpur," NPTEL. [Online].
Available: <https://nptel.ac.in/courses/108104098>.

Assessment:

A. In-Semester Assessment (25 Marks)

1. Continuous Internal Evaluation (CIA)

- a) 10 Marks – Laboratory work / Experiments

- b) 10 Marks - Use any 2 lab tools from Annexure I (one tool before MSE and one tool after MSE)
- c) 05 Marks – Attendance and Active participation

B. End-Semester Assessment (25 Marks)

1. Practical/ Oral Examination

Practical/ Oral exams to be conducted based on the content of the syllabus.

Course Type	Course Code	Course Name	Credits
PEL	EC4PEL12	Data Compression and Encryption Lab	01
Examination Scheme			
Continuous Assessment		Practical/ Oral	Total Marks
25		25	50

Prerequisite:

1. Digital Communication & Mathematics

Lab Objectives:

1. To understand and implement multimedia data compression techniques for efficient data storage and transmission.
2. To analyze the performance of image, audio, and video compression algorithms using Python-based simulations.
3. To develop and test cryptographic algorithms for ensuring confidentiality, integrity, and authentication of digital information.
4. To Apply system security techniques and tools to identify, prevent, and mitigate security threats in communication systems.

Lab Outcomes:

1. To apply multimedia compression techniques for efficient storage and transmission of data.
2. To analyze image, audio, and video compression algorithms and evaluate their performance.
3. To Implement cryptographic algorithms and number theory concepts for secure communication.
4. To demonstrate authentication, network security, and system protection mechanisms.

List of Suggested Experiments:

(A minimum of 10 experiments covering the entire syllabus must be conducted in batches.)

Sr. No.	Name of the Experiment	Hours	LO Mapping
1	Module 1: Data Compression and Image Compression This module introduces lossless and lossy compression techniques used for efficient storage and transmission of multimedia data. Suggested Experiments: 1. Implementation of Run Length Encoding (RLE). 2. Implementation of LZW Compression Algorithm. 3. Arithmetic Coding and Decoding of text data. 4. Image Compression using DCT. 5. Performance comparison of lossless and lossy compression techniques.	6	LO1 LO2
2	Module 2: Video and Audio Compression This module focuses on multimedia compression standards for audio and video data. Suggested Experiments: 1. Implementation of μ-Law and A-Law Companding. 2. Motion estimation and motion compensation simulation. 3. Video compression using motion compensation. 4. Analysis of MPEG video compression techniques. 5. Comparative analysis of audio compression techniques.	4	LO1 LO2
3	Module 3: Data Security and Symmetric Key Cryptography This module introduces classical and modern encryption techniques for secure communication. Suggested Experiments: 1. Implementation of Caesar Cipher and Substitution Cipher. 2. Implementation of Transposition Cipher. 3. Encryption and Decryption using DES.	4	LO3

	4. AES Encryption and Decryption of files.		
4	Module 4: Number Theory for Cryptography This module covers mathematical foundations required for modern cryptographic systems. Suggested Experiments: 1. Verification of Fermat's Theorem. 2. Verification of Euler's Theorem. 3. Implementation of Chinese Remainder Theorem.	4	LO3
5	Module 5: Public Key Cryptography and Authentication This module focuses on public key encryption, authentication, and integrity verification mechanisms. Suggested Experiments: 1. RSA Key Generation, Encryption and Decryption. 2. Diffie-Hellman Key Exchange Implementation. 3. Implementation of SHA Hash Function. 4. HMAC Generation and Verification. 5. Digital Signature Generation and Verification using RSA.	4	LO3 LO4
6	Module 6: System Security This module introduces practical security mechanisms used in modern computer networks and information systems. Suggested Experiments: 1. Firewall Rule Simulation using Python. 2. Intrusion Detection using Log Analysis. 3. Biometric Authentication System Simulation.	4	LO4

Text Books:

- [1] K. Sayood, Introduction to Data Compression, 3rd ed. San Francisco, CA, USA: Morgan Kaufmann, 2006.
- [2] M. Nelson and J.-L. Gailly, The Data Compression Book, 2nd ed. New York, NY, USA: M&T Books, 1995.
- [3] W. Stallings, Cryptography and Network Security: Principles and Practice, 5th ed. New Delhi, India: Pearson Education, 2011.
- [4] B. A. Forouzan, Cryptography and Network Security. New Delhi, India: Tata McGraw-Hill, 2010.

Reference Books:

- [1] D. Salomon, Data Compression: The Complete Reference, 4th ed. London, UK: Springer, 2007.
- [2] M. Bishop, Computer Security: Art and Science. Boston, MA, USA: Addison-Wesley, 2003.
- [3] B. Meneses, Network Security and Cryptography, 7th ed. Boston, MA, USA: Cengage Learning, 2019.

