SHIV NADAR
UNIVERSITY
CHENNAI

Rajiv Gandhi Salai, Kalavakkam – 603 110

SSN School of Engineering

DEPARTMENT OF BIOMEDICAL ENGINEERING

B.TECH. BIOMEDICAL ENGINEERING

CURRICULUM & SYLLABUS

REGULATIONS 2025

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO1: Our graduates will demonstrate strong foundational knowledge and technical proficiency in Biomedical Engineering, with specialized skills in Artificial Intelligence, Data Science, Embedded Electronics, Medical Robotics, and Neurotechnology to address complex healthcare challenges.

PEO2: Our graduates will engage in innovative, interdisciplinary research and development through active collaboration with industry and academia to translate biomedical innovations into sustainable and impactful healthcare solutions.

PEO3: Our graduates will evolve as ethical, socially responsible, and professionally competent leaders in Biomedical Engineering, contributing effectively to societal well-being and lifelong learning.

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)

PSO1: To design, analyze, and develop indigenous medical devices that address societal healthcare challenges through the integration of life sciences, engineering, and technology.

PSO2: To apply AI, machine learning, and data science tools to develop intelligent, data-driven diagnostic and therapeutic systems.

PSO3: To translate interdisciplinary research into practical healthcare technologies while upholding ethical standards and societal responsibility.

CURRICULUM

SEMESTER - I

S. No.	COURSE TITLE	COURSE CATEGORY	CONTACT PERIODS	L	T	P	C
1	Matrices and Calculus	MD	4	3	1	0	4
2	Electric Circuit Theory	MD	3	3	0	0	3
3	Communicative English	AEC	4	2	0	2	3
4	Physiology for Engineers	MC	3	3	0	0	3
5	Principles of Electronic Devices and Circuits	MC	3	3	0	0	3
6	Professional Ethics and Human Values	VAC	2	2	0	0	2
7	Programming in Python for Data Science	VAC	3	1	0	2	2
8	Electronic Devices and Circuits Laboratory	SEC	4	0	0	4	2
9	Extra Academic Activity 1*	VAC	2	0	0	2	1*
TOTAL			**28**	**17**	**1**	**10**	**22+1***

SEMESTER - II

S. 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	Engineering Physics	MD	5	3	0	2	4
4	Environmental Science	VAC	2	2	0	0	2
5	Analog and Digital Integrated Circuits	MC	6	4	0	2	5
6	Biochemistry and Microbiology	MC	3	3	0	0	3
7	Bioscience and Physiology Laboratory	SEC	4	0	0	4	2
8	Extra Academic Activity 2*	VAC	2	0	0	2	1*
TOTAL			**29**	**17**	**0**	**12**	**22+1***

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

SEMESTER - III

S. No.	COURSE TITLE	COURSE CATEGORY	CONTACT PERIODS	L	T	P	C
1	Transforms and Random Processes	MS	3	2	1	0	3
2	Digital Signal Processing	MC	3	2	1	0	3
3	Medical Physics	MS	2	2	0	0	2
4	Physiological Sensors & Measurement	MC	2	2	0	0	2
5	Design Thinking, Innovation, and Entrepreneurship	SEC	4	2	0	2	3
6	Biomedical Instrumentation	MC	3	3	0	0	3
7	Interactive Engineering graphics	VAC	2	0	0	2	1
8	Digital Signal Processing Laboratory	SEC	2	0	0	2	1
9	Biomedical Instrumentation Laboratory	MC	4	0	0	4	2
10	Physiological Sensors & Measurement Laboratory	MC	4	0	0	4	2
TOTAL			**29**	**13**	**2**	**14**	**22**

SEMESTER - IV

S. No.	COURSE TITLE	COURSE CATEGORY	CONTACT PERIODS	L	T	P	C
1	Biomechanics	MC	3	3	0	0	3
2	Diagnostic and Therapeutic Equipment	MC	3	3	0	0	3
3	Medical Device Design and Regulatory Compliance	MS	2	2	0	0	2
4	Medical Imaging Techniques	MC	3	3	0	0	3
5	Biomaterials	MC	3	3	0	0	3
6	Biocontrol Systems	MC	3	3	0	0	3
7	Engineering Practices Lab	VAC	2	0	0	2	1
8	Biomechanics & Biomaterials Laboratory	SEC	2	0	0	2	1
9	Diagnostic and Therapeutic Technologies Laboratory	MC	4	0	0	4	2
TOTAL			**25**	**17**	**0**	**8**	**21**

SEMESTER - V

S. No.	COURSE TITLE	COURSE CATEGORY	CONTACT PERIODS	L	T	P	C
1	Medical Robotics	MC	4	2	0	2	3
2	Embedded Systems and Programming	MC	5	3	0	2	4
3	Medical Image Processing	MC	5	3	0	2	4
4	AI in Healthcare	MC	3	3	0	0	3
5	Object Oriented Programming and Java	MS	4	2	0	2	3
6	Biophotonics	MS	3	3	0	0	3
TOTAL			**24**	**16**	**0**	**8**	**20**

