SHIV NADAR
UNIVERSITY
CHENNAI

Rajiv Gandhi Salai, Kalavakkam – 603 110

SSN School of Engineering

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

B.TECH. ELECTRONICS AND COMMUNICATION ENGINEERING (VLSI DESIGN AND TECHNOLOGY)

CURRICULUM & SYLLABUS

REGULATIONS 2025

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO 1: Core Knowledge Development: Be competent in applying electronics and communication engineering (VLSI Design and Technology) principles to develop socially and environmentally acceptable engineering solutions.

PEO 2: Professional Development: Find fulfilling career in electronic and communication engineering (VLSI Design and Technology) or associated industries or higher education and research, or as entrepreneurs.

PEO 3: Attitude towards Lifelong-Learning: Develop the ability and attitude to adapt to evolving technological and social challenges.

PROGRAM OUTCOMES (POs)

PO1: Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization to develop to the solution of complex engineering problems. (WK1 to WK4)

PO2: Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)

PO3: Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. (WK5)

PO4: Conduct Investigations of Complex Problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions. (WK8).

PO5: Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems. (WK2 and WK6)

PO6: The Engineer and The World: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment. (WK1, WK5, and WK7).

PO7: Ethics: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)

PO8: Individual and Collaborative Team work: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.

PO9: Communication: Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences.

PO10: Project Management and Finance: Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.

PO11: Life-Long Learning: Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change. (WK8)

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO 1: Design, develop and analyze electronic systems through application of relevant mathematics and engineering principles.

PSO 2: Design, develop and analyze VLSI systems through application of fundamentals from materials, devices and digital, analog, mixed-signal and radio frequency circuits.

PSO 3: Adapt to emerging electronics and VLSI technologies and develop innovative solutions for existing and newer problems.

CURRICULUM

SEMESTER - I

Sl. No.	Course Title	Course Category	Contact Periods	L	T	P	C
1	Matrices and Calculus	MD	4	3	1	0	4
2	Engineering Physics	MD	3	3	0	0	3
3	Communicative English	AEC	4	2	0	2	3
4	Electron Devices and Circuits	MC	3	3	0	0	3
5	Circuit Analysis	MC	3	3	0	0	3
6	Professional Ethics and Human Values	VAC	2	2	0	0	2
7	Electronics Engineering Practice	SEC	4	0	0	4	2
8	Engineering Physics Laboratory	MD	4	0	0	4	2
9	Extra Academic Activity 1*	VAC	2	0	0	2	1*
Total			**29**	**16**	**1**	**12**	**22+1***

SEMESTER - II

Sl. No	Course Title	Course Category	Contact Periods	L	T	P	C
1	Differential Equations and Complex Functions	MC	3	3	0	0	3
2	Technical Writing	AEC	4	2	0	2	3
3	Programming in Python for Data Science	VAC	3	1	0	2	2
4	Environmental Science	VAC	2	2	0	0	2
5	Digital Electronics	MC	5	3	0	2	4
6	Analog Electronics	MC	5	3	0	2	4
7	PCB Design	SEC	4	0	0	4	2
8	Extra Academic Activity 2*	VAC	2	0	0	2	1*
Total			**26**	**14**	**0**	**14**	**20+1***

***Note at a later page on Extra Academic Activity.**

SEMESTER - III

Sl. No.	Course Title	Course Category	Contact Periods	L	T	P	C
1	Random Signal Analysis	MS	4	2	0	2	3
2	Linear Integrated Circuits	MC	2	2	0	0	2
3	Microprocessors and Microcontrollers	MS	4	2	0	2	3
4	Signals and Systems	MC	3	3	0	0	3
5	Design Thinking, Innovation, and Entrepreneurship	SEC	4	2	0	2	3
6	Electromagnetics	MC	3	3	0	0	3
7	Linear Integrated Circuits Laboratory	MC	4	0	0	4	2
8	Signals and Systems Laboratory	MC	4	0	0	4	2
9	PCB Fabrication and Assembly	SEC	2	0	0	2	1
10	Interactive Engineering graphics	VAC	2	0	0	2	1
Total			**32**	**14**	**0**	**18**	**23**

SEMESTER - IV

Sl. No.	Course Title	Course Category	Contact Periods	L	T	P	C
1	Digital Signal Processing	MC	5	3	0	2	4
2	Transmission Lines and Waveguides	MC	2	2	0	0	2
3	Principles of Communication Systems	MC	3	3	0	0	3
4	Digital System Design using HDL	MC	4	2	0	2	3
5	Control Systems	MS	2	2	0	0	2
6	Semiconductor Device Modeling	MC	3	3	0	0	3
7	Communication Engineering Laboratory	MC	4	0	0	4	2
8	EDA Tools for Semiconductor Device Modeling	SEC	2	0	0	2	1
9	Engineering Practices Laboratory	VAC	2	0	0	2	1
Total			**27**	**15**	**0**	**12**	**21**

SEMESTER - V

Sl. No.	Course Title	Course Category	Contact Periods	L	T	P	C
1	Nano Scale Transistors	MC	3	3	0	0	3
2	Full Custom Digital IC Design	MC	6	2	0	4	4
3	Full Custom Analog IC Design	MC	6	2	0	4	4
4	VLSI Interconnects & Modelling	MC	3	3	0	0	3
5	OOPS and Data Structures	MS	5	3	0	2	4
6	Principles of Semiconductor Technology	MS	1	1	0	0	1
Total			**24**	**14**	**0**	**10**	**19**

SEMESTER - VI

Sl. No.	Course Title	Course Category	Contact Periods	L	T	P	C
1	VLSI Design Automation	MC	3	3	0	0	3
2	Full Custom Mixed Signal IC Design	MC	6	2	0	4	4
3	Full Custom RF IC Design	MC	6	2	0	4	4
4	System on Chip Design	MC	2	2	0	0	2
5	Program Minor 1	MS	4	2	0	2	3
6	Program Minor 2	MS	4	2	0	2	3
7	Capstone Project Phase 1	PD	8	0	0	8	4
Total			**33**	**13**	**0**	**20**	**23**

SEMESTER - VII

Sl. No.	Course Title	Course Category	Contact Periods	L	T	P	C
1	VLSI Testing and Verification	MC	6	2	0	4	4
2	Low Power IC Design	MC	4	2	0	2	3
3	Program Minor 3	MS	3	3	0	0	3
4	Program Minor 4	MS	3	3	0	0	3
5	Program Minor 5	MS	4	0	0	4	2
6	Ability Enhancement Course #	AEC	2	2	0	0	2
7	Capstone Project Phase 2	PD	12	0	0	12	6
8	Internship	SI	4	0	0	4	2
Total			**38**	**12**	**0**	**26**	**25**

The following is a list of courses that are offered under the Ability Enhancement Course:
1. Writing for Research
2. Creative Writing
3. Psychology and Communication
4. Professional Communication

SEMESTER - VIII

Sl. No.	Course Title	Course Category	Contact Periods	L	T	P	C
1	Program Minor 6	MS	2	2	0	0	2
2	Program Minor 7	MS	3	3	0	0	3
3	Capstone Project Phase 3	PD	4	0	0	4	2
Total			**9**	**5**	**0**	**4**	**7**

COURSE SUMMARY

The listed courses are broadly classified as per the recommendations from the UGC.

Sl. No.	Broad Category of Course	Minimum Credit Requirement	Credit Distribution (SNU)
1	Major Core (MC)	80	80
2	Minor Stream (MS)	32	32
3	Multidisciplinary (MD)	09	09
4	Ability Enhancement Course (AEC)	08	08
5	Skill Enhancement Course (SEC)	09	09
6	Value Added Courses (VAC)	06-08	08+2*
7	Summer Internship (SI)	02-04	02
8	Project Dissertation (PD)	12	12
Total		**160**	**160+2***

The semester wise credit breakup of the Curriculum based on the above credit breakup proposed by the UGC is as follows:

Semester / Category	MC	MS	MD	AEC	SEC	VAC	SI	PD	TOTAL
1	6		9	3	2	2+1*			**22+1***
2	11			3	2	4+1*			**20+1***
3	12	6			4	1			**23**
4	17	2			1	1			**21**
5	14	5							**19**
6	13	6						4	**23**
7	7	8		2			2	6	**25**
8		5						2	**7**
Total	**80**	**32**	**9**	**8**	**9**	**8+2***	**2**	**12**	**160+2***

*The credits earned through the Extra Academic Activities under Value added courses are not included in the calculation of Cumulative Grade Point Average (CGPA).