Online References:

1. D. Mukhopadhyay, "Cryptography and Network Security," NPTEL, IIT Kharagpur.
Available: <https://nptel.ac.in/courses/106105031>.
2. S. Gangopadhyay, "Introduction to Cryptology," NPTEL, IIT Roorkee, Course ID: noc17_cs36.
Available: https://onlinecourses-archive.nptel.ac.in/noc17_cs36/preview.
3. NPTEL, "Information Security," SWAYAM, Course ID: noc22_cs90.
Available: https://onlinecourses.nptel.ac.in/noc22_cs90/preview.

Assessment:

A. In-Semester Assessment (25 Marks)

1. **Continuous Internal Evaluation (CIA)**
 - a) 10 Marks – Laboratory work / Experiments
 - b) 10 Marks - Use any 2 lab tools from Annexure I (one tool before MSE and one tool after MSE)
 - c) 05 Marks – Attendance and Active participation

B. End-Semester Assessment (25 Marks)

1. **Practical/ Oral Examination**
Practical/ Oral exams to be conducted based on the content of the syllabus.

Course Type	Course Code	Course Name	Credits
PEL	EC4PEL13	NoSQL Databases Lab	01
Examination Scheme			
Continuous Assessment		Practical/ Oral	Total Marks
25		25	50

Prerequisite:

1. DBMS, Python, Linux

Lab Objectives:

1. To understand the limitations of RDBMS and gain hands-on experience with the four main types of NoSQL databases: Key-Value, Document, Column-family, and Graph.
2. To master data modeling techniques in non-relational environments through practical implementation.
3. To understand the CAP theorem and its implications on distributed consistency in a live environment.

Lab Outcomes:

1. Configure and implement basic CRUD operations and data partitioning strategies across Key-Value and Document databases. Implement efficient CRUD operations and data partitioning strategies using Redis.
2. Design optimized schemas for columnar and graph databases to model complex data relationships and high-velocity transactions.
3. Execute advanced data analysis using the MongoDB Aggregation Framework and graph traversal algorithms in Neo4j.
4. Develop a polyglot persistence solution that integrates multiple NoSQL databases to address specific architectural trade-offs and consistency models.

List of Suggested Experiments:

(A minimum of 10 experiments covering the entire syllabus must be conducted in batches.)

Sr. No.	Details	Hours	LO Mapping
1	SQL vs NoSQL Comparative Study 1. Compare relational and NoSQL databases using a sample dataset 2. Identify use cases where NoSQL is preferred	2	LO1
2	Redis Setup and Basic Operations 1. Install and configure Redis 2. Perform CRUD operations using Strings and Lists	2	LO1
3	Redis Advanced Data Structures 1. Work with Sets, Hashes, Sorted Sets 2. Implement a real-world use case (leaderboard / session management)	2	LO1
4	Redis Pub/Sub Messaging 1. Implement publisher–subscriber model 2. Simulate real-time messaging system	2	LO2
5	MongoDB CRUD Operations 1. Install and configure MongoDB 2. Perform insert, update, delete, and query operations	2	LO1
6	MongoDB Data Modeling 1. Design schema using embedding vs referencing 2. Analyze performance trade-offs	2	LO2
7	MongoDB Aggregation Framework 1. Perform aggregation operations (group, match, sort, pipeline) 2. Analyze complex datasets	2	LO3

8	Cassandra Setup and CQL Operations 1. Install Apache Cassandra 2. Create keyspaces, tables, and perform CRUD using CQL	2	LO1
9	Cassandra Data Modeling and Replication 1. Design schema for large-scale/time-series data 2. Study replication factor and consistency levels	2	LO2
10	Neo4j Graph Creation and Queries 1. Install Neo4j 2. Create nodes and relationships 3. Query using Cypher	2	LO3
11	Graph Traversal and Use Case Implementation 1. Implement shortest path / recommendation system 2. Model a social network or fraud detection system	2	LO3
12	Polyglot Persistence Mini Experiment 1. Combine multiple databases (e.g., MongoDB + Redis + Neo4j) 2. Design a small real-world application architecture	2	LO4

Text Books:

- [1] P. J. Sadalage and M. Fowler, *NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence*. New Delhi, India: Pearson India Education Services Pvt. Ltd., 2013.
- [2] D. McCreary and A. Kelly, *Making Sense of NoSQL: A Guide for Managers and the Rest of Us*, 1st ed. Shelter Island, NY, USA: Manning Publications, 2013.
- [3] L. Perkins, E. Redmond, and J. R. Wilson, *Seven Databases in Seven Weeks: A Guide to Modern Databases and the NoSQL Movement*, 2nd ed. Raleigh, NC, USA: Pragmatic Bookshelf, 2018.