SEMESTER - VI

S. No.	COURSE TITLE	COURSE CATEGORY	CONTACT PERIODS	L	T	P	C
1	Wearable Devices and Computing	MC	3	3	0	0	3
2	Medical Data Analytics	MC	5	3	0	2	4
3	Brain Computer Interface	MC	5	3	0	2	4
4	Rehabilitation Engineering	MC	2	2	0	0	2
5	Program Minor 1	MS	3	3	0	0	3
6	Program Minor 2	MS	3	3	0	0	3
7	Capstone Project Phase 1	PD	8	0	0	8	4
TOTAL			**29**	**19**	**0**	**12**	**23**

SEMESTER - VII

S. No.	COURSE TITLE	COURSE CATEGORY	CONTACT PERIODS	L	T	P	C
1	Tissue Engineering	MC	5	3	0	2	4
2	Internet of Medical Things (IoMT)	MC	3	3	0	0	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	2	2	0	0	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			**34**	**16**	**0**	**18**	**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

S. 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 in the curriculum are broadly classified as per the recommendations from the UGC.

Sl. No	Broad Category of Course	Minimum Credit Requirement	Actual Credits
1	Major Core (MC)	80	80
2	Minor Stream (MS)	32	32
3	Multidisciplinary (MD)	09	11
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**	**162+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	-	7	3	2	4+1*	-	-	22+1*
2	11	-	4	3	2	2+1*	-	-	22+1*
3	12	5	-	-	4	1	-		22
4	17	2	-	-	1	1	-	-	21
5	14	6	-	-	-	-	-	-	20
6	13	6	-	-	-	-	-	4	23
7	7	8	-	2	-	-	2	6	25
8	-	5	-	-	-	-	-	2	7
Total	80	32	11	8	9	8+2*	2	12	**162+2***

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

MINOR STREAMS

The Department of Biomedical Engineering offers its students the following list of Minor Streams.

1. AI and Neurotechnology
2. Medical Robotics and Embedded Systems
3. Medical Technology (Foundation Minor)

Each Minor Stream has 7 courses worth 19 credits. The student must enroll in any one of the above Three 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- AI AND NEUROTECHNOLOGY

S. No.	COURSE TITLE	SEMESTER	CONTACT PERIODS	L	T	P	C
1	Deep Learning for Healthcare	6	3	3	0	0	3
2	Neural Signal and Image Processing	6	3	3	0	0	3
3	Computer Vision and Healthcare Applications	7	3	3	0	0	3
4	Neuro Prosthetics and Rehabilitation	7	3	3	0	0	3
5	MINOR STREAM BASKET 1	7	2	2	0	0	2
6	MINOR STREAM BASKET 2	8	2	2	0	0	2
7	MINOR STREAM BASKET 3	8	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 (2 Credit courses)	*Minor Stream Basket 2 (2 Credit courses)*	*Minor Stream Basket 3 (3 Credit courses)*
Bigdata Analytics in Healthcare	Affective Computing in Human-Computer Interface	AI Ethics and Safety
Generative AI in Healthcare	Neuroimaging	Predictive Analytics in Medicine
AI-driven Clinical Decision Support Systems	Neuro Modulation	Edge Computing in Healthcare
Explainable AI in Healthcare	Neuro Morphic Computing	Cloud Computing and Deployment in Healthcare
Cybersecurity in Healthcare	Theoretical and Computational Neuroscience	Sports Analytics and AI
		Neuro Marketing
		Medical Natural Language Processing
		Neuromodeling

MINOR STREAM 2 - MEDICAL ROBOTICS AND EMBEDDED SYSTEMS

S. No.	COURSE TITLE	SEMESTER	CONTACT PERIODS	L	T	P	C
1	Bio Mechatronics	6	3	3	0	0	3
2	Embedded Medical Devices and Delivery Systems	6	3	3	0	0	3
3	Human Robot Interaction	7	3	3	0	0	3
4	Embedded Bio-Photonics	7	3	3	0	0	3
5	MINOR STREAM BASKET 1	7	2	2	0	0	2
6	MINOR STREAM BASKET 2	8	2	2	0	0	2
7	MINOR STREAM BASKET 3	8	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 (2 Credit courses)	*Minor Stream Basket 2 (2 Credit courses)*	*Minor Stream Basket 3 (3 Credit courses)*
Wearable Robots	Micro And Smart Systems in Healthcare	Assistive Robotics
Extended Reality for Healthcare	Smart Sensors and Actuators for Healthcare	Digital Twins in Healthcare
Healthcare Autonomous Mobile Robots (HAMRs)	Wireless Communication in Healthcare	Biomimetic robotics and sensing
Haptics for Medical Applications	Implantable and Wearable VLSI Systems	Embedded Security
Robotic Vision and Surgical Systems	Edge AI for Healthcare	Point of Care Diagnostics
		Cloud Analytics for IoMT

