

RAJALAKSHMI ENGINEERING COLLEGE
(An AUTONOMOUS Institution and Affiliated to Anna University, Chennai)

DEPARTMENT OF BIOMEDICAL ENGINEERING

B.E BIOMEDICAL ENGINEERING

REGULATIONS 2023

CHOICE BASED CREDIT SYSTEM (CBCS)

CURRICULUM AND SYLLABUS

DEPARTMENT VISION

To create a center of academic excellence in the field of Biomedical engineering through innovative research contributions and industrial oriented teaching and training for betterment in healthcare.

DEPARTMENT MISSION

- To motivate faculty members and students to explore their creativity to develop innovative products by utilizing modern technologies to serve the society
- To inculcate the industrial need of the biomedical engineers among the students through relevant training and value added courses.
- To produce technically intense engineers by practicing innovative teaching methodologies

PROGRAMME EDUCATIONAL OBJECTIVES (PEO)

PEO I: To provide students with sound foundation in the mathematical, scientific and engineering fundamentals necessary to formulate, analyze and solve engineering problems and to prepare them for graduate studies and for successful careers in healthcare sector.

PEO II: To impart students with skills for research, design and development of biomedical devices and allied integrated systems for betterment of human society

PEO III: To instill the ethical values, skills, leadership and team spirit for comprehensive and wholesome personality, to promote entrepreneurial interest among students and to create fervour for use of Engineering in addressing societal concerns.

PROGRAMME OUTCOMES (PO)

Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate

consideration for the public health and safety, and the cultural, societal, and environmental considerations.

Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSO)

PSO 1: An ability to apply advanced technology for measurement and interpretation of data acquired from biological system addressing the problems associated with the interaction between living and non-living materials and systems

PSO 2: An ability to use software tools, mathematics, science and engineering for precise diagnosis and therapeutic applications

PSO 3: An ability to develop healthcare information system for automation and remote access

CREDIT DISTRIBUTION**R-2023**

CATEGORY	CREDITS AS PER SEMESTER								CREDITS TOTAL
	I	II	III	IV	V	VI	VII	VIII	
Humanities and Social sciences (HS)	2	1							3
Basic Sciences (BS)	9	9	4	4					26
Engineering Sciences (ES)	5	14		4	2				25
Professional Core (PC)			20	11	15	12	4		62
Professional Elective (PE)					3	6	9		18
Open Elective (OE)				3	3				6
Project, Seminar & Internship (EEC)				1	1	4	7	8	21
TOTAL	16	24	24	23	24	22	20	8	161

CURRICULUM**Semester I**

SL. No	Course code	Category	Course Title	L	T	P	Contact Periods	Credits
Theory Courses								
1	HS23111	HS	Technical Communication I	2	0	0	2	2
2	MA23111	BS	Linear Algebra and Calculus	3	1	0	4	4
3	GE23111	ES	Engineering Graphics	2	0	4	6	4
4	GE23117	BS	Heritage of Tamils/தமிழர் மரபு	1	0	0	1	1
5	MC23112	HS	Environmental Science and Engineering	3	0	0	3	0
Lab Integrated Theory Course								
6	CY23131	BS	Chemistry For Electronics Engineering	3	0	2	5	4
Laboratory Course								
7	GE23121	ES	Engineering Practice Laboratory - Civil and Mechanical	0	0	2	2	1
				14	1	8	23	
TOTAL CREDITS								16

Semester II

SL. No	Course code	Category	Course Title	L	T	P	Contact Periods	Credits
Theory Courses								
1	MA23212	BS	Differential Equations and Complex Variables	3	1	0	4	4
2	ME23211	ES	Engineering Mechanics for Biomedical Engineers	3	1	0	4	4
3	GE23217	BS	Tamils Technology/ தமிழரும் தொழில் நுட்பமும்	1	0	0	1	1
Lab Integrated Theory Courses								
4	CS23232	ES	Fundamentals of Data Structures using C	3	0	4	7	5
5	PH23231	BS	Physics for Bioscience	3	0	2	5	4
6	BM23231	ES	Electric Circuits and Machines	3	0	2	5	4

Laboratory Courses								
7	HS23221/ HS23222	HS	Technical Communication II/ English for professional competence	0	0	2	2	1
8	GE23122	ES	Engineering Practice Laboratory- Electrical and Electronics	0	0	2	2	1
				16	2	12	30	
TOTAL CREDITS								24

Semester III

SL. No	Course code	Category	Course Title	L	T	P	Contact Periods	Credits
Theory Courses								
1	MA23312	BS	Fourier series and Number theory	3	1	0	4	4
2	BM23311	PC	Human Anatomy and Physiology	3	0	0	3	3
3	BM23312	PC	Biomedical Instrumentation	3	0	0	3	3
4	BM23313	PC	Biochemical Science	3	0	0	3	3
Lab Integrated Theory Courses								
5	BM23331	PC	Electronic Devices & Circuits	3	0	2	5	4
6	BM23332	PC	Sensors and Measurements	2	0	2	4	3
Laboratory Courses								
7	BM23321	PC	Biochemistry and Physiology Laboratory	0	0	4	4	2
8	BM23322	PC	Biomedical Instrumentation Laboratory	0	0	4	4	2
				17	1	12	30	
TOTAL CREDITS								24

Semester IV

SL. No	Course code	Category	Course Title	L	T	P	Contact Periods	Credits
Theory Courses								
1	BM23411	PC	Analog and Digital Integrated Circuits	3	0	0	3	3
2	BM23412	PC	Communication Systems and Standards	3	0	0	3	3
3	MC23111	HS	Indian Constitution and Freedom Movement	3	0	0	0	0

4		OE	OE 1	3	0	0	3	3
Lab Integrated Theory Courses								
5	MA23436	BS	Probability and Random Process	3	0	2	4	4
6	BM23431	PC	Pathology and Microbiology	2	0	2	4	3
7	CS23336	ES	Introduction to Python Programming	1	0	4	5	3
Laboratory Courses								
8	BM23421	PC	Analog and Digital Integrated Circuits Laboratory	0	0	4	4	2
9	BM23422	ES	PCB Design Laboratory	0	0	2	2	1
10	GE23421	EEC	Soft Skills-I	0	0	2	2	1
				18	0	16	30	
				TOTAL CREDITS				23

Semester V

SL. No	Course code	Category	Course Title	L	T	P	Contact Periods	Credits
Theory Courses								
1	BM23511	PC	Biocontrol systems	3	0	0	3	3
2	BM23512	PC	Diagnostic and Therapeutic Equipment	3	0	0	3	3
3		OE	OE 2	3	0	0	3	3
4		PE	PE 1	3	0	0	3	3
Lab Integrated Theory Courses								
4	BM23531	PC	Signals and Systems Analysis	1	1	2	4	3
5	BM23532	PC	Microcontroller and Embedded System Design	3	0	2	5	4
6	CS23422	ES	Python Programming for Machine learning	0	0	4	4	2
Laboratory Courses								
7	BM23521	PC	Diagnostic and Therapeutic Equipment Laboratory	0	0	4	4	2
8	GE23521	EEC	Soft Skills –II	0	0	2	2	1
				16	1	14	31	
				TOTAL CREDITS				24

Semester VI

SL. No	Course code	Category	Course Title	L	T	P	Contact Periods	Credits
Theory Courses								
1	BM23611	PC	Radiological Equipment	3	0	0	3	3
2	BM23612	PC	Biomechanics	3	1	0	4	4
3		PE	PE 2	3	0	0	3	3
4		PE	PE 3	3	0	0	3	3
Lab Integrated Theory Courses								
5	BM23631	PC	Biosignal Processing	1	1	2	4	3
6	BM23632	PC	Physiological Modeling Laboratory	1	0	2	3	2
7	BM23633	EEC	Design thinking for Innovation in Biomedical Engineering	1	0	2	3	2
Laboratory Courses								
8	BM23621	EEC	Medical Industrial Training	0	0	2	2	1
9	GE23621	EEC	Problem solving techniques	0	0	2	2	1
				15	2	10	27	
TOTAL CREDITS								22

Semester VII

SL. No	Course code	Category	Course Title	L	T	P	Contact Periods	Credits
Theory Courses								
1	BM23711	EEC	Comprehension In Biomedical Engineering	1	0	0	1	1
2		PE	PE 4	3	0	0	3	3
3		PE	PE 5	3	0	0	3	3
4		PE	PE 6	3	0	0	3	3
Lab Integrated Theory Courses								
5	BM23731	PC	Medical Image Processing	2	1	2	5	4
Laboratory Courses								
6	BM23721	EEC	Artificial Intelligence and Machine learning for Biomedical Engineering	0	0	4	4	2

7	BM23722	EEC	Project Phase-I	0	0	6	6	3
8	BM23723	EEC	Hospital Training	0	0	2	2	1
				12	1	14	27	
TOTAL CREDITS								20

Semester VIII

SL. No	Course code	Category	Course Title	L	T	P	Contact Periods	Credits
Laboratory Course								
1	BM23821	EEC	Project Phase-II	0	0	16	16	8
				0	0	16	16	
TOTAL CREDITS								8

TOTAL CREDITS: 161

PROFESSIONAL ELECTIVES

MEDICAL INSTRUMENTATION								
SLNo	Course code	Course Title	Category	Contact Periods	L	T	P	C
1	BM23A11	MEDICAL OPTICS	PE	3	3	0	0	3
2	BM23A12	BIOMEMS	PE	3	3	0	0	3
3	BM23A13	SURGICAL OPTICAL DEVICES	PE	3	3	0	0	3
4	BM23A14	INTERNET OF THINGS IN MEDICINE	PE	3	3	0	0	3
5	BM23A15	BIOSENSORS	PE	3	3	0	0	3
6	BM23A16	VLSI DESIGN	PE	3	3	0	0	3
BIO-ENGINEERING								
1	BM23B11	NEURAL ENGINEERING	PE	3	3	0	0	3
2	BM23B12	TISSUE ENGINEERING	PE	3	3	0	0	3
3	BM23B13	TRANSPORTATION IN LIVING SYSTEMS	PE	3	3	0	0	3
4	BM23B14	BIOMATERIALS AND APPLICATIONS	PE	3	3	0	0	3
5	BM23B15	MEDICAL CODING	PE	3	3	0	0	3
8	BM23B16	NANOTECHNOLOGY AND APPLICATIONS	PE	3	3	0	0	3
7	GE23B15	MEDICAL PHYSICS	PE	3	3	0	0	3
MEDICAL IMAGING MODALITIES								
1	BM23C11	PATTERN RECOGNITION & NEURAL NETWORKS	PE	3	3	0	0	3
2	BM23C12	BIOMETRIC SYSTEMS	PE	3	3	0	0	3
3	BM23C13	SOFT COMPUTING TECHNIQUES	PE	3	3	0	0	3
4	BM23C14	DEEP LEARNING AND DEPLOYMENT OF AI MODELS	PE	3	3	0	0	3
5	BM23C15	APPLICATIONS OF EXTENDED REALITIES IN HEALTHCARE	PE	3	3	0	0	3
6	BM23C16	MEDICAL INFORMATICS	PE	3	3	0	0	3