MINOR STREAMS

The Department of Electronics and Communication Engineering offers its students the following list of Minor Streams.

1. Devices and Fabrication
2. Circuits and Systems
3. Signal Processing
4. High Frequency Communication
5. Embedded Systems and IoT

Each Minor Stream has seven courses equivalent to 19 credits. The student must enroll in any one of the above Five Minor Streams. Minor Streams tagged with Foundations must not be enrolled by students whose Major Core courses overlap with the listed courses in the Minor Stream.

MINOR STREAM 1 - Devices and Fabrication

Sl. No.	Course Title	Semester	Contact Hours	L	T	P	C
1	Digital Subsystem Design	VI	4	2	0	2	3
2	Analog and RF Subsystem Design	VI	4	2	0	2	3
3	VLSI Technology	VII	3	3	0	0	3
4	MINOR STREAM BASKET 1	VII	3	3	0	0	3
5	MINOR STREAM BASKET 2	VII	4	0	0	4	2
6	MINOR STREAM BASKET 3	VIII	2	2	0	0	2
7	MINOR STREAM BASKET 4	VIII	3	3	0	0	3

The following is the tentative list of courses that may be offered under the ***Minor Stream Baskets***:

Minor Stream Basket 1 (3 Credit courses)	***Minor Stream Basket 2 (2 Credit courses)***	***Minor Stream Basket 3 (2 Credit courses)***	***Minor Stream Basket 4 (3 Credit courses)***
Nano Sensors and Devices	Nano Sensors and Devices Laboratory	Flexible Electronics	VLSI Packaging
Emerging Memory Devices	Emerging Memory Devices Laboratory	Power Electronic Devices	Photonic Devices
Compound Semiconductors and Devices	Compound Semiconductors and Devices Laboratory	Quantum Devices	Solid State Microwave Devices

MINOR STREAM 2 - Circuits and Systems

Sl. No.	Course Title	Semester	Contact Hours	L	T	P	C
1	Digital Subsystem Design	VI	4	2	0	2	3
2	Analog and RF Subsystem Design	VI	4	2	0	2	3
3	Reconfigurable Architectures	VII	3	3	0	0	3
4	MINOR STREAM BASKET 1	VII	3	3	0	0	3
5	MINOR STREAM BASKET 2	VII	4	0	0	4	2
6	MINOR STREAM BASKET 3	VIII	2	2	0	0	2
7	MINOR STREAM BASKET 4	VIII	3	3	0	0	3

The following is the tentative list of courses that may be offered under the ***Minor Stream Baskets***:

Minor Stream Basket 1 (3 Credit courses)	***Minor Stream Basket 2 (2 Credit courses)***	***Minor Stream Basket 3 (2 Credit courses)***	***Minor Stream Basket 4 (3 Credit courses)***
Security Solutions in VLSI	Security Solutions in VLSI Laboratory	Multicore Architectures	Energy Harvesting Systems
Embedded and IOT Systems	Embedded and IoT Systems Laboratory	Hardware-Software Codesign	Network On-Chip
VLSI Signal Processing	VLSI Signal Processing Laboratory	Quantum Circuits	AI for VLSI Design

MINOR STREAM 3 - Signal Processing

Sl. No.	Course Title	Semester	Contact Hours	L	T	P	C
1	Statistical Signal Processing	VI	3	3	0	0	3
2	Multirate Signal Processing	VI	3	3	0	0	3
3	Computer Vision	VII	3	3	0	0	3
4	MINOR STREAM BASKET 1	VII	3	3	0	0	3
5	MINOR STREAM BASKET 2	VII	2	2	0	0	2
6	MINOR STREAM BASKET 3	VIII	2	2	0	0	2
7	MINOR STREAM BASKET 4	VIII	3	3	0	0	3

The following is the tentative list of courses that may be offered under the ***Minor Stream Baskets***:

Minor Stream Basket 1 (3 Credit courses)	***Minor Stream Basket 2 (2 Credit courses)***	***Minor Stream Basket 3 (2 Credit courses)***	***Minor Stream Basket 4 (3 Credit courses)***
Speech Recognition and Synthesis	Speech Enhancement	Bio Medical Signal and Image Processing	Detection and Estimation Techniques
Multimedia Compression Techniques	Adaptive Signal Processing	Sparse Signal Processing	Machine Learning for Signal Processing
Text and Language Processing	Wavelet Signal Processing	Real-time Signal Processing	Array Signal Processing

MINOR STREAM 4 - High Frequency Communication

Sl. No.	Course Title	Semester	Contact Hours	L	T	P	C
1	RF and Microwave Circuit Design	VI	3	3	0	0	3
2	Optical Communication Networks	VI	3	3	0	0	3
3	5G Mobile Networks	VII	3	3	0	0	3
4	MINOR STREAM BASKET 1	VII	3	3	0	0	3
5	MINOR STREAM BASKET 2	VII	2	2	0	0	2
6	MINOR STREAM BASKET 3	VIII	2	2	0	0	2
7	MINOR STREAM BASKET 4	VIII	3	3	0	0	3

The following is the tentative list of courses that may be offered under the ***Minor Stream Baskets***:

Minor Stream Basket 1 (3 Credit courses)	***Minor Stream Basket 2 (2 Credit courses)***	***Minor Stream Basket 3 (2 Credit courses)***	***Minor Stream Basket 4 (3 Credit courses)***
Information Theory and Coding	Digital Signal Integrity	Integrated Photonics	Error Control Coding
Electromagnetic Interference and Compatibility	Underwater Communication	Optimization for Wireless Communication	Radar Engineering
Satellite Communication Systems	Bio Electromagnetics	Millimeter Wave Communication	Wearable Technology

MINOR STREAM 5 - Embedded Systems and IoT

Sl. No.	Course Title	Semester	Contact Hours	L	T	P	C
1	IoT Architectures	VI	3	3	0	0	3
2	Embedded Systems and Programming	VI	3	3	0	0	3
3	Sensors, Actuators, and Interfaces	VII	3	3	0	0	3
4	MINOR STREAM BASKET 1	VII	3	3	0	0	3
5	MINOR STREAM BASKET 2	VII	2	2	0	0	2
6	MINOR STREAM BASKET 3	VIII	2	2	0	0	2
7	MINOR STREAM BASKET 4	VIII	3	3	0	0	3

The following is the tentative list of courses that may be offered under the ***Minor Stream Baskets***:

Minor Stream Basket 1 (3 Credit courses)	***Minor Stream Basket 2 (2 Credit courses)***	***Minor Stream Basket 3 (2 Credit courses)***	***Minor Stream Basket 4 (3 Credit courses)***
Wireless Sensor Networks	Advanced Embedded System Design	Automotive electronics	Real Time Operating Systems
Security and Privacy in IoT	IoT Communication Technologies	Smart IoT Systems	Design of Real Time systems
Big data Analytics for IoT	Advanced Embedded Processors	SoC for IoT Applications	Industrial IoT 4.0

MICROSPECIALIZATION

The University proposes to offer Micro-Specializations to Undergraduate students. Its salient features are as follows:

1. Each Micro-Specialization has a defined structure in terms of three sequential components:
    - **Component I** - One Foundation course that constitutes a mandatory requirement and also a prerequisite for subsequent components.
    - **Component II** - Two courses from a specified vertical.
    - **Component III** - Project/Design/Term Paper
2. A Student would be required to complete all three components (10-14 credits) from the specified stream to earn a Micro-Specialization.

Eligibility for Micro-Specialization registration

To register for a Micro-Specialization, the student must have completed all curricular requirements up to the previous semester and have a CGPA $\geq$ 8.5. The student must maintain a CGPA $\geq$ 8.5 without any backlog in the subsequent semesters to keep the Micro-Specialization registration active. The Micro-Specialization must not overlap with the Major Core courses or Minor Stream courses credited as part of the degree program.

Provisional List of Micro-Specialization Verticals

The following is the list of Micro-Specialization verticals will be offered to our department:

1. FPGA Based System Design

Sl. No.	Course Title	Semester	Contact Hours	L	T	P	C
1	Digital System Design	VI	4	2	0	2	3
2	FPGA Architecture and HDL Programming	VII	4	3	0	2	4
3	FPGA-Based System Integration and Optimization	VII	4	2	0	2	3
4	Project Work	VIII	8	0	0	8	4

SYLLABUS

SEMESTER - I

Course Code	Category	MATRICES AND CALCULUS (Common to EEE, ECE, VLSI, MECH, CHEM, BME, CIVIL)	L	T	P	C	Contact Hours
	MD		3	1	0	4	4
Course Level		*Prerequisite Courses: Nil*					

COURSE OBJECTIVES:

1. To apply the concepts of eigenvalues and eigenvectors in the reduction of quadratic form.
2. To obtain the Taylor's expansion of various functions and extreme values of functions.
3. To equip with the concepts of integral calculus and applying it in evaluating the integrals of real and complex functions.
4. To apply the Green's theorem, Divergence theorem and Stokes theorem in engineering problems.