Reference Books:

- [1] K. Chodorow, *MongoDB: The Definitive Guide: Powerful and Scalable Data Storage*, 3rd ed. Sebastopol, CA, USA: O'Reilly Media, 2019.
- [2] J. Carpenter and E. Hewitt, *Cassandra: The Definitive Guide: Distributed Data at Web Scale*, 3rd ed. Sebastopol, CA, USA: O'Reilly Media, 2022.
- [3] I. Robinson, J. Webber, and E. Eifrem, *Graph Databases: New Opportunities for Connected Data*, 2nd ed. Sebastopol, CA, USA: O'Reilly Media, 2015.
- [4] J. L. Carlson, *Redis in Action*, 1st ed. Shelter Island, NY, USA: Manning Publications, 2013.
- [5] S. Tiwari, *Professional NoSQL*, 1st ed. Hoboken, NJ, USA: Wrox/Wiley, 2011.

Online References:

1. MongoDB, "MongoDB Manual," *MongoDB Docs*. Available: <https://www.mongodb.com/docs/manual/>.
2. Redis, "Welcome to Redis Docs," *Redis Docs*. Available: <https://redis.io/docs/latest/>
3. Neo4j, "Introduction - Cypher Manual," *Neo4j Documentation*. Available: <https://neo4j.com/docs/cypher-manual/current/introduction/>
4. Apache Cassandra, "Welcome to Apache Cassandra's Documentation," *Apache Cassandra*. Available: <https://cassandra.apache.org/doc/latest/>

Assessment:

A. In-Semester Assessment (25 Marks)

1. **Continuous Internal Evaluation (CIA)**
 - a) 10 Marks – Laboratory work / Experiments
 - b) 10 Marks - Use any 2 lab tools from Annexure I (one tool before MSE and one tool after MSE)
 - c) 05 Marks – Attendance and Active participation

B. End-Semester Assessment (25 Marks)

1. **Practical/ Oral Examination**
Practical/ Oral exams to be conducted based on the content of the syllabus.

Course Type	Course Code	Course Name	Credits
PEL	EC4PEL14	Linear Integrated Circuits Lab	01
Examination Scheme			
Continuous Assessment		Practical/ Oral	Total Marks
25		25	50

Prerequisite:

1. Analog Electronics

Lab Objectives:

1. Understand and verify the working of operational amplifier circuits.
2. Implement oscillators and waveform generators using op-amps and IC 555.
3. Analyze and design voltage regulator circuits.
4. Implement active filters and waveform shaping circuits using linear integrated circuits for signal conditioning applications.

Lab Outcomes:

1. Design and implement linear op-amp circuits such as amplifiers, filters, and integrators.
2. Analyze non-linear circuits like comparators, Schmitt triggers, and rectifiers.
3. Implement IC 555 based multivibrators and voltage regulator circuits.
4. Evaluate the performance of VCO and PLL circuits in practical applications.

List of Suggested Experiments:

(A minimum of 10 experiments covering the entire syllabus must be conducted in batches.)

Sr. No.	Name of the Experiment	Hours	LO Mapping
1	Module 1: Operational Amplifier Fundamentals Suggested Experiments: 1. Design inverting, non-inverting amplifier and buffer using IC 741. 2. Design Summing Amplifier and Difference Amplifier using IC 741. 3. Design Voltage-to-Current Converter with Grounded Load.	6	LO1
2	Module 2: Linear Applications of Operational Amplifier Suggested Experiments: 1. Design and Analyze Integrator. 2. Design and Analyze Differentiator. 3. Design and Analyze Second-Order Low-Pass, High-Pass, Band-Pass and Band-Reject Filters. 4. Design Wein bridge and RC phase shift Oscillator.	8	LO1
3	Module 3: Non-Linear Applications of Operational Amplifier Suggested Experiments: 1. Design Schmitt Trigger using Op-Amp. 2. Design Square & Triangular wave generator.	4	LO2
4	Module 4: Timer IC 555 and its Applications Suggested Experiments: 1. Design Astable Multivibrator.	4	LO3

	2. Design Monostable Multivibrator.		
5	Module 5: Voltage Regulators Suggested Experiments: 1. Design Low-Voltage Low-Current Regulator using IC 723. 2. Design High-Voltage High-Current Regulator using IC 723.	2	LO3
6	Module 6: Special Purpose Integrated Circuits Suggested Experiments: 1. Design Frequency Modulator using IC 566. 2. Design FSK Demodulator using IC 565.	2	LO4

Text Books:

- [1] R. A. Gayakwad, Op-Amps and Linear Integrated Circuits, 4th ed. New Delhi, India: Pearson Prentice Hall, 2010.
- [2] D. R. Choudhury and S. B. Jain, Linear Integrated Circuits, 4th ed. New Delhi, India: New Age International Publishers, 2011.