ASSISTIVE TECHNOLOGY								
1	BM23D11	MEDICAL TEXTILES FUNDAMENTALS	PE	3	3	0	0	3
2	BM23D12	MEDICAL ROBOTICS	PE	3	3	0	0	3
3	BM23D13	ASSIST DEVICES	PE	3	3	0	0	3
4	BM23D14	REHABILITATION ENGINEERING	PE	3	3	0	0	3
5	BM23D15	WEARABLE SYSTEMS	PE	2	2	0	0	2
6	BM23D16	TELEHEALTH TECHNOLOGY	PE	1	1	0	0	1
MODELLING& SIMULATION								
1	BM23E11	3D PRINTING IN MEDICAL APPLICATIONS	PE	3	3	0	0	3
2	BM23E12	PHYSIOLOGICAL MODELLING	PE	3	3	0	0	3
3	BM23E13	BIOFLUID DYNAMICS	PE	3	3	0	0	3
4	BM23E14	MICRO FLUIDICS	PE	3	3	0	0	3
5	BM23E15	BIOSTATISTICS	PE	3	3	0	0	3
6	BM23E16	VIRTUAL BIOINSTRUMENTATION	PE	3	3	0	0	3
PRODUCT DEVELOPMENT AND MANAGEMENT								
1	BM23F11	MEDICAL ETHICS & STANDARDS	PE	3	3	0	0	3
2	BM23F12	HOSPITAL ENGINEERING & MANAGEMENT	PE	3	3	0	0	3
3	BM23F13	HEALTH CARE PRODUCT DEVELOPMENT	PE	2	2	0	0	2
4	BM23F14	ENTREPRENEURSHIP in BIOMEDICAL ENGINEERING	PE	1	1	0	0	1
5	BM23F15	MEDICAL SAFETY, QUALITY ASSURANCE AND REGULATORY AFFAIRS	PE	3	3	0	0	3
6	BM23F16	INDUSTRIAL SAFETY & MANAGEMENT	PE	3	3	0	0	3
7	BM23F17	ECONOMICS FOR ENGINEERS	PE	3	3	0	0	3

SEMESTER I

HS 23111	TECHNICAL COMMUNICATION I Common to all branches of B.E/B. Tech programme	Category HS	L 2	T 0	P 0	C 2
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OBJECTIVES

- To facilitate students develop their comprehension skills
- To enable students to improve their receptive skills
- To equip learners with better vocabulary and enhance their writing skills
- To aid students speak effectively in all kinds of communicative contexts.
- To improve the learners' basic proficiency in workplace communication

UNIT-I DEVELOPING COMPREHENSION SKILLS 6

Listening: Introduction to Informational listening – Listening to Podcasts, News

Reading: Intentional Reading - Short Narratives and Passages.

Speaking: Introducing Oneself, Narrating a Story / Incident.

Writing: Sequential Writing – connecting ideas using transitional words (Jumbled Sentences), Process Description

Grammar: Verbs – Main & Auxiliary: Simple Tenses – Form, Function and Meaning.

Vocabulary: Word formation – Prefix, Suffix, Compound Words.

UNIT-II LISTENING AND EXTENDED READING 6

Listening: Deep Listening – Listening to Talk Shows and Debates

Reading: In-depth Reading - Scanning Passages

Speaking: Describing Current Issues, Happenings, etc.,

Writing: Note Making, Note Taking – Paragraph Writing

Grammar: Continuous Tenses, Prepositions, Articles

Vocabulary: One Word Substitutes, Phrasal Verbs.

UNIT-III FORMAL WRITING AND VERBAL ABILITY 6

Listening: Listening to Lectures and Taking Notes

Reading: Interpretation of Tables, Charts and Graphs

Speaking: SWOT Analysis on Oneself

Writing: Formal Letter Writing and Email Writing

Grammar: Perfect Tenses, Phrases and Clauses, Discourse Markers

Vocabulary : Verbal Analogy / Cloze Exercise

UNIT-IV ENHANCING SPEAKING ABILITY 6

Listening: Listening to eminent voices of one's interest (Martin Luther King, APJ Abdul Kalam, etc.)

Reading: Timed Reading, Filling KWL Chart.

Speaking: Just a Minute, Impromptu

Writing: Check-list, Instructions.

Grammar: 'Wh' Questions / 'Yes' or 'No' Questions, Imperatives

Vocabulary: Synonyms, Antonyms, Different forms of the same words.

UNIT-V LANGUAGE FOR WORKPLACE

6

Listening: Extensive Listening (Audio books, rendering of poems, etc.)**Reading:** Extensive reading (Jigsaw Reading, Short Stories, Novels)**Speaking:** Short Presentations on Technical Topics**Writing:** Recommendations, Essay Writing**Grammar:** Impersonal Passive, Reported Speech, Concord**Vocabulary :** Informal Vocabulary and Formal Substitutes**Contact Hours: 30****COURSE OUTCOMES****On completion of the course, students will be able to**

- apply their comprehension skills and interpret different contents effortlessly
- read and comprehend various texts and audio visual contents
- infer data from graphs and charts and communicate it efficiently in varied contexts
- participate effectively in diverse speaking situations
- to present, discuss and coordinate with their peers in workplace using their language skills

TEXT BOOK(S):

1. Effective Technical Communication by M. Ashraf Rizvi (Author) 2nd Edition Paperback 2017
2. Sylvan Barnet and Hugo Bedau, 'Critical Thinking Reading and Writing', Bedford/st. Martin's: Fifth Edition (June 28, 2004)
3. MeenakshiUpadhyay, Arun Sharma – Verbal Ability and Reading Comprehension.
4. Teaching Speaking: A Holistic Approach, Book by Anne Burns and Christine ChuenMengGoh, Cambridge University Press

REFERENCE BOOKS(S) / WEB LINKS:

1. Basic Vocabulary in Use: 60 Units of Vocabulary Practice in North American English With Answers 2nd Edition by Michael McCarthy (Author), Felicity O'Dell (Author), John D. Bunting (Contributor)
2. Reading Development and Difficulties By Kate Cain
3. The 7 Habits of Highly Effective People by Stephen Covey, Simon and Schuster, UK
4. Everybody Writes: Your Go-To Guide to Creating Ridiculously Good Content Hardcover by Ann Handley.

CO/ PO	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO2	PSO 3
CO 1	-	-	-	1	-	-	-	-	-	3	-	-	-	-	-
CO 2	-	-	-	1	-	-	-	-	-	3	-	-	-	-	-
CO 3	-	1	-	1	-	-	-	-	-	3	-	-	-	-	-
CO 4	-	-	-	2	-	-	-	-	1	3	-	-	-	-	-
CO 5	-	-	-	1	-	-	-	-	1	3	-	-	-	-	-
AVG.	-	1	-	1.2	-	-	-	-	1	3	-	-	-	-	-

MA23111	LINEAR ALGEBRA AND CALCULUS	Category	L	T	P	C
	Common to I sem. B.E. - CSE, EEE, ECE, BME and B.Tech. IT.	BS	3	1	0	4

OBJECTIVES

- To introduce the matrix techniques and to explain the nature of the matrix.
- To collect the matrix algebra techniques and the concepts of basis and dimension in vector spaces.
- To construct normalization of vectors and ortho-normal vectors.
- To understand techniques of calculus which are applied in the Engineering problems.
- To apply the techniques of Integration in finding area and volumes.

UNIT-I MATRICES**12**

Matrices - Eigenvalues and eigenvectors - Diagonalization of matrices using orthogonal transformation - Cayley-Hamilton Theorem(without proof) - Quadratic forms - Reduction to canonical form using orthogonal transformation - Numerical computation of Eigen value using Power method.

UNIT-II LINEAR TRANSFORMATION**12**

Vector spaces – Subspaces – Linear combinations and system of Linear equations – Linear independence and Linear dependence – Bases and Dimensions – Linear Transformation – Matrix representation of Linear Transformation - Null space, Range space and dimension theorem (without proof).

UNIT-III INNER PRODUCT SPACES**12**

Inner product and norms - Gram Schmidt orthonormalization process - QR Factorization - Singular value decomposition.

UNIT-IV FUNCTIONS OF SEVERAL VARIABLES**12**

Partial differentiation–Total derivative–Change of variables–Jacobians–Partial differentiation of implicit functions– Taylor’s series for functions of two variables–Maxima and minima of functions of two variables–Lagrange’s method of undetermined multipliers.

UNIT-V MULTIPLE INTEGRALS**12**

Double integrals–Change of order of integration–Area enclosed by plane curves–Triple integrals–Volume of solids– Numerical computation of double integrals-trapezoidal rule.

Total Contact Hours: 60**COURSE OUTCOMES**

On completion of the course, students will be able to

- Demonstrate the matrix techniques in solving the related problems in engineering and technology.
- Apply the concepts of basis and dimension in vector spaces to the solution of related complex engineering problems.

- Construct orthonormal basis by the concepts of normalization in inner products and to analyse complex engineering problems.
- Interpret the problems in Engineering and Technology using the principles of mathematical calculus.
- Evaluate multiple integrals to conduct investigations of complex problems.

TEXT BOOK(S):

1. Grewal B.S., "Higher Engineering Mathematics ", Khanna Publishers, New Delhi, 43rd Edition, 2014.
2. T Veerarajan, Linear Algebra and Partial Differential Equations, McGraw Hill Education, 2019.
3. Friedberg, A.H., Insel, A.J. and Spence, L., Elementary Linear Algebra, a matrix approach, 2nd edition Pearson, 2014.

REFERENCE BOOKS(S) / WEB LINKS:

1. Ramana. B.V., "Higher Engineering Mathematics ", McGraw Hill Education Pvt. Ltd, New Delhi, 2018.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley and Sons, 10th Edition, New Delhi, 2016.

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	2	1	-	-	-	-	-	-	-	1	-	1	1	-
CO 2	3	3	-	-	-	-	-	-	-	-	-	-	1	-	-
CO 3	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	2	2	-	-	-	-	-	-	-	-	1	1	-	-	-
CO 5	2	2	-	-	-	-	-	-	-	-	-	1	1	1	-
AVG.	2.6	2.2	1	-	-	-	-	-	-	-	1	1	1	1	-

GE23111**ENGINEERING GRAPHICS****Category****L T P C****ES****2 0 4 4****OBJECTIVES:**

- To understand the importance of the drawing in engineering applications
- To develop graphic skills for communication of concepts, ideas and design of engineering products
- To expose them to existing national standards related to technical drawings.
- To improve their visualization skills so that they can apply this skill in developing new products.
- To improve their technical communication skill in the form of communicative drawings

CONCEPTS AND CONVENTIONS (Not for Examination) 1

Importance of graphics in engineering applications–Use of drafting instruments– BIS conventions and specifications–Size, layout and folding of drawing sheets– Lettering and dimensioning. Basic Geometrical constructions.