UNIT 1 MATRICES (9 HOURS)

Eigenvalues and Eigenvectors - Cayley-Hamilton Theorem - Diagonalization: Similarity transformation - Quadratic form – Reduction of quadratic form to canonical form using orthogonal transformation, Eigen values by Power method.

UNIT 2 DIFFERENTIAL CALCULUS (9 HOURS)

Curvature, radius of curvature - Cartesian and parametric forms – Centre of curvature – Circle of curvature in Cartesian form, Evolutes, Envelopes, Evolute as envelope of normals.

UNIT 3 MULTIPLE INTEGRALS (9 HOURS)

Double integrals, Triple integrals: Cartesian and polar coordinates – Change of order of integration, Change of variables, Area and volume as multiple integrals.

UNIT 4 VECTOR CALCULUS (9 HOURS)

Gradient and directional derivative – Divergence and curl – Vector identities - line integral, Surface integral, Volume integral- Green's theorem, Gauss divergence and Stoke's theorems.

UNIT 5 FUNCTIONS OF SEVERAL VARIABLE (9 HOURS)

Partial derivatives – Total derivative – Jacobian – Functions of two variables: Taylor's series and Maxima and minima– Constrained optimization using Lagrange's method.

TEXTBOOKS:

1. Grewal B.S, Higher Engineering Mathematics, Khanna Publishers, 45th Edition, 2020.
2. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons, Inc., 10th Edition, 2020.

REFERENCE BOOKS

1. Bali, N.P., Goyal, M., Watkins, C., Advanced Engineering Mathematics, Laxmi Publications Pvt. Limited, 2007.
2. Boyce, W.E., and DiPrima, R.C., Elementary Differential Equations and Boundary Value Problems, Wiley India, 2012.
3. George B. Thomas Jr., Maurice D. Weir, Joel R. Hass, Thomas' Calculus: Early Transcendental, 13th Edition, Pearson Education, 2013.
4. O'Neil. P. V., Advanced Engineering Mathematics, 7th Edition, Cengage Learning India Pvt., Ltd, New Delhi, 2011.
5. Howard Anton, Irl C. Bivens, Stephen Davis, Calculus Early Transcendentals, 11th Edition, John Wiley & Sons, Inc., 2016.

COURSE OUTCOMES

	Course Outcomes	**Knowledge Level**
CO1	Analyze and diagonalize matrices using eigenvalues, eigenvectors, and similarity transformations.	KL3
CO2	Compute curvature, radius and centre of curvature, and find evolutes and envelopes of plane curves.	KL3
CO3	Evaluate double and triple integrals in Cartesian and polar coordinates, change the order of integration, and compute areas and volumes using multiple integrals.	KL3
CO4	Evaluate vector integrals using gradient, divergence, curl, and theorems like Green's, Gauss, and Stokes	KL3
CO5	Evaluate partial derivatives, total derivatives, Jacobians, and use Taylor series and Lagrange's method to solve maxima, minima, and constrained optimization problems.	KL3

Course Code	Category	ENGINEERING PHYSICS	L	T	P	C	Contact Hours
	MD		3	0	0	3	3
Course Level		*Prerequisite Courses: Nil*					

COURSE OBJECTIVES:

This is an introductory physics course that aims to enhance the understanding of physics concepts in the different areas of speech, ultrasonics, lasers, optical communication and quantum mechanics that are of relevance to respective engineering programs. The course will enable the students to

- Understand the perception of sound, its metrics, and production and applications of ultrasound.
- Understand basics of quantum mechanics and associated theories.
- Explain physics of semiconductors.
- Describe the principle of laser action and working of lasers.
- Analyse the propagation of light through optical fibres and its application to communication systems and sensors

UNIT 1 ACOUSTICS (4 HOURS)

Classification- Music & Noise - Characteristics of Sound: Pitch/Frequency, Loudness/Intensity-decibel scale - Weber–Fechner law – Loudness Curves- Quality/Timbre

UNIT 2 ULTRASONICS (5 HOURS)

Production - Magnetostriction and Piezoelectric methods – Detection – Piezoelectric, Acoustic grating – Non-Destructive Testing – pulse echo system -reflection and transmission modes –Modes of data presentation- A, B and C scan displays – Sonogram.

UNIT 3 QUANTUM PHYSICS (9 HOURS)

Planck's theory (derivation) – Deduction of Wien's displacement law and Rayleigh-Jeans law from Planck's theory – Properties of Matter waves - wave particle duality - Schrödinger's wave equation – Time independent and time dependent equations – Physical significance of wave function – Particle in a one dimensional box and extension to three dimensional box – Degeneracy of electron energy states – Quantum free electron theory – Density of states – Fermi-Dirac statistics– Free electron concentration in metals.

UNIT 4 SEMICONDUCTORS (9 HOURS)

Classification of semiconductors based on doping and band gap – Intrinsic semiconductor – Concept of hole – carrier concentration derivation –Fermi level and its variation with temperature – electrical conductivity – band gap determination –Extrinsic semiconductors – Carrier concentration

derivation in n-type and p-type semiconductors – Variation of Fermi level with temperature and impurity concentration.

UNIT 5 LASERS (9 HOURS)

Interaction of Radiation with Matter-Spontaneous and stimulated emissions– Einstein's A and B coefficients – Conditions for Laser action –Population inversion – Active medium – pumping schemes – Optical resonant cavity- Light Amplification-Types of lasers – Nd: YAG, CO_2 and Semiconductor lasers- homo junction & hetero junction laser.

UNIT 6 FIBRE OPTICS (9 HOURS)

Principle and propagation of light in optical fibres –Numerical aperture and Acceptance angle, Classification of optical fibres (material, mode & refractive index) – Losses in fibres – attenuation, dispersion – Fibre optical communication system (Block diagram) – Active and passive sensors – pressure, strain, displacement.

TEXTBOOK:

1. M. N. Avadhanulu, P. G. Kshirsagar, "A text book of Engineering Physics" , S. Chand & Co. Ltd. Revised Edition 2014

REFERENCE BOOKS:

1. Kasap, S.O., Principles of Electronic Materials and Devices, (Special Indian Editio McGraw-Hill Education, 3rd Edition, 2017.
2. Kittle Charles, "Introduction to Solid State Physics", Wiley, 2004
3. Gaur R.K. and Gupta S.L. Engineering Physics. Dhanpat Rai publishers, 2012
4. Halliday, D., Resnick, R. & Walker, J. ― Principles of Physics. Wiley, 2015
5. James Beauchamp (Editor) - Analysis, Synthesis, and Perception of Musical Sounds –The Sound of Music- Springer; 2007 th Edition (December 19, 2006)
6. Serway, R.A. & Jewett, J.W. ― Physics for Scientists and Engineers. Cengage Learning, 2010.
7. Tipler, P.A. & Mosca, G. ― Physics for Scientists and Engineers with Modern Physics', W.H.Freeman, 2007

COURSE OUTCOMES

	Course Outcomes	Knowledge Level
CO1	Analyze the characteristics and perception of sound, understand production and detection of ultrasonic waves and their applications.	KL4
CO2	Explain the basic quantum mechanical concepts and their applications.	KL3
CO3	Analyze the physics of semiconductors.	KL4
CO4	Explain the principle, properties and working of different types of lasers.	KL3
CO5	Illustrate the principle of light propagation, causes for losses and dispersion and evaluate their impact on fiberoptic communication systems and working of fiberoptics displacement, pressure and strain sensors	KL4

Course Code	Category	COMMUNICATIVE ENGLISH	L	T	P	C	Contact Hours
	AEC		2	0	2	3	4
Course Level		*Prerequisite Courses: Nil*					

COURSE OBJECTIVES:

The learners will be able to:

1. Enhance conversation fluency and networking skills in English.
2. Contribute efficiently to meetings and group discussions.
3. Deliver well-structured presentations and participate in interviews.
4. Learn the language and strategies of successful negotiations.
5. Communicate effectively during conflict-resolving situations.