Reference Books:

- [1] K. R. Botkar, Integrated Circuits. New Delhi, India: Khanna Publishers, 2004.
- [2] S. Franco, Design with Operational Amplifiers and Analog Integrated Circuits, 3rd ed. New Delhi, India: Tata McGraw-Hill, 2004.
- [3] D. A. Bell, Operational Amplifiers and Linear Integrated Circuits, Indian ed. New Delhi, India: Oxford University Press, 2011.
- [4] R. F. Coughlin and F. F. Driscoll, Operational Amplifiers and Linear Integrated Circuits, 6th ed. Upper Saddle River, NJ, USA: Prentice Hall, 2003.
- [5] J. Millman, C. Halkias, and S. K. Mohapatra, Millman's Electronic Devices and Circuits, 3rd ed. New Delhi, India: McGraw-Hill Education, 2010.

Online References:

1. H. J. Pandya, "Integrated Circuits MOSFETs OP-Amps and their Applications," SWAYAM, IISc Bangalore, Course ID: noc20_ee13. Available: https://swayam.gov.in/nd1_noc20_ee13/preview.
2. NPTEL, "Op-Amp & Linear ICs," SWAYAM, Course ID: ntr25_ed139. Available: https://onlinecourses.swayam2.ac.in/elearning/preview/ntr25_ed139.
3. IIT Kharagpur, "Basic Electronics Virtual Laboratory," Virtual Labs. Available: <https://be-iitkgp.vlabs.ac.in/List%20of%20experiments.html>.

Assessment:

A. In-Semester Assessment (25 Marks)

1. Continuous Internal Evaluation (CIA)

- a) 10 Marks – Laboratory work / Experiments
- b) 10 Marks - Use any 2 lab tools from Annexure I (one tool before MSE and one tool after MSE)
- c) 05 Marks – Attendance and Active participation

B. End-Semester Assessment (25 Marks)

1. Practical/ Oral Examination

Practical/ Oral exams to be conducted based on the content of the syllabus.

Annexure I

Guidelines for Continuous Internal Assessment

a. Theory Courses

i. CIA: 20 marks

Assessment tools	Attendance & Active Participation
15 marks	05 marks

ii. CIA:15 marks

Assessment tools	Attendance & Active Participation
12 marks	03 marks

Sr. No	Assessment tools for Theory
1.	Numerical Assignment/s (min 20 problems) and Class test based on above numerical assignment.
2.	Assignment on live problems/ case studies, wherein problems are given prior. Students are expected to research and collect required resources. They can use the resources and solve the problem on assigned date and time in Institute premises in presence of faculty member.
3.	Class test
4.	Think-pair-share worksheets/ Mind mapping/ Flip classroom/ Team-Pair/ Solo
5.	Open book test/ Open notes test
6.	Literature review of papers and write summary
7.	Case study, Presentation, group discussion, technical debate on recent trends in the said course
8.	Development of Working model for demonstration of concept
9.	GATE Based Assignment tests / Tutorials etc
10.	NPTEL assignment solving

Note: Select any two tools before MSE and two tools after MSE from the list given above. All four tools should be unique.

For continuous assessment, it is essential that ***all Course Outcomes (COs) are adequately covered*** through a balanced combination of tools given above.

b. Lab Courses (25 marks)

Lab Performance	Any two Assessment Tools (Given below)	Attendance & Active Participation
10 marks	10 marks	05 marks

Sr. No	Assessment Tool for Laboratory
1.	Assignment/s
2.	Mock Oral
3.	Mock Practical
4.	Case study
5.	Mini project
6.	Paper publication

c. Theory Tutorials (25Marks)

Tutorial Performance	Attendance & Active Participation
20 marks	05 marks

d. Other Courses (50 Marks)

Assignment/s	Case study and Presentation	Any two tools (given below)	Attendance & Active Participation
15 marks	15 marks	10 marks	10 marks

Tools:

- Class test
- Role play / Mind map
- Quizzes
- Group Discussion
- Summary of paper/ Document / Video

e. Skill Based Lab Courses (50 Marks)

Lab Performance	Assignment	Mini project	Attendance & Active Participation
15 marks	10 marks	20 marks	5 marks

f. Mini Project (25 Marks)

Progress Presentation - I	Progress Presentation - II	Final Report Submission	Attendance & Active Participation
5 marks	10 marks (5 Marks for presentation and 5 Marks for External competition participation)	5 marks	5 marks

g. Internship (50 Marks)

First Progress Presentation	Mid semester Progress Presentation	Final Report
10 marks	15 marks	25 marks