UNIT-I PLANE CURVES AND PROJECTION OF POINTS 5+12

Curves used in engineering practices: Conics–Construction of ellipse, parabola and hyperbola by eccentricity method – Cycloidal Curves–Construction of cycloid, epicycloid and hypocycloid – Construction of involutes of square and circle–Drawing of tangents and normal to the above curves, Principles of Projection and Projection of points.

UNIT-II PROJECTION OF LINES AND PLANE SURFACES 6+12

Projection of straight lines (First angle projection) inclined to both the principal planes – Determination of true lengths and true inclinations by rotating line method

Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.

UNIT-III PROJECTION OF SOLIDS AND PROJECTION OF SECTIONED SOLIDS 6+12

Projection of simple solids like prisms, pyramids, cylinder and cone when the axis is inclined to one of the principal planes by rotating object method.

Sectioning of solids in simple vertical position when the cutting plane is inclined to HP and perpendicular to VP – obtaining true shape of the section.

Practicing three-dimensional modeling of simple objects by CAD software (Not for examination)

UNIT-IV DEVELOPMENT OF SURFACE AND ISOMETRIC PROJECTIONS 6+12

Development of lateral surfaces of simple and sectioned solids – Prisms, pyramids cylinders and cones.

Principles of isometric projection–isometric scale–Isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders and cones

Model making of isometric projection of combination of solids as assignment (Not for End semester).

UNIT-V FREE HAND SKETCHING AND PERSPECTIVE PROJECTIONS 6+12

Free Hand sketching: Freehand sketching of multiple views from pictorial views of objects - Freehand sketching of pictorial views of object from multiple views

Perspective projection of simple solids-Prisms, pyramids, cylinder and cone by visual ray method.

Total Contact Hours: (L=30; P=60) 90 Periods

COURSE OUTCOMES:

On completion of the course, students will be able

- To construct different plane curves and to comprehend the theory of projection.
- To draw the basic views related to projection of lines and planes.
- To draw the projection of simple solids and to draw the projection of development of surfaces of Sectioned solids in simple vertical position.
- To draw the orthographic projection from pictorial objects and Isometric projections of simple solids
- To visualize Perspective view of simple solids

TEXTBOOK(S):

1. Bhatt N.D. and PanchalV.M., "Engineering Drawing", Charotar Publishing House, 50th Edition, 2010.
2. NatarajanK.V., "A textbook of Engineering Graphics", Dhanalakshmi Publishers, Chennai, 2017.

REFERENCE BOOKS(S) / WEB LINKS::

1. Varghese P I., "Engineering Graphics", McGraw Hill Education (I) Pvt.Ltd. 2013.
2. V.B.Sikka "Civil Engineering Drawing", S.K Kataria& Sons, New Delhi.
3. Venugopal K. and PrabhuRaja V., "Engineering Graphics", New Age International (P) Limited, 2008.
4. Gopalakrishna K.R., "Engineering Drawing" (Vol. I&II combined), Subhas Stores, Bangalore, 2017.
5. Basant Agarwal and Agarwal C.M., "Engineering Drawing", McGraw Hill Publishing Company Limited, New Delhi, 2018.

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	2	2	1	-	1	-	2	2	2	-	2	-	-	-
CO 2	3	2	2	1	-	1	-	2	2	2	-	2	-	-	-
CO 3	3	2	2	1	-	1	-	2	2	2	-	2	-	-	-
CO 4	3	2	2	1	-	1	-	2	2	2	-	2	-	-	-
CO 5	3	2	2	1	-	1	-	2	2	2	-	2	-	-	-
AVG.	3	2	2	1	-	1	-	2	2	2	-	2	-	-	-

MC23112	ENVIRONMENTAL SCIENCE AND ENGINEERING	Category	L	T	P	C
	Common to all branches of B.E./B.Tech. courses (Except B.Tech-CSBS)	HS	3	0	0	0

OBJECTIVES:

- To develop the understanding of environmental and associated issues
- To develop an attitude of concern for the environment
- To promote enthusiasm in participating environmental protection initiatives
- To nurture skills to solve environmental degradation issues.

UNIT I AIR AND NOISE POLLUTION 9

Definition –sources of air pollution –chemical and photochemical reactions in the atmosphere - formation of smog, PAN, acid rain, ozone depletion, particulate pollutants-Air quality standards-Air quality indices - control of particulate air pollutants-gravitational settling chambers, cyclone separators, wet collectors, fabric filters (Bag-house filter), electrostatic precipitators (ESP)-catalytic converters.

Noise pollution –sources - health effects - standards- measurement and control methods.

UNIT II WATER POLLUTION AND ITS MANAGEMENT 9

Definition-causes-effects of water pollution-point and nonpoint sources of wastewater-marine pollution - thermal pollution - Control of water pollution by physical, chemical and biological methods – wastewater treatment-primary, secondary and tertiary treatment-sources and Characteristics of industrial effluents- zero liquid discharge.

UNIT III SOLID WASTE AND HAZARDOUS WASTE MANAGEMENT 9

Solid waste – types- municipal solid waste management: sources, characteristics, collection, and transportation- sanitary landfill, recycling, composting, incineration, energy recovery options from waste - Hazardous waste – types, characteristics, and health impact - hazardous waste management: neutralization, oxidation reduction, precipitation, solidification, stabilization, incineration and final disposal.

E-waste-definition-sources-effects on human health and environment- E-waste management-steps involved - Role of E-waste management within the initiatives of the Govt. of India-Swachh Bharat Mission.

UNIT IV SUSTAINABLE DEVELOPMENT 9

Sustainable development- concept-dimensions-sustainable development goals - value education- gender equality – food security - poverty – hunger - famine - Twelve principles of green chemistry - Green technology - definition, importance - Cleaner development mechanism - carbon credits, carbon trading, carbon sequestration, eco labeling-International conventions and protocols-Disaster management.

UNIT V ENVIRONMENTAL MANAGEMENT AND LEGISLATION 9

Environmental Management systems - ISO 14000 series- Environmental audit-Environmental Impact Assessment- life cycle assessment- human health risk assessment - Environmental Laws and Policy- Objectives - Polluter pays principle, Precautionary principle - The Environment (Protection) Act 1986 - Role of Information technology in environment and human health.

Contact Hours: 45**COURSE OUTCOMES:**

On completion of the course, the students should be able to:

- associate air and noise quality standards with environment and human health.
- illustrate the significance of water and devise control measures for water pollution.
- analyze solid wastes and hazardous wastes.
- outline the goals of sustainable development in an integrated perspective.
- comprehend the significance of environmental laws.

TEXT BOOK(S):

1. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, 2016.
2. AnubhaKaushik and C. P. Kaushik's "Perspectives in Environmental Studies", 6th Edition, New Age International Publishers, 2018.
3. Johri R., E-waste: implications, regulations, and management in India and current global best practices, TERI Press, New Delhi

REFERENCE BOOKS(S) / WEB LINKS:

1. R.K. Trivedi, 'Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards', Vol. I and II, Enviro Media. 38. Edition 2010.
2. Cunningham, W.P. Cooper, T.H. Gorhani, 'Environmental Encyclopedia', Jaico Publ., House, Mumbai, 2001.
3. Fowler B, Electronic Waste – 1 st Edition (Toxicology and Public Health Issues), 2017Elsevier

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	1	2	3	1	-	2	2	2	1	1	1	2	-	2	-
CO 2	1	2	3	1	-	2	2	2	1	1	1	2	-	2	-
CO 3	-	-	3	1	-	2	3	2	1	-	1	2	-	2	-
CO 4	-	1	2	1	1	3	3	2	1	1	1	2	-	2	-
CO 5	-	1	2	-	-	2	2	2	1	2	2	2	-	2	-
AVG.	0.4	1.2	2.6	0.8	0.2	2.2	2.4	2	1	1	1.2	2	-	2	-

CY23131	CHEMISTRY FOR ELECTRONICS ENGINEERING	Category	L	T	P	C
	Common to B.E. - ECE, BME, EEE, MCT and R&A	BS	3	0	2	4

OBJECTIVES

- To understand the principles of electrochemical processes
- To explore the functioning of sensors and their applications in industries and health care
- To get familiarized with the functioning batteries of and fuel cells
- To acquire knowledge on polymeric materials used in electronics
- To develop proficiency in nanomaterials

UNIT-I DYNAMIC ELECTROCHEMISTRY 9

Applied Electrochemistry: Electrode Potential - EMF series - Corrosion- Causes, Consequences and Prevention. Surface Preparation- electro polishing -Electroplating of copper, electrophoretic deposition - Electrochemical machining, electrochemical etching - electrochemical etching of Cu from PCB.

UNIT-II ELECTROCHEMICAL SENSORS 9

Electrodes - reference electrodes - ion-selective electrode, determination of electrode potential - Galvanic and concentration cells - potentiometric, amperometric and conductometric methods of analysis - potentiometric sensor, optical sensor, thermal sensor, chemical biosignals - sensors for health care – glucose and urea sensors, gas sensors for CO₂, O₂ and NH₃ sensing- blood oxygen sensor.

UNIT-III ELECTROCHEMICAL ENERGY SYSTEMS 9

Batteries- types - characteristics-fabrication and working of lead-acid battery- NICAD battery – Nickel metal hydride batteries -lithium-ion battery – Super capacitors- introduction - types - electrochemical double layer capacitor - activated carbon - carbon aerogels. Fuel cells - classification – principle, working and applications of hydrogen-oxygen fuel cell - solid oxide fuel cell - direct methanol fuel cell and proton exchange membrane fuel cells-biofuel cells.

UNIT-IV POLYMERS IN ELECTRONICS 9

Conducting polymers - conducting mechanisms- polyaniline, Poly pyrrole - photonic polymers - photo resists - Introduction, Liquid crystalline phases, Identification of the mesophases, Lyotropic main chain liquid crystalline polymers, Thermotropic main chain liquid crystal polymers, Applications of liquid Crystals in Displays (LCDs) - Organic LEDs- functioning-advantages and disadvantages over conventional LEDs- commercial uses.

UNIT-V NANO MATERIALS 9

Introduction-Types of nanomaterials-Emergence and challenges in nanotechnology-Synthesis routes for nanomaterials: Bottom-up and top-down approaches- Sol-gel, precipitation, Hydrothermal, Solvothermal, Microwave irradiation, Chemical Vapour Deposition (CVD), Electro deposition- Properties of nanomaterials- Mechanical properties, Chemical, Optical, Electrical and Magnetic properties-applications of nanomaterials.