UNIT 1 CONVERSATION AND NETWORKING SKILLS (12 HOURS)

Introducing yourself, peers and others. Conversation skills: starting a conversation; keeping the conversation going; closing the conversation; giving directions and instructions; learning functional language needed for everyday interactions. Imparting the basic language skills and techniques for telephonic conversations. Role-plays as a technique for practicing conversation. Writing professional emails.

UNIT 2 MEETING AND GROUP DISCUSSION SKILLS (12 HOURS)

Setting up and holding meetings; organizing and conducting effective meetings; learning the language used to lead a meeting; practicing how to agree and disagree with ideas and people politely. Research and pre-meeting preparation and mock meetings. Making notes, summarizing, and reporting in meetings. Group discussion skills: Basic skills required for a GD; strategies for improving discussion skills; learning the language used for a GD; voicing an opinion and arguing a point effectively, leading a discussion; chairing a discussion; discussing to arrive at a consensus. Research and pre-GD preparation, and mock GDs for practice.

UNIT 3 PRESENTATION AND INTERVIEW SKILLS (12 HOURS)

Making effective presentations: structure of a presentation; referring to visual data; describing visuals; non-verbal communication skills; examples of model presentations; and learning the language used to deliver effective and persuasive presentations. Advance topic research and mock presentations for practice. Applying for jobs; writing resumes; and cover letters. Participating in job interviews and other interviews. Strategies for effective interviewing: preparing for the interview, during-the-interview and after-the-interview etiquette. Common interview questions and learning interviewing language skills. Mock interviews for practice.

UNIT 4 NEGOTIATION SKILLS AND ASSERTIVENESS (12 HOURS)

Negotiation strategies; negotiating effectively; exchanging and comparing information; building rapport with people; practicing the language used in negotiations; considering and respecting cultural differences while negotiating; making compromises. Communication styles: passive, aggressive and assertive. Reading case studies and mock negotiation role plays.

UNIT 5 CONFLICT RESOLUTION AND DECISION-MAKING SKILLS (12 HOURS)

Resolving conflicts: listening actively to ideas; handling people smoothly; dealing with and attempting to solve conflicting problems. Making a decision: thinking about various possibilities before decision-making; communicating the pros and cons of a decision; presenting a mutually beneficial solution. Reading case studies and mock conflict resolution role plays. Developing cross-cultural communication skills.

TEXTBOOKS:

1. Bovee, C. L.& Thill, J. V. (2016). Business Communication Today, 15/e. Pearson Education India.
2. Beebe, S. A., & Mottet, T. P. (2021). Business and Professional Communication (3rd ed). Pearson Higher Education AU.
3. Herbert Hirsch. (2007). Essential Communication Strategies: For Scientists, Engineers, and Technology Professionals, 2nd edition. Wiley-IEEE Press.

REFERENCE BOOKS:

1. Dodd, C. H. (2012). Managing business and professional communication (3rd ed). Allyn & Bacon/Pearson.
2. Dwyer, J. (2012). Communication for Business and the Professions: Strategies and Skills (7th ed). Pearson Higher Education AU.
3. Gill Hasson. (2012). Brilliant Communication Skills: What the Best Communicators Know, Do and Say. Ft Pr.
4. Jones, L., & Alexander, R. (2011). New international business English updated edition student's book: Communication skills in English for business purposes (Vol. 3). Cambridge university press.
5. Kerry Patterson, Joseph Grenny, Ron McMillan and Al Switzler. (2013). Crucial Conversations: Tools for Talking When Stakes Are High. Brilliance Audio.

COURSE OUTCOMES

	Course Outcomes	Knowledge Level
CO1	Develop conversation skills and networking skills in English	KL3
CO2	Communicate effectively in meetings and group discussions	KL4
CO3	Deliver engaging presentations and professional interviews	KL5
CO4	Speak and negotiate strategically in formal and informal settings	KL4
CO5	Present effectively during conflict resolving situations	KL5

Course Code	Category	ELECTRON DEVICES AND CIRCUITS	L	T	P	C	Contact Hours
	MC		3	0	0	3	3
Course Level		*Prerequisite Courses: Nil*					

COURSE OBJECTIVES:

1. To impart fundamental knowledge of semiconductor devices and their operating principles.
2. To enable students to analyze the characteristics and performance of diode and transistor circuits.
3. To provide understanding of different transistor configurations and their applications in electronic systems.
4. To familiarize the characteristics of field effect transistors and advanced device concepts such as MESFET and FinFET.
5. To develop the ability to design and implement suitable biasing circuits for stable operation of electronic devices.

UNIT 1 PN JUNCTION DIODES AND APPLICATIONS (9 HOURS)

Introduction to Semiconductor materials - energy band concept - PN junction formation and depletion region – Diode operation under forward and reverse bias – V–I characteristics of PN junction diode – Diode parameters: resistances and capacitances - Breakdown in PN junction diodes – Applications of PN diode – Rectifier, clipping and clamping circuits

UNIT 2 SPECIAL SEMICONDUCTOR DIODES (9 HOURS)

Zener diode: characteristics and voltage regulation – Tunnel diode: operation and characteristics – Varactor diode: principle and RF applications – UJT: characteristics and relaxation oscillator – SCR, TRIAC and DIAC: V–I characteristics and applications – LED and Photodiode: construction, characteristics and applications – LDR: characteristics and applications.

UNIT 3 BIPOLAR JUNCTION TRANSISTORS (9 HOURS)

Construction and working principle of BJT – Transistor action and current components -Modes of operation: cutoff, active and saturation - Transistor configurations: CE, CB and CC - Input and output characteristics - small signal model: approximate pi model - DC and AC load line analysis

UNIT 4 FIELD EFFECT TRANSISTORS (9 HOURS)

Introduction to FETs and comparison with BJT – JFET: construction, operation and characteristics - FET parameters: transconductance, drain resistance and amplification factor - MOSFET: depletion and enhancement types - MOSFET characteristics and applications - MESFET: structure and working principle - FinFET: concept, structure and operating principle

UNIT 5 TRANSISTOR BIASING AND STABILITY ANALYSIS (9 HOURS)

Need for biasing and operating point stabilization - Biasing requirements for amplifiers – BJT biasing techniques: Fixed bias, self bias - Thermal runaway and stability factors - FET biasing: Fixed bias, Self-bias – compensation techniques - Design considerations for biasing circuits

TEXTBOOK:

1. Robert L. Boylestad and Louis Nashelsky, Electronic Devices and Circuit Theory, Pearson Education, Eleventh Edition, 2016.

REFERENCE BOOKS

1. Millman J, Halkias C and Sathyabrada Jit, Electronic Devices and Circuits, McGraw Hill Education (India) Private Ltd., Fourth Edition, 2015.
2. Thomas L. Floyd, Electronic Devices, Pearson Education, Ninth Edition, 2017.
3. M K Achuthan, K N Bhat, Fundamentals of Semiconductor Devices, McGraw Hill Education, 2012.

COURSE OUTCOMES

	Course Outcomes	Knowledge Level
CO1	Evaluate the performance of PN junction diode circuits using characteristic parameters.	KL5
CO2	Select appropriate special purpose diodes for given electronic applications.	KL3
CO3	Analyze BJT operation and evaluate amplifier and switching performance.	KL4
CO4	Compare FET family devices and apply them in electronic circuits.	KL2
CO5	Design stable biasing circuits for BJT and FET devices.	KL6

Course Code	Category	CIRCUIT ANALYSIS	L	T	P	C	Contact Hours
	MC		3	0	0	3	3
Course Level		*Prerequisite Courses: Nil*					

COURSE OBJECTIVES:

1. To learn the basic concepts and behaviour of DC circuits
2. To learn the basic concepts and behaviour of AC circuits
3. To understand various methods of circuit/ network analysis using network theorems.
4. To learn the concepts of resonance and magnetic coupled circuits.
5. To understand the transient and steady-state response of the circuits subjected to DC and pulse excitations and to characterize two-port networks in Z, Y, ABCD and h parameters.

UNIT 1 DC ANALYSIS (9 HOURS)

Ohm's law - Kirchhoff's laws - Resistors, inductors and capacitors in series and parallel circuits - voltage division in resistors and capacitors, current division, source transformation - star delta conversion - Mesh and node analysis.

UNIT 2 AC ANALYSIS (9 HOURS)

Sinusoids, average value and RMS values of waveforms, phasors, phasor arithmetic, phasor relationship for circuit elements - Impedance and admittance - Kirchhoff's laws - Series and parallel circuits - Voltage and current division-Phasor diagrams for RL, RC and RLC circuits - Source transformation - Star Delta conversion - Mesh current and node voltage method of analysis.