MINOR STREAM 3 – MEDICAL TECHNOLOGY

S. No.	COURSE TITLE	SEMESTER	CONTACT PERIODS	L	T	P	C
1	Biomedical Instrumentation	6	3	3	0	0	3
2	Biosignal & Image processing	6	3	3	0	0	3
3	Intelligent Medical Robotics	7	3	3	0	0	3
4	Biostatistics	7	3	3	0	0	3
5	MINOR STREAM BASKET 1	7	2	2	0	0	2
6	MINOR STREAM BASKET 2	8	2	2	0	0	2
7	MINOR STREAM BASKET 3	8	3	3	0	0	3

The following is the tentative list of courses that may be offered under the ***Minor Stream Baskets to other departments.***

Minor Stream Basket 1 (2 Credit courses)	*Minor Stream Basket 2 (2 Credit courses)*	*Minor Stream Basket 3 (3 Credit courses)*
Medical Informatics	Hospital Management	Bio fabrication and 3D Printing
Diagnostic Imaging Systems	Medical Nano Technology	Artificial Organs & Implants
Medical Ethics & Regulatory Affairs	Stem Cell and Regenerative Medicine	Molecular biology
Digital Health and Telemedicine Systems	Biomaterials and Drug Delivery Systems	Genetic Engineering
Medical Optics	Digital Immersive Healthcare	Sports Biomechanics

Note: Students from B.Tech. Biomedical Engineering must not opt for this Minor Stream.

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 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. 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 are the micro-specialization verticals that will be offered by our department:

1. Robotics & Extended Reality (XR) in healthcare
2. Bioengineering & Wearable Systems

SYLLABUS

SEMESTER - I

Course code	Category	MATRICES AND CALCULUS	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.
4. To apply the Green's theorem, Divergence theorem and Stokes theorem in engineering problems

UNIT 1: MATRICES (12 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 (12 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 (12 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 (12 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 (12 HOURS)

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

TEXTBOOK:

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.

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 such as Green's, Gauss' and Stokes' theorems.	KL3
CO5	Evaluate partial derivatives, total derivatives, and Jacobians, and apply Taylor series and Lagrange's method to solve maxima, minima, and constrained optimization problems.	KL3

Course Code	Category	ELECTRIC CIRCUIT THEORY	L	T	P	C	Contact Hours
	MD		3	0	0	3	3
Course Level		*Prerequisite Courses: Nil*					

COURSE OBJECTIVES:

The objective of this course is to enable the student to

1. Introducing electric circuits and its analysis.
2. Impart knowledge on solving circuits using network theorems.
3. Analyze the phenomenon of resonance and coupled circuits.
4. Educate on obtaining the transient response of circuits.
5. Investigate two port network and state analysis

UNIT 1: INTRODUCTION TO CIRCUIT ANALYSIS (6 HOURS)

Ohm's Law – Kirchhoff's laws – Resistors in series and parallel circuits - Network reduction - voltage and current division - Mesh current and node voltage method of analysis for D.C and A.C. circuits - source transformation – star delta conversion.

UNIT 2: NETWORK THEOREMS FOR DC AND AC CIRCUITS (6 HOURS)

Network theorems -Superposition theorem, Thevenin's theorem, Norton's theorem, Reciprocity theorem, Maximum power transfer theorem and Application of Network theorems.

UNIT 3: RESONANCE AND COUPLED CIRCUITS (6 HOURS)

Resonance - Series resonance - Parallel resonance – Bandwidth - Q factor - Selectivity, Self-inductance - Mutual inductance - Dot rule, Coefficient of coupling - Series, Parallel connection of coupled inductors.

UNIT 4: TRANSIENT ANALYSIS (6 HOURS)

Natural response-Forced response - Transient response of RC, RL and RLC circuits to excitation by DC sources - Two port networks, Z parameters, Hybrid (H) Parameters, State space analysis.

UNIT 5: INTRODUCTION TO MACHINES (6 HOURS)

Construction and principle of operation of DC machines, DC generator, - Construction and working principle of single-phase transformer - Single-phase induction motor, Synchronous machine. Application of machines in Healthcare equipment.

TENTATIVE LIST OF EXPERIMENTS:

The following is an indicative list of experiments that complement the theory syllabus and help students achieve the course outcomes. The course instructor may design a curated list of exercises.

1. DC & AC Circuit Analyzer using Simulation.
2. Thevenin Equivalent Based Mobile Charger Model
3. Maximum Power Transfer in Audio Speaker Circuit

4. RLC Resonance Frequency Detector
5. ECG Signal Filter using Resonance Concept
6. State Space Modeling of RLC Circuit (MATLAB)
7. DC Motor Speed Control for Physiotherapy Device
8. DC Motor-Based Syringe Pump
9. Isolation Transformer for Patient Safety
10. Induction Motor-Based Nebulizer Air Pump Model

TEXTBOOKS

1. William H. Hayt Jr, Jack E. Kemmerly and Steven M. Durbin, Engineering Circuits Analysis, McGraw Hill Education, 9th Edition, 2013.
2. Sudhakar A., and Shyam Mohan S.P., Circuits and Network: Analysis and Synthesis, McGraw Hill Education, 5th edition, 2017.