Total Contact Hours:45

LIST OF THE EXPERIMENTS

1. Construction and determination of EMF of simple electrochemical cells and concentration cells
2. Estimation of acids by pH metry
3. Determination of corrosion rate on mild steel by weight loss method
4. Estimation of mixture of acids by conductometry
5. Estimation of extent of corrosion of iron pieces by potentiometry
6. Estimation of copper / ferrous ions by spectrophotometry
7. Estimation of DO by using sensors
8. Estimation of concentration of ions in the given sample solution.
9. Determination of molecular weight of a polymer by viscometry method
10. Synthesis of nanomaterials by simple precipitation method

Total Contact Hours: 30

COURSE OUTCOMES:

On completion of the course, the students should be able to:

- Apply the knowledge of electrochemistry in exploring electrochemical processes.
- Associate the knowledge of sensors in health care and in pollution abatement.
- Recognize the types of batteries and fuel cells.
- Employ advanced materials in industrial applications and display techniques.
- Develop nano and biomaterials for medical applications.

TEXT BOOK(S):

1. P. C. Jain and Monika Jain, "Engineering Chemistry", DhanpatRai Publishing Company (P) Ltd, New Delhi, 2015.
2. O.G.Palanna, "Engineering Chemistry", McGraw Hill Education (India) Pvt, Ltd, New Delhi, 2017.
3. Shikha Agarwal "Engineering Chemistry-Fundamentals and applications", Cambridge University Press, New Delhi, 2015

REFERENCE BOOKS(S) / WEB LINKS:

1. Gowarikar V. R., Viswanathan N.V. and Jayadev Sreedhar, —Polymer Science, New Age International (P) Ltd., New Delhi, 2011.
2. Sujata V Bhat, "Biomaterials", Narosa Publishing House, New Delhi, 2002
3. Pradeep T, "A Text Book of Nanoscience and Nanotechnology", Tata McGraw Hill, New Delhi, 2012.
4. An Introduction To Nanomaterials And Nanoscience (PB 2020) : Asim K DAS, Mahua Das, CBS publishers and distributors Pvt. Ltd.

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	2	2	1	-	-	-	-	-	-	-	-	1	-	-	-
CO 2	3	2	1	-	-	1	1	-	-	-	-	1	1	1	1
CO 3	2	1	1	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	2	1	1	-	-	-	-	-	-	-	-	1	-	-	-
CO 5	3	2	2	-	-	-	-	-	-	-	-	1	-	-	-
AVG.	2.4	1.6	1.2	-	-	1	1	-	-	-	-	1	1	1	1

GE23121

**ENGINEERING PRACTICE LABORATORY-
CIVIL AND MECHANICAL**

Category L T P C

ES 0 0 2 1

OBJECTIVES

To provide exposure to the students with hands on experience on various basic engineering practices in Civil and Mechanical Engineering.

List of Experiments**CIVIL ENGINEERING PRACTICE**

1. Study of pipeline joints, its location and functions: valves, taps, couplings, unions, reducers, and elbows in household fittings.
2. Preparation of basic plumbing line sketches for wash basins, water heaters, etc.
3. Hands-on-exercise: Basic pipe connections – Pipe connections with different joining components.

Carpentry Works:

4. Study of joints in roofs, doors, windows and furniture.
5. Hands-on-exercise: Woodwork, joints by sawing, planning and chiselling.

MECHANICAL ENGINEERING PRACTICE

6. Preparation of butt joints, lap joints and T- joints by Shielded metal arc welding.
7. Gas welding practice.

Basic Machining:

8. Simple Turning and Taper turning
9. Drilling Practice

Sheet Metal Work:

10. Forming & Bending:
11. Model making – Trays and funnels
12. Different type of joints.

Machine Assembly Practice:

13. Study of centrifugal pump
14. Study of air conditioner

Total Contact Hours : 30

COURSE OUTCOMES

On completion of the course, the students should be

- Able to perform plumbing activities for residential and industrial buildings considering safety aspects while gaining clear understanding on pipeline location and functions of joints like valves, taps, couplings, unions, reducers, elbows, etc.
- Able to perform wood working carpentry activities like sawing, planning, cutting, etc. while having clear understanding of the joints in roofs, doors, windows and furniture.
- Able to produce joints like L joint, T joint, Lap joint, Butt joint, etc. through arc welding process while acquiring in depth knowledge in the principle of operation of welding and other accessories
- Able to perform operations like Turning, Step turning, Taper turning, etc. in lathe and Drilling operation in drilling machine

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	1	-	-	-	-	1	-	-	-	-	-	1	-	1	1
CO 2	1	-	-	-	-	1	-	-	-	-	-	1	-	1	1
CO 3	1	-	-	-	-	1	-	-	-	-	-	1	-	1	1
CO 4	1	-	-	-	-	1	-	-	-	-	-	1	-	1	1
CO 5	1	-	-	-	-	1	-	-	-	-	-	1	-	1	1
AVG.	1	-	-	-	-	1	-	-	-	-	-	1	-	1	1

SEMESTER II

MA23212	DIFFERENTIAL EQUATIONS AND COMPLEX VARIABLES	Category	L	T	P	C
	Common to II Sem. B.E. –AERO, AUTO, BME, CIVIL, EEE, ECE, MECH, MCT, R&A and B. Tech. - BT, FT &CHEM	BS	3	1	0	4

OBJECTIVES

- To provide students with an introduction to the theory of ordinary differential equations through applications, methods of solution, and numerical approximations.
- To introduce students to how to solve linear Partial Differential with different methods.
- To enable the students to study the Laplace Transforms, properties of Laplace Transform, inverse Laplace Transform and some applications to solve the differential equations and integral equations.
- To explain the concept of a vector integration in a plane and in space.
- To describe basic properties of complex variables and to have the ability to compute complex integrals.

UNIT-I ORDINARY DIFFERENTIAL EQUATIONS 12

Second and higher order Linear differential equations with constant coefficients - Method of variation of parameters – Legendre’s linear equations – Numerical solution of ODE - Single Step methods: Taylor’s series method, Euler’s method.

UNIT-II PARTIAL DIFFERENTIAL EQUATIONS 12

Formation of partial differential equations - Classification of PDE – Solutions of standard types of first order partial differential equations - Lagrange’s linear equation –Linear homogeneous partial differential equations of second and higher order with constant coefficients.

UNIT-III LAPLACE TRANSFORM 12

Laplace transform –Basic properties – Transforms of derivatives and integrals of functions - Transforms of unit step function and impulse functions, periodic functions. Inverse Laplace transform – Problems using Convolution theorem – Solution of linear ODE of second order with constant coefficients using Laplace transformation techniques.

UNIT-IV VECTOR CALCULUS 12

Gradient, divergence and curl – Directional derivative – Irrotational and Solenoidal vector fields – Vector integration – Green’s theorem in a plane, Gauss divergence theorem and Stokes’ theorem (excluding proofs) – Simple applications involving cubes and rectangular parallelopipeds.

UNIT-V COMPLEX VARIABLES 12

Analytic functions — Construction of analytic function - Bilinear transformation –Singularities – Cauchy’s integral theorem (without proof) - Residues – Residue theorem (without proof) - Simple problems - Contour integral over $|z|=1$.

Total Contact Hours: 60

COURSE OUTCOMES

On completion of the course, students will be able to

- Apply the methods as a potent tool in the solution of a variety of problems in the natural sciences and technology.
- Develop specific methodologies, techniques and resources in Partial differential equations to conduct research and produce innovative results in the area of specialization.
- Use Laplace transform and inverse transform techniques to solve the complex problems in engineering and technology.
- Apply the concepts in multivariable analysis, including space curves; directional derivative; gradient; multiple integrals; line and surface integrals; vector fields; divergence, curl; the theorems of Green and Stokes, and the divergence theorem in different fields of engineering.
- Demonstrate the concept of Analytic functions, conformal mapping and complex integration in solving Engineering problems.

TEXT BOOK(S):

1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 43rd Edition, 2014.
2. Veerarajan. T, Engineering Mathematics –II, McGraw Hill Education, 2018.
3. Erwin Kreyszig, "Advanced Engineering Mathematics ", John Wiley and Sons, 10th Edition, New Delhi, 2016.
4. Glyn James, "Advanced Modern Engineering Mathematics", Pearson Education, 4th Edition, New Delhi, 2011.
5. Jain R.K. and Iyengar S.R.K., "Advanced Engineering Mathematics", Narosa Publications, 5 th Edition, New Delhi, 2017.

REFERENCE BOOKS(S) / WEB LINKS:

1. Ramana. B.V., "Higher Engineering Mathematics ", McGraw Hill Education Pvt. Ltd, New Delhi, 2016.
2. T Veerarajan, Transforms and Partial Differential Equations, Third Edition, 2018.
3. Bali, N.P. and Manish Goyal, A Text Book of Engineering Mathematics, Lakshmi Publications Pvt. Ltd., New Delhi, 4th Edition 2006.
4. Peter V.O'Neil, "Advanced Engineering Mathematics", Cengage Learning India Pvt, Ltd, 7th Edition, New Delhi, 2012.

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	2	1	-	-	-	-	-	-	-	-	1	1	1	-
CO 2	3	2	1	-	-	-	-	-	-	-	-	1	1	-	-
CO 3	3	2	1	-	-	-	-	-	-	-	-	-	1	-	-
CO 4	2	2	1	-	-	-	-	-	-	-	-	-	1	-	-

CO 5	3	2	1	-	-	-	-	-	-	-	-	1	1	-	-
AVG.	2.8	2	1	-	-	-	-	-	-	-	-	1	1	1	-

ME23211	ENGINEERING MECHANICS FOR BIOMEDICAL ENGINEERS	Category	L	T	P	C
		ES	3	1	0	4

OBJECTIVES:

- To be exposed to the fundamental principles of mechanics
- To learn effect of force on bodies
- To learn basics of fluid mechanics and relate it to bio-fluids
- To understand the action of friction and motion

UNIT I BASICS AND STATICS OF PARTICLES 12

Introduction – Units and Dimensions – Laws of Mechanics – Lami's theorem, Parallelogram and triangular Law of forces — Vectorial representation of forces – Vector operations of forces - additions, subtraction, dot product, cross product – Coplanar Forces – rectangular components – Equilibrium of a particle – Forces in space – Equilibrium of a particle in space. Equivalent systems of forces – Principle of transmissibility.

UNIT II EQUILIBRIUM OF RIGID BODIES 12

Free body diagram – Types of supports – Action and reaction forces – stable equilibrium – Moments and Couples – Moment of a force about a point and about an axis – Vectorial representation of moments and couples – Scalar components of a moment – Varignon's theorem – Single equivalent force - Equilibrium of Rigid bodies in two and three dimensions.

UNIT III DYNAMICS OF PARTICLES 12

Displacements, Velocity and acceleration, their relationship – Relative motion – Newton's laws of motion – Work Energy Equation– Friction force – Laws of sliding friction – equilibrium analysis of simple systems with sliding friction.

UNIT IV MECHANICS OF SOLIDS 12

Rigid bodies and deformable solids – Tension, Compression and Shear Stresses – Deformation of rigid and non-rigid bodies - Centroids and centre of mass- Centroids of lines and areas - Rectangular, circular, triangular areas by integration – Principal moments of inertia of plane areas – Principal axes of inertia - Mass moment of inertia – mass moment of inertia for prismatic, cylindrical and spherical solids from first principle.