UNIT 3 NETWORK THEOREMS FOR DC AND AC CIRCUITS (9 HOURS)

Superposition theorem - Thevenin's and Norton's theorems - Maximum power transfer theorem

UNIT 4 RESONANCE AND COUPLED CIRCUITS (9 HOURS)

Resonance - Series and Parallel resonance - frequency response - Quality factor and Bandwidth - Self and Mutual inductance - Coefficient of coupling - Dot convention - Modelling of coupled circuits - Coupled inductors in series and parallel.

UNIT 5 TRANSIENT ANALYSIS & TWO PORT NETWORKS (9 HOURS)

Transient response of RL and RC, and RLC circuits for DC excitation - Two- port networks, Characterization of two-port networks in terms of Z, Y, ABCD and h parameters, representation of one parameter in terms of other - Interconnection of two-port networks - Symmetry and Reciprocity.

TEXTBOOK:

1. Hayt, William H., Jr., Jack E. Kemmerly, Jamie D. Phillips, and Steven M. Durbin. Engineering Circuit Analysis. 10th ed. New York: McGraw Hill, 2024.

REFERENCE BOOKS

1. Joseph A. Edminister, Mahmood Nahvi, Electric circuits, Schaum's outline series, Tata McGraw-Hill Publishing Company, 6th edition, 2016.
2. Charles K. Alexander, Mathew N.O. Sadiku, Fundamentals of Electric Circuits, McGraw Hill, 6th edition, 2017.
3. J. David Irwin, R. Mark Nelms, Basic Engineering Circuit Analysis, John Wiley & Sons, 11th edition, 2015.
4. Bruce A. Carlson, Circuits, Cengage Learning, India Edition, 2008.

COURSE OUTCOMES

	Course Outcomes	**Knowledge Level**
CO1	Apply the basic concepts of circuit analysis, such as Kirchhoff's laws and mesh current and node voltage methods, to analyse DC and AC circuits.	KL3
CO2	Apply the basic circuit analysis concepts and network theorems to DC and AC circuits.	KL3
CO3	Analyze the frequency response of parallel and series resonance circuits and magnetic coupling circuits.	KL4
CO4	Analyze transient response for RC, RL and RLC circuits.	KL4
CO5	Analyze two-port networks in terms of Z, Y, ABCD and h parameters.	KL4

Course Code	Category	PROFESSIONAL ETHICS AND HUMAN VALUES	L	T	P	C	Contact Hours
	VAC		2	0	0	2	2
Course Level		*Prerequisite Courses: Nil*					

COURSE OBJECTIVES:

1. To provide students with a foundation in ethics and human values for personal, social, and professional life.
2. To enable students to understand and apply ethical principles in decision-making and workplace conduct.
3. To develop awareness of social responsibility, civic virtues, and sustainable practices in professional and personal contexts.

UNIT 1 INTRODUCTION TO ETHICS AND VALUES (6 HOURS)

Meaning and scope of ethics, morals, and values, Life skills and emotional intelligence, Personal versus professional ethics, Stakeholders and their influence on decisions, Ethical dilemmas and methods of resolution, Case studies highlighting basic ethical issues

UNIT 2 RESPONSIBILITY, SOCIAL IMPACT, AND WORKPLACE CONDUCT (6 HOURS)

Attributes of a profession, roles, duties, and responsibilities, Professional obligations and social impact of decisions, Corporate Social Responsibility (CSR) and sustainable practices, Legal and social responsibilities, Workplace safety and rights, Case studies on societal and organizational ethical issues

UNIT 3 THEORIES AND DECISION-MAKING FRAMEWORKS (6 HOURS)

Major ethical theories: Utilitarianism, Deontology, Virtue Ethics, Rights-based approaches, Application of theories in professional scenarios, Decision-making frameworks for dilemmas, Responsibility for safety, health, and well-being, Risk assessment and accountability, Case studies illustrating applied concepts.

UNIT 4 RIGHTS, GLOBAL ISSUES, AND ETHICAL CODES (6 HOURS)

Rights and duties in workplace, Professional standards and codes of conduct, Ethics audit: implementation and evaluation, Global challenges: environmental ethics, media ethics, bioethics, research ethics, Cross-cultural considerations and international case studies

UNIT 5 HUMAN VALUES AND PROFESSIONAL DEVELOPMENT (6 HOURS)

Nature, classification, and significance of human values, Value-based decision-making in personal and professional life, Integration of human values in daily life, Harmony with self, family, society,

and environment, Developing positive attitudes, moral courage, and integrity, Strategies for internalizing and applying values, Practical exercises and case studies on character building and ethical living.

TEXTBOOKS:

1. Professional Ethics Includes Human Values, R. Subramanian, Oxford University Press, 2nd Edition, 2017.
2. Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 3rd revised edition, 2023.

REFERENCE BOOKS

1. A Textbook on Professional Ethics and Human Values by R.S. Naagarazan, New Age Intl. Publishers, 2006.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. Human Values and Professional Ethics, by Vaishali R Khosla & Kavita Bhagat, Technical Publications, First Edition, 2009.

COURSE OUTCOMES

	Course Outcomes	**Knowledge Level**
CO1	Explain the basic concepts of ethics, morals, and values, and differentiate between personal and professional ethics.	KL2
CO2	Describe the responsibilities of professionals and the social and legal impact of their decisions, including CSR and workplace safety.	KL2
CO3	Discuss major ethical theories and their role in resolving ethical dilemmas in professional situations.	KL2
CO4	Identify rights, professional standards, ethical codes, and global challenges relevant to workplace and international practices.	KL2
CO5	Illustrate human values in personal and professional life to foster integrity, positive attitudes, and responsible behavior.	KL3

Course Code	Category	ELECTRONICS ENGINEERING PRACTICE	L	T	P	C	Contact Hours
	SEC		0	0	4	2	4
Course Level		*Prerequisite Courses: Nil*					

COURSE OBJECTIVES:

1. To enable students to perform experimental analysis of electronic device characteristics and circuit behaviour.
2. To provide practical exposure to network theorems through hardware verification.
3. To develop skills in circuit design, PCB soldering, and testing of basic electronic applications.

List of Experiments:

Cycle – I: Device Characteristics Experiments

1. V–I characteristics of PN Junction Diode
2. Characteristics of Zener Diode
3. Input and output characteristics of BJT (CB configuration)
4. Drain and transfer characteristics of JFET
5. Characteristics of UJT

Cycle – II: Network Theorem Experiments

1. Verification of Kirchhoff's Voltage Law (KVL)
2. Verification of Kirchhoff's Current Law (KCL)
3. Verification of Thevenin's Theorem
4. Verification of Norton's Theorem
5. Verification of Maximum Power Transfer Theorem
6. Verification of Reciprocity Theorem

Cycle – III: Simulation Based Experiments

1. Comparative study of BJT amplifier configurations (CE, CB, and CC) using simulation tools.
2. Simulation study of the effect of MOSFET physical parameters on device characteristics.

Cycle – IV: Application-based Implementation

Formulate an engineering problem using electronic devices and circuit analysis, design the circuit, and implement the solution through general purpose PCB design.

COURSE OUTCOMES

	Course Outcomes	Knowledge Level
CO1	Analyze the characteristics of electronic devices and interpret the results for a specific application.	KL4
CO2	Verify network theorems through experimental measurements and evaluate circuit performance.	KL5
CO3	Design, assemble, and test basic electronic circuits on general purpose PCB using standard laboratory practices.	KL6

Course Code	Category	ENGINEERING PHYSICS LABORATORY	L	T	P	C	Contact Hours
	MD		0	0	4	2	4
Course Level		*Prerequisite Courses: Nil*					

COURSE OBJECTIVES:

To determine some of the physical, electrical and optical properties of materials.