COURSE OUTCOMES

	Course Outcomes	**Knowledge Level**
CO1	Analyze AC and DC circuits.	KL3
CO2	Analyze circuit theorems and apply them to various electrical circuit applications.	KL4
CO3	Summarize the concept of resonance and design different combinations of resonant circuits.	KL2
CO4	Design transient circuits for different types of excitations.	KL3
CO5	Calculate two-port network parameters and analyze their interconnections and symmetry.	KL4

Course	**Category**	**COMMUNICATIVE ENGLISH**	**L**	**T**	**P**	**C**	**Contact**

Code							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.

COURSE OUTCOMES

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

Course Code	Category	PHYSIOLOGY FOR ENGINEERS	L	T	P	C	Contact Hours
	MC		3	0	0	3	3
Course Level		*Prerequisite Courses: Nil*					

COURSE OBJECTIVES:

1. To understand the structural organization of the human body and mechanisms of homeostasis.
2. To explain the anatomy and physiology of digestive and excretory systems.
3. To describe the functional mechanisms of musculoskeletal and respiratory systems.
4. To comprehend cardiovascular dynamics and endocrine regulation.
5. To analyze neural organization and the physiology of special senses.

UNIT 1: THE BODY AND ITS STRUCTURAL ORGANIZATION (9 HOURS)

Cell: structure and function, Cell membrane and transport, Membrane physiology: ionic basis of membrane potential. Nernst equation, Goldman equation, Resting membrane potential. Action potential. Tissues: Epithelial, Connective, Muscle and Nervous tissues. Anatomical planes, positions, sections and body cavities, Homeostasis: feedback mechanisms and control systems.

UNIT 2: INTAKE, PROCESSING AND ELIMINATION (9 HOURS)

Digestive System: Organs of digestive system and their functions. Mastication and deglutition. Peristalsis and gastrointestinal motility, Digestion, absorption and assimilation, Excretory System: Structure of kidney, nephron and urinary bladder, Renal blood flow and glomerular filtration rate, mechanism of urine formation and regulation, micturition reflex.

UNIT 3: MOVEMENT AND RESPIRATION (9 HOURS)

Muscular System: Skeletal muscle and smooth muscle, structure and properties. Sliding filament theory. Excitation–contraction coupling. Skeletal System: Types of bones. Bone formation and remodeling. Types of cartilages and Joint., Respiratory System: parts of respiratory system, Lung mechanics, Lung volumes and capacities, Spirometry, Gas exchange and oxygen transport.

UNIT 4: CIRCULATORY DYNAMICS AND HORMONAL CONTROL (9 HOURS)

Cardiovascular System: Blood and its constituents, Vascular hemodynamics, Transport in capillaries. The heart-as a pump, Cardiac action potential, Cardiac cycle. Cardiac output and its regulation. Electrocardiogram (ECG). Endocrine glands and their hormones: pituitary, thyroid, and parathyroid, Feedback regulation of hormone secretion.

UNIT 5: NEURAL AND SENSORY PHYSIOLOGY (9 HOURS)

Nervous System: Organization and basic anatomy, Neurons and Synapses, Parts of Brain, Functional areas of cerebral cortex, Reflex mechanisms, Autonomic nervous system. Sense Organs: Eye –Sense of Vision, Refractive errors, Optic nerve pathway, Ear – Structure or ear,

mechanism of hearing, Sense of balance and equilibrium, Auditory and Vestibular pathways.

TEXTBOOKS:

1. Elaine.N. Marieb, Essential of Human Anatomy and Physiology, Pearson Education, Eight Edition, New Delhi, 2007.
2. Eldra Pearl Solomon, Introduction to Human Anatomy and Physiology, W.B. Saunders Company, 2015.
3. Pritha S Bhuiyan, Lakshmi Rajgopal, K Shyam Kishore, Inderbir Singh's Textbook of Human Neuroanatomy (Fundamental And Clinical), Jaypee Publishers, 2014.

COURSE OUTCOMES

	Course Outcomes	**Knowledge Level**
CO1	Explain cellular organization, membrane physiology, and homeostatic control.	KL2
CO2	Describe digestion, absorption, renal function, and elimination processes.	KL2
CO3	Interpret muscle contraction, bone physiology, and respiratory mechanisms.	KL3
CO4	Analyze cardiac function, vascular dynamics, and hormonal feedback regulation.	KL3
CO5	Explain neural integration, autonomic control, and special senses.	KL2

Course	**Category**	**PRINCIPLES OF ELECTRONIC**	**L**	**T**	**P**	**C**	**Contact**

Code		DEVICES AND CIRCUITS					Hours
	MC		3	0	0	3	3
Course Level		*Prerequisite Courses: Nil*					

COURSE OBJECTIVES:

1. Understand the basics of diodes and its application.
2. Familiarize with the structure, operation, and characteristics of BJTs, and with the design of BJT amplifiers.
3. Gain knowledge on the structure, operation, and characteristics of MOSFET and its application.
4. Learn the concept of feedback amplifiers and oscillators.
5. Familiarize with the concepts of tuned amplifiers and wave-shaping circuits.