UNIT V BASICS OF MECHANICS OF FLUIDS 12

Fluids – density – pressure – blood pressure and gravity – buoyancy – moments of force and stability – movement in water – Newton's laws of viscosity – Definitions and simple problems on Newtonian fluid, Non-Newtonian fluid, Euler equations and Navier Stoke's equations, Viscoelasticity, laminar flow, Couette flow, turbulent flow and Hagen-Poiseuille equation.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

On Completion of the course, students will be able to

- Use scalar and vector analytical techniques for analyzing forces in statically determinate structures
- Analyse the impact of force on bodies/structure
- Solve rigid body subjected to dynamic forces
- Apply fundamental concepts of kinematics and kinetics of particles to the analysis of simple practical problems
- Analyse fluid flow under different pressure and volume (hemodynamic conditions)

TEXT BOOK(S):

1. Beer, F.P and Johnston Jr. E.R., “Vector Mechanics for Engineers (In SI Units): Statics and Dynamics”, 8th Edition, Tata McGraw-Hill Publishing company, New Delhi (2004).
2. Dr. R. K. Bansal, A Text Book of Fluid Mechanics, Laxmi Publications (P) Ltd., New Delhi.

REFERENCE BOOKS(S) / WEB LINKS:

1. Hibbeler, R.C and Ashok Gupta, “Engineering Mechanics: Statics and Dynamics”, 11th Edition, Pearson Education 2010.
2. Vela Murali, “Engineering Mechanics”, Oxford University Press (2010).
3. Lee Waite, “Biofluid Mechanics in Cardiovascular Systems”, The McGraw-Hill Companies, 2006.

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	3	1	1	-	-	-	-	2	1	3	1	-	1	-
CO 2	3	3	1	1	-	-	-	-	2	1	3	1	-	1	-
CO 3	3	3	1	1	-	-	-	-	2	1	3	1	-	1	-
CO 4	3	3	1	1	-	-	-	-	1	1	3	1	-	1	-
CO 5	2	2	1	1	-	-	-	-	1	1	3	1	-	1	-
AVG.	2.8	2.8	1	1	-	-	-	-	1.6	1	3	1	-	1	-

CS 23232 FUNDAMENTALS OF DATA STRUCTURES USING C **Category** **L T P C**
ES **3 0 4 5**

OBJECTIVES

- To learn the features of C
- To learn about functions, pointers and structures
- To explore the applications of linear data structures list

- To explore the applications of linear data structures stack and queue
- To learn the basic sorting and searching algorithms and about hashing

UNIT-I PROGRAMMING BASICS 10

Structure of a C program – Constants, Variables – Data Types – Expressions using operators in C – Managing Input and Output operations – Decision Making and Branching – Looping statements. Arrays – Initialization – Declaration – One dimensional and Two dimensional arrays. Strings - String operations

UNIT-II FUNCTIONS, POINTERS AND STRUCTURES 9

Functions – Pass by value – Pass by reference – Recursion – Pointers - Definition – Initialization – Structures and unions -definition – Structure within a structure - Programs using structures.

UNIT-III LINEAR DATA STRUCTURES – LIST 9

Abstract Data Types (ADTs) – List ADT – array-based implementation – linked list implementation — singly linked lists—applications of lists –Polynomial Manipulation – All operation (Insertion, Deletion, Merge, Traversal)

UNIT-IV LINEAR DATA STRUCTURES – STACKS, QUEUES 8

Stack ADT – Evaluating arithmetic expressions- Balancing Symbols- Queue ADT – circular queue implementation –applications of queues.

UNIT-V SORTING, SEARCHING AND HASH TECHNIQUES 9

Sorting algorithms: Insertion sort – Selection sort – Bubble sort – Quick sort – Merge sort – Searching: Linear search – Binary Search Hashing: Hash Functions – Separate Chaining – Open Addressing – Rehashing

Contact Hours : 45

LIST OF EXPERIMENTS

- 1 Programs using I/O statements and expressions.
- 2 Programs using decision-making statements
- 3 Programs using Arrays and Strings
- 4 Programs using Functions
- 5 Programs using Structures
- 6 Linked list implementation of List
- 7 Array implementation of Stack and Queue ADTs
- 8 Linked list implementation of Stack and Queue ADTs
- 9 Applications of List, Stack and Queue ADTs
- 10 Implementation of Searching and Sorting algorithms
- 11 Hashing –Linear probing

Contact Hours : 60

Total Contact Hours : 105

COURSE OUTCOMES:

On Completion of the course, students will be able to:

- Formulate simple algorithms and programs using branching and looping.
- Use arrays, pointers and structures to formulate algorithms and programs.
- Implement linear data structure operations using C.
- Suggest appropriate linear data structures for any given data set.
- Appropriately choose the sorting and searching algorithm for an application and apply hashing concepts for a given problem.

TEXT BOOKS(S):

1. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Pearson Education India, Second Edition, 2015.
2. Mark Allen Weiss, — Data Structures and Algorithm Analysis in C, Second Edition, Pearson Education, 2002.

REFERENCE BOOKS(S) / WEB LINKS:

1. Ellis Horowitz, Sartaj Sahni, Susan Anderson-Freed, —Fundamentals of Data Structures in C, Second Edition, University Press, 2008.
2. Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, —Data Structures and Algorithms, Pearson Education, 2009.
3. Reema Thareja, Data Structures Using C, Second Edition, Oxford University Press, 2014.
4. Robert Kruse, C.L.Tondo, Bruce Leung, Shashi Mogalla , — Data Structures and Program Design in C, Second Edition, Pearson Education, 2007.
5. Ellis Horowitz, Sartaj Sahni and Susan Anderson Freed, Fundamentals of Data Structures in C, 2nd Edition, University Press, 2008.
6. Herbert Schildt, C: The Complete Reference, Fourth Edition, McGraw Hill, 2017.

WebLink(s):

- 1 https://www.tutorialspoint.com/compile_c_online.php
- 2 <https://www.codechef.com/ide>
- 3 <https://www.jdoodle.com/c-online-compiler>
- 4 https://rextester.com/l/c_online_compiler_gcc
- 5 <http://vlabs.iitb.ac.in/vlab/labscse.html>
- 6 <https://www.hackerrank.com/>
- 7 <https://www.geeksforgeeks.org/>
- 8 <https://leetcode.com/>

PLATFORM NEEDED:

Hardware: PC with 2 GB RAM, i3 Processor Software: C compiler for Windows/Linux.

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	1	2	2	2	1	-	-	-	1	2	1	1	2	3	-
CO 2	2	2	3	2	1	-	-	-	1	-	2	1	2	2	2

CO 3	1	2	1	2	1	-	-	-	-	-	-	1	1	2	-
CO 4	1	1	2	1	1	-	-	-	-	-	-	2	2	2	-
CO 5	1	1	2	1	1	-	-	-	-	-	-	1	1	2	-
AVG.	1.2	1.6	2.0	1.6	1.0	-	-	-	1	2	1.5	1.2	1.6	2.2	2

PH23231

PHYSICS FOR BIOSCIENCE

Category L T P C

BS 3 0 2 4

OBJECTIVES:

- To enhance the fundamental knowledge of oscillations, Ultrasonic wave properties and its applications.
- To strengthen the basic information of semiconducting materials, characteristic and its applications.
- To study the behaviour of superconducting materials and optical fibres for medical applications.
- To understand the properties of nuclear radiation and elementary particles.
- To study the advanced analytical techniques.

UNIT-I WAVES AND ULTRASONICS

9

Oscillatory motion – forced and damped oscillations: differential equation and its solution – plane progressive waves – wave equation – Fundamentals of sound– generation of ultrasound – magnetostriction and piezo-electric method – properties - acoustical grating- velocity of Ultrasonics- Non-destructive Testing – pulse echo system through transmission and reflection modes - A,B and C – scan displays.

UNIT-II PHYSICS OF SEMICONDUCTORS

9

Fundamentals of semiconductors–Intrinsic semiconductor– carrier concentration in an intrinsic semiconductor – variation of Fermi level with temperature – band gap determination-Extrinsic semiconductor- carrier concentration of N-type and P-type–variation of Fermi level with temperature and impurity concentration –Hall effect – Determination of Hall coefficient – Formation of PN junction -LED and Solar cells.

UNIT-III MATERIALS FOR MEDICAL APPLICATIONS

9

Introduction to Superconductivity - Properties of Superconductors - BCS theory (qualitative) – Type-I and Type II Superconductors - Applications-Cryotron-Josephson devices- SQUID-MRI scan and Magnetic Levitation. Magnetism in materials - magnetic field and magnetic induction –permeability - susceptibility–types of magnetic materials – Dia, Para, Ferro, anti-ferro and ferrites-hysteresis. Fiber optics –Total internal reflection, Numerical aperture and acceptance angle - types of fibers-Temperature and displacement sensors- endoscopy.

UNIT-IV NUCLEAR AND PARTICLE PHYSICS

9

Radioactivity - characteristics of radioactive material – isotopes - probing by isotopes, reactions involved in the preparation of radioisotopes, the Szilard-Chalmer's reaction – radiochemical principles in the use of tracers - nuclear medicines – Interaction of charged particles with matter –Specific ionization, Linear energy transfer, range, Bremsstrahlung, Annihilation. Gamma-Ray Spectrometry- Liquid Scintillation Counters-Characteristics of Counting Systems-Gamma Well Counters.

UNIT-V ADVANCED ANALYTICAL TECHNIQUES**9**

Theory, Instrumentation and Applications of: Thermogravimetric Analysis - Differential Thermal Analysis - Differential Scanning Calorimetry. Surface analysis – Electron microscope-magnification-resolving power- Scanning electron microscope, Atomic force microscope - Transmission electron microscope,–Principle, instrumentation and applications

Contact Hours : 45**List of Experiments**

1. Determination of Velocity of ultrasound and compressibility of given liquid – Ultrasonic interferometer.
2. Determination of wavelength of diode laser and angular divergence.
3. Determination of Band gap of given semiconducting material.
4. Determination of Hall coefficient of the given semiconducting material.
5. Determination of solar cell characteristics.
6. Determine the energy loss of material by using B-H curve set up.
7. Determination of free space permeability using Helmholtz coil.
8. Determination of Numerical aperture and angle of acceptance of the optical fiber cable.
9. Spectrometer – Wavelength of Hg spectrum by diffraction grating.
10. Spectrometer –Determine refractive index of a prism.

Contact Hours : 30**Total Contact Hours : 75****COURSE OUTCOMES:**

On completion of the course, the students will be able to

- apply the knowledge of oscillating particles and generation of waves in real time applications.
- comprehend the principles of semiconductors and their device fabrication.
- make use the properties of superconductors and optical fibre in engineering and technology.
- apply the characteristics of nuclear and elementary particles to develop innovative instruments.
- utilize the concepts of advanced analytical techniques.