Tentative List of Experiments:

1. Determination of velocity and compressibility of the given liquid - Ultrasonic interferometer
2. Determination of Planck's Constant
3. Determination of specific resistance of the given wire - Carey Foster Bridge
4. Determination of Energy bandgap of the given semiconductor - Band Gap of Semi-Conductor
5. Determination of grating element / average size of the particles of a given powder sample using laser
6. Determine the numerical aperture, acceptance angle & losses in fibres of the given optical fibre cable

Advanced Physics Lab (Open-ended)

7. Mini Project that is conceived and executed by end of the semester.

COURSE OUTCOMES

	Course Outcomes	Knowledge Level
CO1	Determine material properties of medium associated with ultrasound propagation.	KL3
CO2	Use lasers for study of materials and optical fibres.	KL3
CO3	Determine electrical properties of metals and semiconductors like specific resistance of a conductor, bandgap of semiconductors.	KL3
CO4	Develop appropriate procedures/methodologies based on study objectives.	KL6

SEMESTER - II

Course Code	Category	DIFFERENTIAL EQUATIONS AND COMPLEX FUNCTIONS (Common to ECE, VLSI, BME, CIVIL, EEE, MECH, CHEM)	L	T	P	C	Contact Hours
	MC		3	0	0	3	3
Course Level		*Prerequisite Courses: Nil*					

COURSE OBJECTIVES:

The objective of the course is to enable the students

- To understand the concept of ordinary and partial differential equations and utilize it in solving engineering problems.
- Find the Laplace Transforms of standard functions and solve second order linear ordinary differential equations with constant coefficients.
- To construct Analytic functions and evaluate integrals using Cauchy's integral formula

UNIT 1 ORDINARY DIFFERENTIAL EQUATIONS (9 HOURS)

Solution of second and higher order linear differential equations with constant coefficients (RHS functions - $e^{mx}, sinmx, cosmx, x^n, x^n f(x),\ e^{mx} f(x)$, Application to harmonic oscillation of an undamped Mass-Spring system- Method of variation of parameters - Simultaneous linear differential equations with constant coefficients of first order.

UNIT 2 LAPLACE TRANSFORMS (9 HOURS)

Definition, properties – Transform of elementary functions, unit step function and unit impulse function, shifting theorems – Transforms of derivatives and integrals, Evaluation of integrals by Laplace transforms - Periodic functions – Initial and final value theorems.

UNIT 3 INVERSE LAPLACE TRANSFORMS (9 HOURS)

Inverse transforms – Definition, Properties - Method of Partial Fractions, Inverse Laplace transforms of derivatives and integrals - Convolution theorem - Applications of Convolution Theorem - Ordinary Differential Equations: Solution by using Laplace Transforms.

UNIT 4 ANALYTIC FUNCTIONS (9 Hours)

Analytic functions – necessary and sufficient conditions, Cauchy-Riemann equations in Cartesian and polar form (with proof) – Properties – harmonic functions, Construction of analytic function, conformal mapping – some standard transformations w = z + c, cz, 1/z, bilinear transformation.

UNIT 5 COMPLEX INTEGRATION (9 HOURS)

Line integral – Cauchy's integral theorem – Cauchy's integral formula, Taylor's and Laurent's series, Singularities – Residues – Residue theorem – Application of residue theorem for evaluation

of real integrals – Use of circular contour and semicircular contour (except the poles on the real axis).

TEXTBOOKS:

1. Grewal B.S, Higher Engineering Mathematics, Khanna Publishers, 45th Edition, 2020.
2. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons, Inc., 10th Edition, 2020.

REFERENCE BOOKS:

1. Bali, N.P., Goyal, M., Watkins, C., Advanced Engineering Mathematics, Laxmi Publications Pvt. Limited, 2007.
2. Boyce, W.E., and DiPrima, R.C., Elementary Differential Equations and Boundary Value Problems, Wiley India, 2012.
3. George B. Thomas Jr., Maurice D. Weir, Joel R. Hass, Thomas' Calculus: Early Transcendental, 13th Edition, Pearson Education, 2013.
4. O'Neil. P. V., Advanced Engineering Mathematics, 7th Edition, Cengage Learning India Pvt., Ltd, New Delhi, 2011.
5. Howard Anton, Irl C. Bivens, Stephen Davis, Calculus Early Transcendentals, 11th Edition, John Wiley & Sons, Inc., 2016.

COURSE OUTCOMES

	Course Outcomes	**Knowledge Level**
CO1	Solve second and higher order linear ordinary differential equations with constant coefficients, handle simultaneous linear ODEs.	KL4
CO2	Obtain the Laplace Transforms of standard functions.	KL4
CO3	Apply the concepts of inverse Laplace Transforms in solving differential equations.	KL3
CO4	Solve problems in Analytic functions and construction of analytic functions using C-R equations.	KL3
CO5	Compute line integrals, residues, and real integrals via residue theorems.	KL3

Course Code	Category	TECHNICAL WRITING	L	T	P	C	Contact Hours
	AEC		2	0	2	3	4
Course Level		*Prerequisite Courses: Nil*					

COURSE OBJECTIVES:

The learners will be able:

1. To prepare effective instructions, checklists and emails
2. To write different kinds of paragraphs and argumentative essays
3. To develop and revise effective resumes, cover letters and SOPs
4. To document and organise various kinds of reports, case studies and white papers
5. To create well-structured proposals and press releases

UNIT 1 WRITING INSTRUCTIONS, CHECKLISTS AND EMAILS (12 HOURS)

Writing instructions and checklists; using bulleted lists and numbered lists. Writing professional emails: appropriate greetings, subject line, writing three-body paragraphs – introduction, body, and closing paragraph; discussion of samples. Language skills: Tenses – present and past.

UNIT 2 WRITING ARGUMENTATIVE PARAGRAPHS AND ESSAYS (12 HOURS)

Writing paragraphs. Structure of a paragraph: basic, compare and contrast. Product descriptions and process descriptions. Interpreting charts and graphs. Writing argumentative essays; handling three types of arguments: Classical, Rogerian, Toulmin; structure of an argumentative essay: introduction, building the thesis, body paragraphs with three arguments or claims and supporting evidence, conclusion. Sample essays. Language skills: Connectors and definitions

UNIT 3 WRITING JOB APPLICATIONS AND SUMMARIES (12 HOURS)

Writing job applications; resumes and cover letters. Writing the statement of purpose (SOP): Outline – professional narrative, previous experience, research interests, and career goals. Writing summaries: reading the text; identifying the main ideas and supporting details. Writing paraphrases: step by step paraphrasing; text comparison; sentence analysis. Language skills: subject-verb agreements

UNIT 4 WRITING REPORTS, CASE STUDIES AND WHITE PAPERS (12 HOURS)

Writing datasheets: outline – descriptions, graphics, benefits, features and specifications, requirements, and contact information. Writing abstracts. Writing technical reports; practising IMRAD structure; Engineering reports & Feasibility reports. Writing case studies and white papers: main components of an issue case study – problems, search for solutions, implementation of the solution and results. Language skills: Active voice, passive voice

UNIT 5 WRITING PROPOSALS AND PRESS RELEASES (12 HOURS)

Writing business proposals: format -- title page, table of contents, executive summary, project details, deliverables and milestones, budget, conclusion. Writing for Websites: Inverted pyramid style; headings and subheading; bulleted lists; short paragraphs with one idea. Writing press releases: outline – headline, date of publication, contact information, summary, intro paragraph, detail paragraphs, and about section. Language skills: Correction of errors, proofreading and editing.

TEXTBOOKS:

1. Laplante, P. A. (2018). Technical writing: A practical guide for engineers, scientists, and nontechnical professionals. CRC Press.
2. David Bonamy. (2013) Technical English Level 2 Course Book. Pearson

REFERENCE BOOKS:

1. Kmiec, D., & Longo, B. (2017). The IEEE guide to writing in the engineering and technical fields. John Wiley & Sons.
2. Lewis Lansford; Peter Astley. (2013). Oxford English for Careers: Engineering 1: Student's Book. Oxford University Press.
3. Mark Ibbotson. (2008). Cambridge English for Engineering, 2008, Cambridge University Press.
4. Rubens, P. (2002). Science and technical writing: A manual of style. Routledge.

COURSE OUTCOMES

	Course Outcomes	Knowledge Level
CO1	Write instructions, checklists and emails with clarity and readability.	KL3
CO2	Compose paragraphs, and structure an argumentative essay effectively.	KL4
CO3	Create and edit resumes, cover letters and SOPs concisely.	KL4
CO4	Document well-structured reports, case studies and white papers.	KL5
CO5	Develop effective proposals and press releases.	KL5

Course Code	Category	PROGRAMMING IN PYTHON FOR DATA SCIENCE	L	T	P	C	Contact Hours
	VAC		1	0	2	2	3
Course Level		*Prerequisite Courses: Nil*					

COURSE OBJECTIVES:

- To learn Python fundamentals and modularity in problem solving.
- To learn data types in Python and file handling.
- To learn numerical computations using NumPy.
- To learn data manipulations using Pandas.
- To perform visualization and statistical analysis using Python libraries.

UNIT 1 PYTHON FUNDAMENTALS (4 HOURS)

Introduction to Python – Expressions and operators - Variables and Assignment - conditional and Iterative statement; Functions: Local and global scope, Methods of passing arguments, Recursion.