UNIT 1: PN JUNCTION DEVICES (9 HOURS)

PN Junction diode - structure, operation and V-I characteristics, Quantitative analysis of PN Diode, Current equation — Transition and Diffusion Capacitances, Breakdown in PN Junction Diodes. Rectifiers — Half Wave, Full Wave and Bridge rectifiers, Filters. Zener diode and its characteristics - Zener diode voltage regulators.

UNIT 2: TRANSISTORS (9 HOURS)

BJT structure, operation — Types of configurations: CE, CB and CC — characteristics, Q-point, DC and AC load line, Biasing of transistors - fixed bias, voltage divider bias. BJT Small signal model — hybrid model— Analysis of CE amplifiers — Gain and frequency response, Differential amplifier using BJT.

UNIT 3: METAL OXIDE SEMICONDUCTOR FIELD EFFECT TRANSISTORS (9 HOURS)

Introduction to FET, MOSFET— Structure, operation, and characteristics — Types- Enhancement MOSFET, Depletion MOSFET, and Biasing of MOSFET - fixed bias, voltage divider bias, Differential amplifier using MOSFET.

UNIT 4: FEEDBACK AMPLIFIERS AND OSCILLATORS (9 HOURS)

Characteristics of negative feedback amplifiers — voltage / current - Series feedback- positive feedback amplifiers, Condition for oscillations, Types- Hartley, Colpitts, RC phase shift, Wien Bridge.

UNIT 5: TUNED AMPLIFIERS AND WAVE SHAPING CIRCUITS (9 HOURS)

Tuned amplifiers — L and LC Circuits, Single and multi-tuned Amplifiers, Wave shaping circuits - Diode clipper, Diode clamper and comparator, Multivibrators.

TEXTBOOKS:

1. Robert Boylestad and Louis Nashelsky, Electron Devices and Circuit Theory, Pearson Prentice Hall, 10th edition, July 2008.
2. Salivahanan, S., and Sureshkumar, N., Electronic Devices and Circuits, McGraw Hill, Fourth Edition, 2017.

COURSE OUTCOMES

	Course Outcomes	Knowledge Level
CO1	Summarize the working principle of PN junction diodes and their applications.	KL2
CO2	Configure BJT-based amplifiers using various biasing techniques.	KL3
CO3	Explain the construction, biasing, and applications of MOSFETs.	KL3
CO4	Design oscillators and negative feedback amplifiers for various applications.	KL3
CO5	Analyze the working and operation of tuned amplifiers and wave-shaping circuits.	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.

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	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:

1. To learn Python fundamentals and modularity in problem solving.
2. To learn data types in Python and file handling.
3. To learn numerical computations using NumPy.
4. To learn data manipulations using Pandas.
5. 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 (4 HOURS)

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

TENTATIVE LIST OF EXPERIMENTS:

The following is an indicative list of experiments that complement the theory syllabus and help students achieve the course outcomes. The course instructor may design a curated list of exercises.

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).

COURSE OUTCOMES

	Course Outcomes	Knowledge Level
CO1	Apply sequential, alternate, and iterative approaches for solving problems.	KL3
CO2	Solve problems using different data types 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	ELECTRONIC DEVICES AND CIRCUITS LABORATORY	L	T	P	C	Contact Hours

	SEC		0	0	4	2	4
Course Level		*Prerequisite Courses: Nil*					

COURSE OBJECTIVES:

The objective of this course is to enable the student to

1. Be familiar with Thevenin & Norton theorems, KVL & KCL, and Super Position Theorems.
2. Be exposed to RL and RC circuits.
3. Know series and parallel resonance circuits.
4. Learn the characteristics of basic electronic devices.
5. Understand the characteristics of Amplifiers.

Tentative List of Experiments:

Cycle I

1. Characteristics of PN Junction Diode
2. Characteristics of Zener diode
3. Basic amplifier circuit and design – CE, CC, CB (BJT)
4. Characteristics of FET
5. Characteristics of SCR
6. Clipper and Clamper
7. HWR and FWR

Cycle II

8. Verifications of KVL & KCL
9. Verifications of Thevenin & Norton theorem
10. Verifications of Superposition Theorem
11. Verifications of maximum power transfer & reciprocity theorem
12. Determination of Resonance Frequency of RLC Circuits
13. Transient analysis

MICRO PROJECT:

Micro project – Design a Bioamplifiers to amplifier and filter a biosignal, using a power supply switch (TRIAC and DIAC), a voltage regulator, amplifier, and filters.

COURSE OUTCOMES:

	Course Outcomes	Knowledge Level
CO1	Analyse the characteristics of basic electronic devices and amplifiers.	KL3
CO2	Verify Network theorems and design resonance and transient circuits.	KL3

SEMESTER - II

Course Code	Category	DIFFERENTIAL EQUATIONS AND	L	T	P	C	Contact Hours

	MC	**COMPLEX FUNCTIONS (Common to ECE, VLSI, BME, CIVIL, EEE, MECH, CHEM)**	**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 Lap lace 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.