TEXT BOOK(S):

1. Kasap, S.O. "Principles of Electronic Materials and Devices", McGraw-Hill Education, 2017.
2. Umesh K Mishra & Jasprit Singh, "Semiconductor Device Physics and Design", Springer, 2014.
3. Wahab, M.A. "Solid State Physics: Structure and Properties of Materials". Narosa Publishing House, 2009.
4. B.H Brown, R.H.Smallwood, D.CBarber .P.V Lawford Medical physics and Biomedical Engineering, CRC Press 1998.

REFERENCE BOOK(S) / WEB LINKS:

1. S. O. Pillai, Solid state Physics (Multi colour Edition), New Age International Publisher, 2018.
2. Arthur Besier and S. RaiChoudhury, Concepts of Modern Physics (SIE), 7th Edition, 2017.
3. B.L.Theraja, Modern Physics, 16th edition, S.Chand, 2018.
4. J.B.Rajam, Atomic Physics, 7th edition, S.Chand, 2010.

5. Charles Kittel, Introduction to Solid State Physics, 8th Edition, Willey India Pvt.Ltd, 2012.
6. Garcia, N. & Damask, A. "Physics for Computer Science Students". Springer-Verlag, 2012.

BM23231	ELECTRIC CIRCUITS AND MACHINES	Category	L	T	P	C
		ES	3	0	2	4

OBJECTIVES

- To provide knowledge on solving circuits using network theorems
- To impart knowledge on obtaining the transient response of RC, RL and RLC circuits
- To impart knowledge in types, construction and working of transformers
- To impart knowledge in types, construction and working of DC machines
- To impart knowledge in types, construction and working of AC rotating machines

UNIT I DC AND AC (ONLY SINUSOIDAL) CIRCUITS 9

Ohm's Law – Kirchhoff's laws – Resistors in series and parallel circuits – Mesh current and node voltage method of analysis, Network reduction using circuit theorems- Thevenin's and Norton's Theorem – Superposition Theorem

UNIT II RESONANCE AND TRANSIENT RESPONSE IN DC CIRCUITS 9

Series and parallel resonance –frequency response – Quality factor and Bandwidth, Transient response of RL, RC and RLC Circuits using Laplace transform for AC input

UNIT III TRANSFORMER 9

Introduction - Ideal and Practical Transformer – Phasor diagram-- Per Unit System – Equivalent circuit- Testing- Efficiency and Voltage Regulation– Three Phase Transformers –Applications- Auto Transformers, Advantages- Harmonics.

UNIT IV DC MACHINES 9

Introduction – Constructional Features– Motor and Generator mode - EMF and Torque equation – Circuit Model – Methods of Excitation- Characteristics – Starting and Speed Control – Universal Motor- Stepper Motors – Brushless DC Motors- Applications

UNIT V AC ROTATING MACHINES 9

Principle of operation of three-phase induction motors – Construction –Types – Equivalent circuit, Speed Control - Single phase Induction motors -Construction– Types–starting methods. Alternator: Working principle–Equation of induced EMF – Voltage regulation, Synchronous motors- working principle-starting methods – Torque equation.

LAB EXPERIMENTS: 30 Hours

1. Verification of KVL and KCL
2. Verification of super position theorem
3. Verification of Theven's theorem
4. Verification of Norton's theorem

5. RC and RL transients
6. Series and parallel resonance
7. Load test on DC shunt motor.
8. Speed control of DC shunt motor.
9. No load and load test on single-phase transformer
10. Implementation of motor (0.5 Nm) control using optical technique
11. Design and development of 15V, 2A regulated power supply

TOTAL: 75 PERIODS

COURSE OUTCOMES:

On Completion of the course students will be able to

- Realise the working of DC and AC circuits
- Analyse the transient response of DC and AC Circuits
- Explain the working principle of electrical machines
- Analyze the output characterizes of electrical machines
- Choose the appropriate electrical machines for various applications

TEXT BOOK(S):

1. William H. Hayt Jr, Jack E. Kemmerly and Steven M. Durbin, "Engineering Circuits Analysis", Tata McGraw Hill publishers, 6th edition, New Delhi, 2003.
2. Dr. D P Kothari, Prof I J Nagrath "Basic Electrical Engineering", 3rd Edition, Tata McGraw-Hill, 2009.

REFERENCE BOOKS(S) / WEB LINKS::

1. Sudhakar A and Shyam Mohan SP, "Circuits and Network Analysis and Synthesis", Tata McGraw Hill, 2007.
2. Chakrabati A, "Circuits Theory (Analysis and synthesis), Dhanpat Rai & Sons, New Delhi, 1999.
3. Theraja B.L, Theraja.A.K. "A Textbook of Electrical Technology: Vol 2 AC and DC Machines, S.Chand Publication, 2012
4. K.Venkataratnam, — Special Electrical MachinesII, Universities Press (India) Private Limited, 2008.

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1		1	1	-	-	-	-	-	-	-	-	-	1	-	-
CO 2	3	2	1	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	3	1	2	-	-	-	-	-	-	-	-	-	1	1	-
CO 4	3	1	1	-	-	-	-	-	-	-	-	-	-	-	-
CO 5	3	1	2	-	1	-	-	-	-	-	-	-	1	1	-
AVG.	3	1.6	1.4	-	0.2	-	-	-	-	-	-	-	0.6	0.4	-

HS23221	TECHNICAL COMMUNICATION II Common to all branches of B.E/B.Tech programmes	Category HS	L 0	T 0	P 2	C 1
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OBJECTIVES

- To facilitate students to improve their vocabulary for a better communication
- To enable learners to understand and reproduce language
- To aid students to write technical reports in a convincing manner
- To expose students to different sentence structures

UNIT I VOCABULARY FOR BETTER COMMUNICATION 6**Listening:** Telephonic Conversations and TV News**Reading:** Newspapers and Magazines**Speaking:** Conversational Practice: Speaking in a given situation, Asking permission and requesting etc.,**Writing:** Job Application Letter and Resume**Grammar:** Reference words: pronouns and determiners**Vocabulary:** Guessing meanings of words in different contexts.**UNIT II FUNCTIONAL LANGUAGE ASPECTS 6****Listening:** Motivational listening – listening to real life challenges**Reading:** Articles and Technical reports**Speaking:** Using Polite Expressions, Indirect Questions**Writing:** Paraphrasing a Text, Poem**Grammar:** Purpose Statements, Cause and Effect Expressions**Vocabulary:** Neologisms.**UNIT III TECHNICAL REPORTWRITING 6****Listening:** Empathetic Listening – Giving Solutions to Problems**Reading:** Inferential Reading**Speaking:** Dialogues – Interviewing Celebrities / Leaders / Sportspersons, etc.,**Writing:** Report Writing**Grammar:** Functional Usage of Expressions – used to, gone / been, etc.,**Vocabulary:** Words Often Confused.**UNIT IV STRUCTURAL GRAMMAR 6****Listening:** Comprehension (IELTS practice tests)**Reading:** Intensive Reading for specific information**Speaking:** Pick and Talk**Writing:** Proposals**Grammar:** Sentence Structures – Simple, Compound, Complex Sentences**Vocabulary:** Replacing dull words with vivid ones**UNIT V PRESENTATION SKILLS 6****Listening:** Discriminative listening – sarcasm, irony, pun, etc.,**Reading:** Practice of chunking – breaking up reading materials**Speaking:** Mini presentation on some topic**Writing:** Minutes of the meeting

Grammar: Correction of Errors

Vocabulary: Advanced vocabulary – fixing appropriate words in the given context.

COURSE OUTCOMES

On completion of the course students will be able to

- communicate effectively using appropriate vocabulary.
- use the acquired language skills to comprehend various types of language contents .
- evaluate different texts and write effective technical content.
- use appropriate sentence structures to convey their thoughts in varied contexts.
- present their concepts and ideas in an effective manner.

Total Contact Hours: 30

TEXT BOOK(S)

1. Raymond Murphy, “Intermediate English Grammar,” Second Edition , Cambridge University Press, 2018
2. Meenakshi Raman & Sangeeta Sharma, “Technical Communication” Third Edition, Oxford University Press, 2015
3. Teaching Speaking: A Holistic Approach, Book by Anne Burns and Christine ChuenMengGoh, Cambridge University Press

REFERENCE BOOKS(S) / WEB LINKS::

1. Michael McCarthy (Author), Felicity O'Dell (Author), John D. Bunting (Contributor), “Basic Vocabulary in Use: 60 Units of Vocabulary Practice in North American English With Answers” 2nd Edition.
2. Dale Carnegie, “The Art of Public Speaking,” Insight Press
3. Jack C. Richards & Theodore S. Rodgers, “Approaches and Methods in Language Teaching, Second Edition, Cambridge University Press.

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	-	-	-	1	-	-	-	-	-	2	-	-	-	-	-
CO 2	-	-	-	1	-	-	-	-	-	3	-	-	-	-	-
CO 3	-	2	-	1	-	-	-	-	-	3	-	-	-	-	-
CO 4	-	-	-	1	-	-	-	-	2	3	-	-	-	-	-
CO 5	-	-	-	1	-	-	-	-	2	2	-	-	-	-	-
AVG.	-	2	-	1	-	-	-	-	2	2.6	-	-	-	-	-

HS 23222	ENGLISH FOR PROFESSIONAL COMPETENCE	Category	L	T	P	C
	Common to all branches of B.E/B. Tech programme – Second Semester	HS	0	0	2	1

OBJECTIVES:

- To facilitate the learners in acquiring listening and reading competence
- To enable the learners to communicate effectively through written and oral medium

- To assist the learners in preparing for competitive examinations
- To train the students in acquiring corporate skills
- To inculcate professional standards among the students and make them realize their responsibility in addressing the challenges

UNIT I RECEPTIVE SKILLS **6**
Listening – Comprehensive Listening – Watching the news – Listening to a peer giving presentation, etc. – Critical Listening – Watching a televised debate, Listening to poems – **Reading** – Extensive Reading – Short stories and One-act Plays – Intensive Reading – Articles or Editorials in Magazines, Blog posts on topics like science and technology, arts, etc.

UNIT II PRODUCTIVE SKILLS **6**
Speaking – Demonstrative Speaking – Process description through visual aids – Persuasive Speaking – Convincing the listener with the speaker’s view – **Writing** – Descriptive Writing - Describing a place, person, process – Subjective Writing – Autobiography, Writing based on personal opinions and interpretations.

UNIT III ENGLISH FOR COMPETITIVE EXAMS **6**
 An introduction to International English Language Testing System (IELTS) – Test of English as a Foreign Language (TOEFL) – Graduate Record Examination (GRE) – Civil Service, Indian Economic Service Examination, Indian Statistical Service Examination, Combined Defence Services Examination, Staff Selection- (Language Related) – Aptitude tests.