UNIT 2 DATA TYPES AND FILE HANDLING (3 HOURS)

Compound Data Types: Strings - Lists - Tuples - Dictionaries; File handling.

UNIT 3 NUMPY FOR NUMERICAL COMPUTATION (2 Hours)

Arrays in Python – Array creation in NumPy – Indexing and slicing operations – Arithmetic operations – Statistical operations using NumPy.

UNIT 4 PANDAS FOR DATA MANIPULATION (3 HOURS)

Series and Data frames in Pandas – Data Loading - Indexing – Data cleaning and preprocessing - Data Manipulation: Sorting, grouping, handling missing values - statistical operations in data frames.

UNIT 5 DATA VISUALIZATION AND STATISTICS (3 HOURS)

Data visualization using Matplotlib: line, bar, scatter, pie, histogram, multiplots; Descriptive Statistics - Correlation Analysis.

SUGGESTED EXPERIMENTS

1. Develop a program to classify students as Excellent, Good, Average, or At Risk using conditional statements.
2. Develop a program to count the number of days with sales above the average using iterative statements.

3. Develop a recursive function to normalize a dataset using Min–Max normalization.
4. Develop a program using strings to count the number of valid and invalid emails.
5. Develop a program to remove duplicate values from a list and sort the cleaned data in ascending order.
6. Develop a program using tuples to store the customer transaction data and compute the total transaction amount.
7. Develop a program to store account number as key and customer details (name, balance, account type) as values using dictionaries and update account balance after deposit or withdrawal.
8. Develop a program to read transaction details from a CSV file and write suspicious transactions to a separate file.
9. A dataset contains monthly sales figures stored in a NumPy array. Develop a program to extract sales data for a specific range of months and access rows and columns using slicing.
10. A dataset of customer balances is stored in a NumPy array. Develop a program to compute quartiles (Q1, Q2, Q3) and interquartile range (IQR).
11. Loan applicant data includes income, age, and credit score is stored in a CSV file. Filter applicants satisfying multiple conditions (e.g., income > ₹50,000 and credit score > 700) using Pandas.
12. A bank wants to visually analyze customer, transaction, and revenue data to support decision-making. Develop a Python application that uses different Matplotlib plots to represent various types of data.
13. Mini Project on Exploratory Data Analysis.

TEXTBOOKS:

1. S Sridhar, J Indumathi, V M Hariharan, "Python Programming", Pearson, 2023. (UNIT I, II).
2. Allen B. Downey, “Think Stats: Exploratory Data Analysis” 3rd edition, O'Reilly, 2025 (UNIT III, IV, V).

REFERENCE BOOKS:

1. Wes McKinney, "Python for Data Analysis", O'Reilly, 2022 (Unit V)
2. Allen B. Downey, ``Think Python", 3rd edition, O'Reilly Media, 2024, Online Version: https://allendowney.github.io/ThinkPython/
3. Ron S. Kenett, Shelemyahu Zacks, Peter Gedeck, "Modern Statistics: A Computer-Based Approach with Python", Springer, 2022.
4. Karl Beecher, ``Computational Thinking – A beginner's Guide to Problem Solving and Programming", British Computer Society (BCS), 2017.
5. John V Guttag, ``Introduction to Computation and Programming Using Python", 3rd edition, MIT Press, 2021.
6. Alan Agresti and Maria Kateri, ``Foundations of Statistics for Data Scientists with R and Python ", First Edition, CRC Press, 2022.

COURSE OUTCOMES

	Course Outcomes	Knowledge Level
CO1	Apply sequential, alternate, and iterative approaches for solving problems.	KL3
CO2	Solve problems by using different datatypes and files.	KL3
CO3	Develop Python programs for numerical computations using NumPy	KL3
CO4	Develop Python programs for data manipulation using Pandas	KL3
CO5	Select appropriate Matplotlib visualization techniques to accurately represent data trends, patterns, and analytical outcomes.	KL5

Course Code	Category	ENVIRONMENTAL SCIENCE	L	T	P	C	Contact Hours
	VAC		2	0	0	2	2
Course Level		*Prerequisite Courses: Nil*					

COURSE OBJECTIVES:

This course aims to:

1. To develop a better understanding of human relationship with environment.
2. To explain the importance of conservation of resources.
3. To create awareness on pollution and environmental degradation.
4. To acquire knowledge on sustainable development.
5. To apply technical skills for solving environmental problems.

UNIT 1 ECOSYSTEM AND BIODIVERSITY (6 HOURS)

Structure and function of an ecosystem – energy flow- food chains, food webs and ecological pyramids – ecological succession. Introduction to biodiversity definition and types– values of biodiversity – threats to biodiversity-conservation of biodiversity: In-situ and ex-situ conservation of biodiversity; role of individuals and communities in biodiversity conservation.

UNIT 2 NATURAL RESOURCES (6 HOURS)

Forest, Water, Food, Energy, Mineral and Land resources – uses and case studies on over exploitation of natural resources; Conservation of natural resources; Equitable use of resources for sustainable lifestyles

UNIT 3 CURRENT ENVIRONMENTAL AND SOCIAL ISSUES (6 HOURS)

Air pollution – particulate pollution (Smog, acid rain, climate change and global warming, ozone layer depletion); Water pollution; Soil pollution and solid waste management; Noise pollution; Nuclear pollution; Role of an individual in the prevention of pollution. Disaster management; Human health and Environment: Issues with water and sanitation; Human rights, HIV/AIDS, Women and child welfare

UNIT 4 SUSTAINABLE DEVELOPMENT AND ENVIRONMENTAL GOVERNANCE (6 HOURS)

Sustainable development goals (SDGs): Origin, Purpose, importance, and challenges in achieving SDG; Circular economy (4 R and 10 R); Upcycling and waste to wealth strategies; Extended Producer Responsibility; Green buildings; Electric and hybrid electric vehicles; Mission LiFE and Sustainable Lifestyle Practices; Environmental legislations: National Green Tribunal; National missions and policies towards SDGs; ESG framework and corporate sustainability

UNIT 5 ENGINEERING INTERVENTION TO REDUCE ENVIRONMENTAL STRESSES (6 HOURS)

Role of technology in environmental studies – AI and IoT- Real time data collection and analysis - Environmental modelling and simulation – GIS - Remote sensing – satellite and sensors - Use of drone for aerial mapping and surveying.

TEXTBOOKS:

1. Anubha Kaushik and Kaushik, C. P. "Environmental Science and Engineering", New Age International Publishers, 14th Edition, 2014.
2. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, 2006.

REFERENCE BOOKS

1. Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education, 2004.
2. Tyler Miller G., and Scott E. Spoolman, "Environmental Science", Cengage Learning India PVT, LTD, Delhi, 2014.
3. M.H. Fulekar, Bhawana Pathak and R.K.Kale, 'Environment and Sustainable Development' Springer Nature, 2013

COURSE OUTCOMES

	Course Outcomes	**Knowledge Level**
CO1	Acquire the basic concepts of ecosystems; understand the importance of biodiversity and conservation strategies.	KL2
CO2	Develop knowledge on natural resources and equitable use of natural resource.	KL2
CO3	Analyse the current environmental problems and its plausible solutions.	KL2
CO4	Explain the concept of sustainable development, its importance and key challenges in implementation of sustainable goals.	KL2
CO5	Describe the role of technology for assessment and management of environment and human health.	KL2

Course Code	Category	DIGITAL ELECTRONICS	L	T	P	C	Contact Hours
	MC		3	0	2	4	5
Course Level		*Prerequisite Courses: Nil*					

COURSE OBJECTIVES:

1. To apply digital fundamentals including number systems, Boolean algebra, and logic minimization techniques for simplified logic design.
2. To design and analyze combinational logic circuits, synchronous and asynchronous sequential circuits.
3. To gain knowledge of different logic families and their characteristics for implementing reliable digital circuits.
4. To understand semiconductor memories and programmable logic devices for the practical realization of digital systems.