COURSE OUTCOMES

	Course Outcomes	Knowledge Level
CO1	Solve second- and higher-order linear ordinary differential equations with constant coefficients, including simultaneous linear ODEs.	KL4
CO2	Obtain the Laplace transforms of standard functions.	KL4
CO3	Apply inverse Laplace transforms to solve differential equations.	KL3
CO4	Solve problems involving analytic functions and construct analytic functions using C-R equations.	KL3
CO5	Compute line integrals, residues, and real integrals using residue theorems.	KL3

Course Code	Category	TECHNICAL WRITING	L	T	P	C	Contact Hours

	AEC		2	0	2	3	4
Course Level		*Prerequisite Courses: Communicative English*					

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

COURSE OUTCOMES

	Course Outcomes	Knowledge Level
CO1	Write instructions, checklists, and emails with clarity and readability.	KL3
CO2	Compose paragraphs and structure argumentative essays 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	ENGINEERING PHYSICS (Common to CHEMICAL, CIVIL,	L	T	P	C	Contact Hours

	MD	BME MECHANICAL)	3	0	2	4	5
Course Level		*Prerequisite Courses: Nil*					

COURSE OBJECTIVES:

The objective of this course is to enable the student to

- Comprehend and identify different crystal structures and their imperfections.
- Develop an understanding of quantum mechanical phenomena and their applications.
- Explain physics of semiconductors.
- Provide an overview of the characteristics of sound, architectural acoustics and the production and applications of ultrasound.
- Understand the origin of laser action, production of laser, fibre optics and their applications.

UNIT 1: CRYSTAL PHYSICS (9 HOURS)

Single crystalline, polycrystalline (common metals/alloys) and amorphous materials– single crystals - Lattice – Unit cell – Bravais lattice – Lattice planes – Miller indices – d spacing in cubic lattice – Calculation of number of atoms per unit cell – Atomic radius – Coordination number – Packing factor for SC, BCC, FCC and HCP structures – Diamond and graphite structures (qualitative treatment) - Crystal Imperfections with Examples – Point, line (Edge and Screw dislocations –Burger vectors) Surface (stacking faults) and Volume defects-Crystals in scintillation detectors (CsI, LSO, BGO and NaI).

LABORATORY EXPERIMENT

1. Determination of the Young's modulus of the given metal/alloy.

UNIT 2: QUANTUM PHYSICS (9 HOURS)

Black body radiation – Planck's radiation law (Qualitative) – Deduction of Wien's displacement law and Rayleigh – Jeans' Law from Planck's theory – Compton Effect (Conceptual)– Photoelectric effect (conceptual)- Properties of Matter waves – wave particle duality - Schrödinger's wave equations – 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 – Applications-Scanning electron microscopy(SEM)-Transmission electron microscopy(TEM).

LABORATORY EXPERIMENT

2. Determination of the Planck's constant and the work function using photoelectric effect.

UNIT 3: 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.

LABORATORY EXPERIMENTS

3. Determination of the band gap of a semiconductor.

UNIT 4: ACOUSTICS AND ULTRASONICS (9 HOURS)

Acoustics: Classification and characteristics of Sound - decibel - Weber–Fechner law– Sabine's formula (conceptual) —factors affecting the acoustics of buildings and their remedies.

Ultrasonics: Production of ultrasonics by Magnetostriction and Piezoelectric methods – acoustic grating -Non-Destructive Testing – pulse echo system through transmission and reflection modes - A, B, C and M– scan displays- Phased Array Ultrasound and Time of Flight Diffraction techniques.

LABORATORY EXPERIMENTS

4. Determination of the velocity of sound in the given liquid and compressibility of the liquid using an Ultrasonic interferometer.

UNIT 5: LASERS AND FIBRE OPTICS (9 HOURS)

Lasers: Spontaneous and stimulated emission- Population inversion -Einstein's A and B coefficients –Conditions for Laser action - Types of lasers (Qualitative) – Nd: YAG, Basics of diode lasers-Industrial and Medical Applications.

Fiber optics: Principle and propagation of light in optical fibres – Numerical aperture and Acceptance angle - Types of optical fibres (material, refractive index, mode) – Fibre Optical Communication system (Block diagram) - Applications- Active and passive fiber sensors - pressure and temperature-fiber optic endoscopy.

LABORATORY EXPERIMENTS

5. Determination of the grating element/wavelength, and the particle size using a laser.
6. Determination of the numerical aperture and acceptance angle of the given optical fibre.

TEXTBOOKS:

1. Gaur, R.K., and Gupta, S.L., Engineering Physics, Dhanpat Rai Publishers, 2012.
2. S. Singaravadivelu and A. Chandrasekaran, Engineering Physics, Vedha Publications, Chennai, 2022.
3. Serway, R.A., & Jewett, J.W., Physics for Scientists and Engineers, Cengage Learning, 2010.
4. Shatendra Sharma and Jyotsna Sharma, "Engineering Physics", Pearson, 2006.

COURSE OUTCOMES

	Course Outcomes	Knowledge Level

CO1	Analyze crystal structures and the influence of imperfections on their properties.	K4
CO2	Comprehend the quantum mechanical principles to correlate with experimental results and their applications.	K2
CO3	Analyze the physics of semiconductors.	K4
CO4	Analyze the applications of acoustics and ultrasonics to engineering and medical disciplines.	K4
CO5	Elucidate the principle and working of lasers and optical fibers, and their applications in the field of industry, medicine and telecommunication	K2

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 I 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 II 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 III 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 IV 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 V 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.