UNIT IV CORPORATE SKILLS **6**
Critical Thinking and Problem Solving – Case Study, Brainstorming, Q & A Discussion – **Team work and Collaboration** – Activities like Office Debates, Perfect Square, Blind Retriever, etc. – **Professionalism and Strong Work Ethics** – Integrity, Resilience, Accountability, Adaptability, Growth Mind set

UNIT V PROJECT WORK **6**
 Case Study based on the challenges faced by the employers and the employees – Devise Plan, Provide Solution

Total Contact Hours **30**

COURSE OUTCOMES:

On completion of the course, students will be able to

- interpret and respond appropriately in the listening and reading contexts.
- express themselves effectively in spoken and written communication
- apply their acquired language skills in writing the competitive examinations
- exhibit their professional skills in their work place
- identify the challenges in the work place and suggest strategies solutions

TEXT BOOK(S):

1. How to Read Better & Faster, Norman Lewis, Goyal Publishers
2. Teaching Speaking: A Holistic Approach, Book by Anne Burns and Christine Chuen Meng Goh, Cambridge University Press
3. The Official Cambridge Guide To IELTS by Pauline Cullen, Cambridge University Press
4. The 7 Habits of Highly Effective People by Stephen Covey, Simon and Schuster, UK

REFERENCE BOOKS(S) / WEB LINKS:

1. Board of Editors. Sure Outcomes. A Communication Skills Course for Undergraduate Engineers and Technologists. Orient Black Swan Limited, Hyderabad, 2013.
2. Hartley, Mary. "The Power of Listening," Jaico Publishing House; First Edition (2015).
3. Chambers, Harry. "Effective Communication Skills for Scientific and Technical Professionals," Persues Publishing, Cambridge, Massachusetts, 2000.

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	-	1	-	-	-	-	-	-	-	3	-	-	-	-	-
CO 2	-	1	-	-	-	-	-	-	-	3	-	-	-	-	-
CO 3	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-
CO 4	-	-	-	-	-	-	2	2	-	3	-	-	-	-	-
CO 5	-	-	1	-	-	-	2	-	-	3	-	-	-	-	-
AVG.	-	1	1	-	-	-	2	2	-	3	-	-	-	-	-

GE23122**ENGINEERING PRACTICE LABORATORY -
ELECTRICAL AND ELECTRONICS****Category L T P C****ES 0 0 2 1****OBJECTIVES**

- To provide hands-on experience on various basic engineering practices in Electrical Engineering.
- To provide hands-on experience on various basic engineering practices in Electronics Engineering.

LIST OF EXPERIMENTS**A. ELECTRICAL ENGINEERING PRACTICE**

1. Residential house wiring using switches, fuse, indicator, lamp and energy meter.
2. Fluorescent lamp wiring.
3. Stair case wiring.
4. Measurement of electrical quantities – voltage, current, power & power factor in RL circuit.
5. Measurement of earth resistance using Megger.
6. Study of Ceiling Fan and Iron Box

B. ELECTRONICS ENGINEERING PRACTICE

1. Study of electronic components and equipment's – Resistor, colour coding, measurement of AC signal parameter (peak-peak, rms period, frequency) using CRO/DSO.

2. a) Measurement of electrical quantities using Multimeter.
b) Testing of electronic components.
3. Study of logic gates AND, OR, EXOR and NOT.
4. Generation of Clock Signals.
5. Soldering practice – Components Devices and Circuits – Using general purpose PCB.
6. Measurement of ripple factor of Half-Wave and Full-Wave Rectifiers.

Contact Hours : 30

COURSE OUTCOMES:

On completion of the course, the students will be able to

- fabricate the electrical circuits
- construct the house wiring circuits
- fabricate the electronic circuits
- verify the truth table of logic gates
- design the Half-wave and Full-Wave Rectifiers using diodes and passive components.

REFERENCES

1. Bawa H.S., “Workshop Practice”, Tata McGraw – Hill Publishing Company Limited, 2007.
2. Jeyachandran K., Natarajan S. & Balasubramanian S., “A Primer on Engineering Practices Laboratory”, Anuradha Publications, 2007.
3. Jeyapoovan T., Saravanapandian M. & Pranitha S., “Engineering Practices Lab Manual”, Vikas Publishing House Pvt.Ltd, 2006.
4. Rajendra Prasad A. & Sarma P.M.M.S., “Workshop Practice”, SreeSai Publication, 2002.

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	3	3	2	-	-	2	-	3	2	-	3	3	3	2
CO 2	3	3	2	2	-	-	2	-	3	2	-	3	3	3	2
CO 3	3	3	3	2	-	-	2	-	3	2	-	3	3	3	2
CO 4	3	3	3	2	-	-		-	3	2	-	3	3	3	2
CO 5	3	3	3	2	-	-		-	3	2	-	3	3	3	2
AVG.	3	3	2.67	2	-	-	2	-	3	2	-	3	3	3	2

SEMESTER III

MA23312	FOURIER SERIES AND NUMBER THEORY	Category	L	T	P	C
		PC	3	1	0	4

OBJECTIVES:

- To express Fourier series to study the behaviour of periodic functions and their applications in system communications, digital signal processing and field theory.
- To represent continuous function arising in wave and heat propagation, signals and systems using Fourier Transforms
- To provide various numerical methods in solving problems that occurs in the field of Engineering and Technology.
- To introduce and apply the concepts of finite fields and congruences.
To present a rigorous development of Number Theory using axioms, definitions, examples, theorems and their proofs.

UNIT-I FOURIER SERIES 12

Dirichlet's conditions – General Fourier series – Odd and even functions – Half range sine series – Half range cosine series – Parseval's identity – Harmonic analysis.

UNIT-II FOURIER TRANSFORMS 12

Statement of Fourier integral theorem – Fourier transform pair – Fourier sine and cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity - Application to boundary value problems.

UNIT-III NUMERICAL SOLUTIONS OF BOUNDARY VALUE PROBLEMS 12

Finite difference method for solving second order differential equations - Finite difference techniques for the solution of two-dimensional Laplace and Poisson equations on rectangular domain – One dimensional heat flow equation by implicit and explicit methods – One Dimensional Wave Equation by Explicit method.

UNIT-IV CONGRUENCES 12

Finite Fields -Linear Diophantine equations – Congruence's – Linear Congruence's – Applications: Divisibility tests – Modular exponentiation-Chinese remainder theorem – 2 x 2 linear systems.

UNIT-V CLASSICAL THEOREMS IN NUMBER THEORY 12

Wilson's theorem – Fermat's little theorem – Euler's theorem – Euler's Phi functions – Tau and Sigma functions.

Contact Hours : 60

COURSE OUTCOMES:

On completion of the course, the students will be able to

- Demonstrate Fourier series to study the behaviour of periodic functions and their applications in engineering problems such as system communications, digital signal processing and field theory.
- Apply the shifting theorems, Fourier integral theorems, Inverse Fourier sine and cosine transforms appropriate problems in engineering and technology.
- Solve differential equations numerically that arise in course of solving complex engineering

problems.

- Explain the fundamental concepts of finite fields and congruence, and their role in modern mathematics and applied contexts.
- Work effectively as part of a group to solve challenging problems in Number Theory.

TEXT BOOK(S):

- 1 Erwin Kreyszig, "Advanced Engineering Mathematics", 10th Edition, Wiley India, 2015.
- 2 Veerarajan. T., "Transforms and Partial Differential Equations", Tata McGraw Hill Education Pvt.Ltd.,New Delhi, Second reprint, 2016.
- 3 Grimaldi, R.P and Ramana, B.V., "Discrete and Combinatorial Mathematics", Pearson Education, 5th Edition, New Delhi, 2007.
- 4 Koshy, T., "Elementary Number Theory with Applications", Elsevier Publications, New Delhi, 2002.
- 5 Grewal B.S., "Higher Engineering Mathematics", 43rd Edition, Khanna Publishers, Delhi, 2014.

REFERENCE BOOK(S) / WEB LINKS:

- 1 Ramana B.V., "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company Limited, New Delhi, 2017.
- 2 Glyn James, "Advanced Modern Engineering Mathematics", 4th Edition, Pearson Education, 2016
- 3 GrewalB.S., and Grewal. J.S., "Numerical Methods in Engineering and Science", 11th Edition, Khanna Publishers, New Delhi, 2013.
- 4 Lidl, R. and Pitz, G, "Applied Abstract Algebra", Springer Verlag, New Delhi, 2nd Edition, 2006.
- 5 Niven, I., Zuckerman.H.S., and Montgomery, H.L., "An Introduction to Theory of Numbers", John Wiley and Sons , Singapore, 2004.

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	2	1	-	-	-	-	-	-	-	-	1	1	1	-
CO 2	3	2	1	-	-	-	-	-	-	-	-	1	1	-	-
CO 3	3	2	1	-	-	-	-	-	-	-	-	-	1	-	-
CO 4	2	2	1	-	-	-	-	-	-	-	-	-	1	-	-
CO 5	3	2	1	-	-	-	-	-	-	-	-	1	1	-	-
AVG.	2.8	2	1	-	-	-	-	-	-	-	-	1	1	1	-

BM23311	HUMAN ANATOMY AND PHYSIOLOGY	Category	L	T	P	C
		PC	3	0	0	3

OBJECTIVES:

- To understand human body basics: cells, tissues, homeostasis, and organization.
- To explore musculoskeletal system: bones, joints, muscles, and skin functions.
- To study cardiovascular and respiratory systems: blood, heart, and lung functions.
- To acquire knowledge of digestive and urinary systems for physiological understanding.
- To comprehend the intricate regulatory dynamics of nervous and endocrine systems.

UNIT-I BASIC ELEMENTS OF HUMAN BODY 9

Introduction to the human body, basic terminologies (directional, regional, planes, levels of organization), cell- structure and organelles, cell membrane transport, action potential (Nernst, Goldman equation), homeostasis, tissue-types and functions.

UNIT-II MUSCULOSKELETAL AND INTEGUMENTARY SYSTEMS: SUPPORT, MOVEMENT, AND PROTECTION 9

Skeletal System - types of bone, salient features and functions of bones of axial and appendicular skeletal system, Joints- Structural and functional classification, types of joints movements.

Organization of skeletal muscle, physiology of muscle contraction, neuromuscular junction, types of muscle contraction. Structure and functions of skin.

UNIT-III CARDIOVASCULAR AND RESPIRATORY SYSTEMS: CIRCULATION AND OXYGENATION 9

Blood - composition and functions, blood grouping and typing

Heart - anatomy, blood circulation, blood vessels, conducting system and electrocardiogram, cardiac cycle, arterial blood pressure, factors regulating blood pressure.

Respiratory system - organs, mechanics of respiration, lung volume and capacities, gaseous transport in the blood, regulation of respiration.

UNIT-IV DIGESTIVE AND URINARY SYSTEMS: NUTRIENT PROCESSING AND WASTE ELIMINATION 9

GI system - organization, accessory digestive organ - liver, pancreas and gallbladder, digestion and absorption of food stuffs, defecation.

Urinary system – structure and functions, physiology of urine formation, blood acid-base regulation by kidney.