UNIT 1 DIGITAL FUNDAMENTALS AND MINIMIZATION TECHNIQUES (9 HOURS)

Analog versus Digital, Number systems: Binary, Octal, Decimal, Hexadecimal, Number-Base Conversions, complement of a number, Binary Codes, Boolean Algebra: Switching algebra, axioms and theorems, Logic gates, Canonical and Standard Forms, Logic minimization: Karnaugh's map - 3 variables, 4 variables and 5 variables, Quine Mc-Cluskey method - 4 variables

UNIT 2 COMBINATIONAL LOGIC CIRCUITS (9 HOURS)

Half adder, full adder, ripple carry adder, carry lookahead adder, half subtractor, full subtractor, binary multiplier, magnitude comparator, code converter, parity generator and checker, Multiplexer, De-multiplexer, decoder, encoder, priority encoder

UNIT 3 SYNCHRONOUS SEQUENTIAL CIRCUIT DESIGN (9 HOURS)

Latches and Flip flops: SR, JK, T and D, setup time and hold time, excitation tables and excitation equations, Analysis of clocked sequential circuits, Synchronous FSM: Mealy and Moore Models, Design procedure, Counters: Ripple counters, Synchronous counters - up/down counters, counters with control input, modulo counters, ring counters, Design of sequence detector, Shift registers: SISO, SIPO, PISO, PIPO, Universal shift registers

UNIT 4 ASYNCHRONOUS SEQUENTIAL CIRCUIT DESIGN (9 HOURS)

Asynchronous FSM: Analysis Procedure, Circuit with Latches, race conditions and cycles, Design procedure, Reduction of Flow tables, Race free assignment, Hazards, Design examples

UNIT 5 LOGIC FAMILIES AND PROGRAMMABLE LOGIC DEVICES (9 HOURS)

Logic families - characteristics, RTL, TTL, ECL, CMOS, Memory - ROM, RAM, PROM, EPROM, EEPROM, EAPROM, Programmable Logic Devices - PLA, PAL

LIST OF EXPERIMENTS

1. Design and implementation of half/full adders using basic gates.
2. Design and implementation of half/full subtractors using basic gates.
3. Design and implementation of code converters.
4. Design and verify 4-bit magnitude comparator using IC7485.
5. Design and implementation of encoder.
6. Design and implementation of decoder.
7. Design and implementation of multiplexer.
8. Design and implementation of demultiplexer.
9. Design and implementation of 2-bit binary ripple counter.
10. Design and implementation of 2-bit binary synchronous counter.
11. Design and implementation of 2-bit shift registers for data transfer operations.

TEXTBOOK:

1. M. Morris Mano and Michael D. Ciletti, Digital Design Pearson, Sixth Edition, 2018.

REFERENCE BOOKS:

1. Donald P Leach, Malvino AP, Goutam Saha, Digital Principles and Applications, McGraw Hill, Eighth Edition, 2014.
2. John F. Wakerly, Digital Design Principles and Practices, Prentice Hall, Fourth Edition, 2012.
3. Charles H. Roth and Larry L. Kenney, Fundamentals of Logic Design, Cengage learning, Seventh Edition, 2018.
4. Donald D. Givone, Digital Principles and Design, Tata McGraw Hill, 2003.

COURSE OUTCOMES

	Course Outcomes	Knowledge Level
CO1	Apply the fundamental concepts of digital system design to obtain the Boolean expressions.	KL3
CO2	Design and implement combinational circuits such as arithmetic circuits, selection logic circuits, magnitude comparators.	KL6
CO3	Design synchronous sequential circuits - counters, shift registers, and finite state machines using flip-flops.	KL6
CO4	Examine asynchronous sequential circuits to detect race conditions and hazards and implement race-free design solutions.	KL4
CO5	Describe the operational characteristics of logic families and programmable logic devices and assess their suitability in digital system applications.	KL2

Course Code	Category	ANALOG ELECTRONICS	L	T	P	C	Contact Hours
	MC		3	0	2	4	5
Course Level		*Prerequisite Courses: Electron Devices and Circuits, Circuit Analysis*					

COURSE OBJECTIVES:

1. To analyse the frequency response of small signal amplifiers
2. To design and analyse single-stage, multi-stage, tuned and power amplifiers.
3. To acquire proficiency in the concept of feedback amplifier.
4. To construct transistor-based waveform generators

UNIT 1 BJT AND MOSFET SINGLE-STAGE AMPLIFIERS (9 HOURS)

Small signal hybrid-π equivalent circuit of BJT and MOSFET - Frequency response of amplifier circuit – Miller effect - Midband analysis of CE, CC and CB amplifiers – Midband analysis of CS, CD and CG amplifiers

UNIT 2 MULTI-STAGE AND DIFFERENTIAL AMPLIFIERS (9 HOURS)

Introduction to Multi-stage amplifiers - Bootstrapping Technique - Darlington amplifier- Cascade and Cascode amplifier using MOSFET – Analysis of differential amplifier using MOSFET.

UNIT 3 TUNED AND POWER AMPLIFIERS (9 HOURS)

Tuned amplifiers - Single tuned amplifiers – Gain and frequency response – MOSFET-based Power amplifiers: classification – efficiency - Class A, Class B, Class AB, Class C Amplifiers - Amplifier distortion - Power transistor-Heat sink.

UNIT 4 TRANSISTOR FEEDBACK AMPLIFIERS (9 HOURS)

Concept of feedback in amplifiers - Advantages of negative feedback – General characteristics of negative feedback – Feedback topologies - voltage / current, series/shunt feedback - Analysis of feedback amplifiers.

UNIT 5 MOSFET SIGNAL GENERATORS (9 HOURS)

Basic principles of sinusoidal oscillators - Condition for oscillation - RC phase shift oscillator, Wien Bridge Oscillator - Hartley, Colpitts - Crystal Oscillators - Multivibrators: Collector coupled - Bistable, Monostable and Astable multivibrators.

LIST OF EXPERIMENTS

1. Analysis of biasing circuits for BJT and MOSFET.
2. Design and Frequency response analysis of Common Drain amplifier
3. Analysis of Source-Follower amplifier circuit.
4. Analysis and design of cascode amplifier.

5. Analysis of Shunt-Shunt feedback amplifier.
6. Analysis and design of RC phase shift oscillator.
7. Analysis and design of Hartley oscillator circuit.

Mini Project:
Analysis and implementation of a suitable Oscillator/Amplifier circuit for any signal processing application.

TEXTBOOK:

1. Donald.A.Neaman, Electronic circuit Analysis and Design – 2nd Edition, Tata Mc Graw Hill. 2009
2. Sedra and Smith, ―Micro Electronic Circuits; Sixth Edition, Oxford University Press, 2011.

REFERENCE BOOKS:

1. Millman J, Halkias C and Sathyabrada Jit, Electronic Devices and Circuits, McGraw Hill Education (India) Private Ltd., Fourth Edition, 2015.
2. Jacob Millman, Microelectronics, McGraw Hill, 2nd Edition, Reprinted, 2009.
3. Robert L. Boylestad and Louis Nashelsky, Electronic Devices and Circuit Theory, Pearson Education, Eleventh Edition, 2016.
4. David A. Bell, Electronic Devices and Circuits, Oxford University Press, Fifth Edition, 2017.

COURSE OUTCOMES

	Course Outcomes	Knowledge Level
CO1	Analyze the frequency response characteristics of small-signal amplifiers	KL4
CO2	Design and analyse the multi-stage amplifiers.	KL6
CO3	Design and evaluate the theoretical concepts of tuned and power amplifiers.	KL6
CO4	Apply the concept of feedback in the design of amplifiers and oscillators.	KL3
CO5	Design and implement transistor-based waveform generators.	KL6

Course Code	Category	PCB DESIGN	L	T	P	C	Contact Hours
	SEC		0	0	4	2	4
Course Level		*Prerequisite Courses: Nil*					

COURSE OBJECTIVES:

1. To understand the fundamentals and types of printed circuit boards.
2. To familiarize students with industry-standard EDA tools.
3. To develop skills in schematic capture and PCB layout design.
4. To generate fabrication-ready files for PCB manufacturing.
5. To apply PCB design concepts in practical circuits and mini projects.

LIST OF EXPERIMENTS

1. Familiarization with Printed Circuit Board (PCB) Fundamentals
2. Familiarization with Electronic Design Automation (EDA) Tools
3. Design of Electronic Circuits Using a Schematic Editor
4. Design of Electronic Circuits Using a PCB Layout Editor
5. Generation of Gerber Files for PCB Manufacturing
6. Design of PCB for LED Power Indicator Circuit
7. Design of PCB for General Electronic Circuits
8. Design of PCB for Power Converter Circuits
9. Mini Project Design and Demonstration

COURSE OUTCOMES

	Course Outcomes	Knowledge Level
CO1	Identify PCB types, materials, and manufacturing processes.	KL3
CO2	Use EDA tools to design electronic schematics and PCB layouts	KL3
CO3	Perform component placement and routing as per PCB design rules.	KL3
CO4	Generate Gerber files suitable for PCB fabrication.	KL6
CO5	Design, implement, and demonstrate a functional PCB-based mini project.	KL6