TEXT 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 and social 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	ANALOG AND DIGITAL INTEGRATED CIRCUITS	L	T	P	C	Contact Hours
	MC		4	0	2	5	6
Course		*Prerequisite Courses: Nil*					

Level		

COURSE OBJECTIVES

1. Describe the basic building blocks and applications of operational amplifiers.
2. Design analog filters and waveform generators using Op-Amps.
3. Explore the working of special ICs such as 555 timers, DAC 0800, and ADC 0808.
4. Learn digital fundamentals and design combinational logic circuits.
5. Understand and design synchronous and asynchronous sequential logic circuits.
6. Develop skills to read datasheets and technical literature to design analog and digital systems using simulation and design tools.

UNIT 1: OPERATIONAL AMPLIFIER (9 Hours)

Ideal and Practical Op-Amp, Op-Amp Characteristics, DC and AC Characteristics, General purpose Op-Amp-Features of 741 Op-Amp, Low power Op-Amp, Linear applications - Inverting, Non-Inverting, summing, subtracting, averaging, Differential, Instrumentation Amplifier, AC Amplifier, Differentiators and Integrators, I-V converter, V-I converters, Nonlinear applications -Comparators, Schmitt Trigger, Precision rectifier.

UNIT 2: ACTIVE FILTERS AND WAVEFORM GENERATORS (9 Hours)

Introduction to Active Filters, Design of 1st and 2nd Order LPF, HPF, various types of Band pass, Band reject Filters, RC Phase shift Oscillator, Wein-bridge Oscillator, Waveform generators - Square, triangular and sawtooth.

UNIT 3: CONVERTERS AND TIMERS (9 Hours)

Basic DAC, Different types of DACs-Weighted resistor DAC, R-2R ladder DAC, Different Types of ADCs - Parallel Comparator Type ADC, Counter Type ADC, Successive Approximation ADC. Features and pin details of DAC / ADC ICs –DAC 0800 and ADC 0808. IC555 Timer - Functional Diagram, Monostable and Astable Operations

UNIT 4: DIGITAL INTEGRATED CIRCUITS (9 Hours)

Introduction to Number Systems, Complements, Binary Codes, and Boolean Theorems, Universal gates – NAND, NOR; Canonical forms – Sum of Products (SOP), Product of Sums (POS); Karnaugh map minimization; Principles of Logic Families- DTL,TTL, ECL,CMOS; Combinational circuits - Design of half and full adders, half and full subtractors, binary parallel adder (ripple carry); Multiplexer, demultiplexer, magnitude comparator; Encoder, decoder, priority encoder.

UNIT 5: SEQUENTIAL CIRCUITS (9 Hours)

Flip-flops – SR, JK, T, D, Master/Slave types; operation, excitation tables, and triggering methods (edge and level). – State minimization State assignment, Analysis and design of Synchronous and Asynchronous sequential circuits. Design of Counters- Ripple Counters, Ring Counters, Shift

registers -Universal Shift Register, Introduction to VLSI and modern digital IC trends.

Tentative List of Experiments:

The following is an indicative list of experiments that complement the theory syllabus and help students achieve the course outcomes. The course instructor may design a curated list of exercises.

1. Design and testing of linear applications of Op Amp- inverting and non-inverting amplifiers, differentiator, integrator, instrumentation amplifier for low level signal.
2. Design and testing of non-linear applications of Op Amp - comparator, schmitt trigger.
3. Second order Active filter design and verification.
4. Phase shift oscillator and Wein bridge Oscillator
5. Multivibrator using 555 timers.
6. Analog to Digital Converter and Digital to Analog Converter using appropriate IC.
7. Design and verification of combinational circuits
8. Study of Flip flops
9. Design and verification of synchronous and asynchronous counters
10. Design and verification of shift registers.

TEXTBOOKS:

1. Roy Choudhury D., Jain S.B., Linear Integrated Circuits, New Age International Pvt. Ltd., 2018, Fifth Edition.
2. Gayakwad R.A., Op-Amps and Linear Integrated Circuits, Pearson Education, 2000, Fourth Edition.
3. Mano M. Morris, Ciletti M.D., Digital Design, Pearson Education, 2017, Sixth Edition.

COURSE OUTCOMES

	Course Outcomes	Knowledge Level
CO1	Demonstrate an understanding of linear and non-linear applications of operational amplifiers.	KL3
CO2	Interpret the principles and design of active filters and waveform generators.	KL3
CO3	Describe and apply the functionality of ADCs, DACs, and 555 timers.	KL3
CO4	Illustrate digital logic fundamentals and design combinational logic circuits.	KL3
CO5	Analyze and implement synchronous and asynchronous sequential logic systems.	KL3

CO6	Design and simulate systems using analog and digital integrated circuits by effectively utilizing datasheets, design tools, and technical literature, while developing problem-solving skills through teamwork and independent learning.	KL4

Course Code	**Category**	**BIOCHEMISTRY AND MICROBIOLOGY**	**L**	**T**	**P**	**C**	**Contact Hours**
	MC		**3**	**0**	**0**	**3**	**3**
Course Level		*Prerequisite Courses: Nil*					

COURSE OBJECTIVES:

1. Understand the structure, properties and biological significance of biomolecules.
2. Explain major metabolic pathways and mechanisms of enzyme action and regulation.
3. Acquire knowledge of microbial morphology, growth characteristics
4. Understand the pathogenesis of infectious diseases and laboratory techniques.
5. Interpret biochemical and molecular basis of disorders and therapeutic interventions.

UNIT 1: STRUCTURE AND PROPERTIES OF BIOMOLECULES (9 HOURS)

Introduction to biochemistry and overview of biomolecules, Carbohydrates: Classification, structure and properties - mono, di, oligo and polysaccharides, Lipids: Classification – simple, compound and derived lipids, Fatty acid nomenclature and properties. Amino Acids and Proteins: Classification, structure and properties, Nucleic Acids: Purines and pyrimidines, nucleosides and nucleotides. Structure of DNA, Types and functions of RNA.

UNIT 2: METABOLISM AND ENZYMOLOGY (9 HOURS)

Carbohydrate metabolism –Glycolysis, TCA cycle, Electron transport chain. Lipid metabolism – β-oxidation and ketogenesis. Enzymes: classification, active site, specificity, mechanism of action. Enzyme regulation: feedback, allosteric, covalent and hormonal regulation. Clinical significance of enzymes in disease diagnosis

UNIT 3: GENERAL MICROBIOLOGY (9 HOURS)

Introduction to microbiology, Morphology and classification of bacteria, virus and fungi, Bacterial growth curve and factors affecting growth. Culture media: types and applications. Sterilization: physical and chemical methods. Culture techniques and observation of culture. Staining techniques: simple staining, Gram staining, AFB staining, capsule and spore staining.

UNIT 4: INFECTIOUS DISEASES AND DIAGNOSTIC MICROBIOLOGY (9 HOURS)

Pathogenesis of common bacterial, viral and fungal diseases, Diagnostic Techniques- Testing for antibiotic sensitivity in bacteria, Determination of resistance/sensitivity of bacteria using disc diffusion method, Determination of minimal inhibitory concentration (MIC) of an antibiotic by serial dilution method, Serological and Molecular Methods in diagnosis.

UNIT 5: DISEASE PATHOGENESIS AND THERAPEUTIC INTERVENTIONS (9 HOURS)

Basic concepts of diseases: etiology and pathogenesis, cellular adaptation, cell injury and cell death (necrosis and apoptosis). Biochemical and molecular basis of disorders: Diabetes mellitus, anemia, renal function disorders and cancer. Therapeutic Interventions: Principles of chemotherapy, vaccination and immunoprophylaxis. Introduction to personalized medicine and biomarker-guided therapy.

TEXTBOOKS:

1. RAFI MD "Textbook of biochemistry for Medical Student" Fourth Edition, Universities Press, Orient Blackswan Private Limited - New Delhi 2021.
2. U Satyanarayana, "Biochemistry", 6th edition, Elsevier Health Sciences, 2021.

3. Ananthanarayanan & Panicker, “Textbook of Microbiology” Universities press, 2024 13th edition.

COURSE OUTCOMES

	Course Outcomes	Knowledge Level
CO1	Describe the structure, classification, and functional significance of biomolecules.	KL2
CO2	Illustrate metabolic pathways and enzyme regulation mechanisms.	KL2
CO3	Identify microorganisms and describe laboratory methods used for their study.	KL3
CO4	Apply diagnostic techniques for infectious disease identification.	KL3
CO5	Analyze disease pathogenesis and explain therapeutic strategies.	KL2

Course Code	Category	BIOSCIENCE AND PHYSIOLOGY LABORATORY	L	T	P	C	Contact Hours
	SEC		0	0	4	2	4
Course Level		*Prerequisite Courses: Nil*					

COURSE OBJECTIVES:

1. Perform qualitative and quantitative biochemical analyses.
2. Analyze physiological and hematological parameters.

TENTATIVE LIST OF EXPERIMENTS:

1. Qualitative tests for carbohydrates and amino acids.
2. Preparation of serum and plasma from blood.
3. Estimation of cholesterol.
4. Estimation of blood glucose.
5. Estimation of hemoglobin.
6. Determination of total RBC count using the Neubauer chamber.
7. Determination of bleeding time and clotting time.
8. Blood grouping and Rh typing.
9. Study of parts and calibration of compound microscopes.
10. Gram staining technique.
11. Motility test – Hanging drop method.

TEXTBOOK:

1. Ramnik Sood, Textbook of Medical Laboratory Technology, 6thEdition, Jaypee Brothers Medical Publishers, 2.

COURSE OUTCOMES:

	Course Outcomes	**Knowledge Level**
CO1	Perform biochemical qualitative and quantitative estimations.	KL2
CO2	Analyze hematological and physiological parameters.	KL3
CO3	Demonstrate microbiological staining and motility testing techniques.	KL3