UNIT-V NERVOUS AND ENDOCRINE SYSTEMS: REGULATION AND CONTROL 9

Organization of nervous system, neuron, neuroglia, neuronal signalling and synaptic transmission, cerebrospinal fluid, brain - structure and functions, spinal cord - gross structure, functions of afferent and efferent nerve tracts and reflex activity.

Special senses – vision and hearing

Endocrine glands - major glands and their hormones, maintenance of calcium homeostasis, maintenance of glucose homeostasis.

Contact Hours : 45

COURSE OUTCOMES:

On completion of the course, the students will be able to

- Demonstrate the cellular components and their function and critically evaluate membrane transport mechanisms and tissue types
- assess different bones and muscles and emphasizing their collective role in maintaining structural integrity
- illustrate the interdependence of circulatory and respiratory systems.
- explain the processes of digestion and urine formation in detail.
- exhibit a thorough comprehension of how the nervous and endocrine systems coordinate to maintain physiological balance

TEXT BOOK(S):

- 1 Elaine.N. Marieb , “Essential of Human Anatomy and Physiology”, Eight Edition, Pearson Education, New Delhi 2007.
- 2 Guyton & Hall, “Medical Physiology”, 13th Edition, Elsevier Saunders, 2015.
- 3 Sarada Subramanyam, K.Madhavan Kutty and H.D.Singh - Text Book of 'Human Physiology'
S.Chand & Company, 1996.
- 4 Valerie C. Scanlon and Tina Sanders, “Essential of Human Anatomy and Physiology”, Fifth Edition, F.A. Davis Company, Philadelphia 2007.

REFERENCE BOOK(S) / WEB LINKS:

- 1 Prabhjot Kaur. Text Book of Anatomy and Physiology. Lotus Publsihers. 2014.
- 2 Eldra Pearl Solomon, “Introduction to Human Anatomy and Physiology”, Third Edition, W.B. Saunders Company, 2008.
- 3 Frederic H. Martini, Judi L. Nath, Edwin F. Bartholomew, Fundamentals of Anatomy and Physiology. Tenth Edition, Pearson Publishers, 2014.

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	3	3	3	1	3	3	3	3	3	1	3	3	3	3
CO 2	3	3	3	3	1	3	3	3	3	3	1	3	3	3	3
CO 3	3	3	3	3	1	3	3	3	3	3	1	3	3	3	3
CO 4	3	3	3	3	1	3	3	3	3	3	1	3	3	3	3
CO 5	3	3	3	3	1	3	3	3	3	3	1	3	3	3	3
AVG.	3	3	3	3	1	3	3	3	3	3	1	3	3	3	3

BM23312**BIOMEDICAL INSTRUMENTATION****Category L T P C****PC 3 0 0 3****OBJECTIVES:**

- To design Bio potential amplifiers for acquisition of bio signals.
- To acquire knowledge in the basics of bio medical instrumentation.
- To understand the different types of electrodes and its placement for various recordings in clinical applications
- To understand the non-electrical physiological parameter measurements.

- To understand the design aspects of various assist and therapeutic devices.

UNIT-I BIOPOTENTIAL AMPLIFIERS 9

Need for bio-amplifier - single ended bio-amplifier, Instrumentation amplifier, differential bio amplifier, Right leg driven ECG amplifier. Band pass filtering, isolation amplifiers – transformer, optical isolation, isolated DC amplifier and AC carrier amplifier, Artifacts and removal, electrical safety equipment analyser.

UNIT-II ELECTRODES IN CLINICAL APPLICATIONS 9

Electrocardiogram (ECG), Electroencephalogram (EEG), Electromyogram (EMG), Electrooculogram (EOG), Electroretinogram (ERG), Recording Electrodes – Electrode-tissue interface, polarization, skin contact impedance, motion artifacts, Silver-Silver Chloride electrodes, Electrodes for ECG, Electrodes for EEG, Electrodes of EMG, Electrical conductivity of electrode jellies and creams, microelectrodes, Needle electrodes.

UNIT-III BIOPOTENTIAL MEASUREMENTS 9

Bio signals characteristics – frequency and amplitude ranges. ECG – Einthoven 's triangle, standard 12lead system, Principles of vector cardiography. EEG – 10-20 electrode system, unipolar, bipolar and average mode. EMG– unipolar and bipolar mode. Recording of ERG, EOG and EGG.

UNIT-IV MEASUREMENT OF NON ELECTRICAL PHYSIOLOGICAL PARAMETERS 9

Temperature, respiration rate and pulse rate measurements, Plethysmography, Pulse oximeters: Transmission oximetry, Reflection oximetry, Blood Pressure: direct methods - Pressure amplifiers - systolic, diastolic, mean detector circuit, indirect methods - auscultatory method, oscillometric method, ultrasonic method. Blood flow - Electromagnetic and ultrasound blood flow measurement.

UNIT-V ASSIST DEVICES AND RESPIRATORY DEVICES 9

Pacemakers, Defibrillators, Hearing aid, Lung Volume and capacities, Spirometer, Ventilators, Pneumotachometers: different types.

Contact Hours : 45

COURSE OUTCOMES:

On completion of the course, the students will be able to

- Design bio-amplifier for various physiological recordings
- Gain knowledge in electrodes and its functions
- Illustrate different electrode placement for various physiological recordings
- Measure various non-electrical physiological parameters.
- Design various assist and therapeutic devices

TEXT BOOK(S):

- 1 Joseph J. Carr and John M. Brown, "Introduction to Biomedical equipment technology", Pearson Education, 4th Edition, 2014.
- 2 John G. Webster, "Medical Instrumentation Application and Design", John Wiley and Sons, New York, 4th Edition, 2009.
- 3 A.K.Sawhney, "A Course in Electrical and Electronic measurements and Instruments", DhanpatRaiand Sons, 2000.
- 4 M. Arumugam, "Biomedical Instrumentation", Anuradha Agencies Publishers, Kumbakonam, R.M.S: 1992.

REFERENCE BOOK(S) / WEB LINKS:

- 1 Khandpur R.S, "Handbook of Biomedical Instrumentation", Tata McGraw Hill, New Delhi, 3rd Edition, 2014.
- 2 L.A Geddes and L.E.Baker, "Principles of Applied Biomedical Instrumentation", John Wiley and Sons, 3rd Edition, Reprint 2008.
- 3 Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer, Biomedical Instrumentation and Measurements, Pearson Education India, 2nd Edition, 2015.
- 4 Myer Kutz, "Standard Handbook of Biomedical Engineering & Design", McGraw-Hill Publisher, 2003.
- 5 John D .E, Susan M.B, Joseph Bronzino , "Introduction to Biomedical Engineering", Elsevier Ltd, Boston, 2012.
- 6 Joseph D Bronzino, "Management of Medical Technology", Elsevier Ltd, 1992.
- 7 Anandanatarajan, "Biomedical Instrumentation", PHI Learning, 2009.

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	2	3	3	3	2	3	-	-	-	-	-	2	3	3	2
CO 2	2	3	3	2	2	3	-	-	-	-	-	2	3	2	2
CO 3	1	3	3	-	2	2	-	-	-	-	-	2	3	3	3
CO 4	1	2	2	2	2	1	-	-	-	-	-	2	3	3	1
CO 5	1	2	2	2	2	1	-	-	-	-	-	2	3	3	3
AVG.	1.4	2.6	2.6	1.8	2	2	-	-	-	-	-	2	3	2.8	2.2

BM23313**BIOCHEMICAL SCIENCE****Category L T P C****PC 3 0 0 3****OBJECTIVES:**

- To understand and explain the fundamental concepts of biochemistry
- To study structural and functional properties of carbohydrates, proteins, lipids and nucleic acids
- To emphasize the role of biomolecules by providing basic information on their metabolism and energetics
- To gain comprehensive knowledge about enzymes, including their classification, kinetics, mode of action, regulation, and clinical significance.
- To acquire knowledge about cell signalling mechanisms, GPCR signalling, and their relevance in human diseases.

UNIT-I INTRODUCTION TO BIOCHEMISTRY**7**

Introduction to Biochemistry, water as a biological solvent, weak acid and bases, electrolytes, pH, buffers, Henderson – Hassel balch equation, physiological buffers in living systems, Properties of water and their applications in biological systems.

UNIT-II CLASSIFICATION AND PROPERTIES OF BIOMOLECULES 10

Classification of carbohydrates - mono, di, oligo and polysaccharides. Structure, properties of monosaccharides.

Classification of lipids- simple, compound and derived lipids. Nomenclature of fatty acid, physical and chemical properties of triglycerides.

Nucleic Acid: DNA - Watson and crick model of DNA, types. Structure and types of RNA.

Amino acid: Classification. Protein: structural organisation.

UNIT-III METABOLISM AND ITS REGULATION 10

Carbohydrate Metabolic pathways: Glycolysis – aerobic and anerobic with energetics, TCA cycle – amphibolic pathway, energetics. ETC and Oxidative Phosphorylation.

Lipid Metabolic pathways: Degradation of fatty acid (beta oxidation), Hormonal regulation of fatty acid oxidation. Lipoprotein: LDL and HDL metabolism – Case Studies

Urea cycle - Detoxification of Ammonia, relationship with Liver Function and regulation.

UNIT-IV ENZYMES 9

Enzymes: Classification, Factors affecting enzymatic activity, Kinetics – Michaelis menton equation, line weaver burk plot, Mode of action, Regulation: Feedback, allosteric and covalent regulation. Clinical significance of enzymes – Case Studies.

UNIT-V CELL SIGNALLING 9

Cell signalling basics, Intercellular signalling: Autocrine, Paracrine, Endocrine, steps, regulation and role of hormones. Intracellular signalling: Reception, activation, deactivation and processing of signals, Molecular tools for intracellular signalling.

Signal transduction by G Protein coupled receptor: activation, inactivation, signalling pathway and role of second messengers.

Case Study: Role of GPCRs in Human Diseases.

Contact Hours : 45

COURSE OUTCOMES:

On completion of the course, the students will be able to

- Demonstrate a proficient understanding of fundamental biochemistry concepts.
- Analyze and describe the structural and functional properties of carbohydrates, proteins, lipids, and nucleic acids.
- Apply the knowledge of biomolecules to explain their role in metabolism and energetics.
- Evaluate and interpret the significance of enzymes, considering their classification, kinetics, mode of action, regulation, and clinical importance.
- Exhibit a thorough grasp of cell signalling mechanisms, particularly GPCR signalling, and their significance in human diseases.

TEXT BOOK(S):

- 1 Peter J. Kennelly, Kathleen M. Botham , Owen McGuinness, Victor W. Rodwell, P. Anthony Weil –“Harper's Illustrated Biochemistry” , 32nd International Edition, Mc Graw Hill Lange Publication, 2023
- 2 Trevor palmer and Philip L Bonner, “Enzymes: Biochemistry, Biotechnology, Clinical Chemistry”, 2nd Edition, Woodhead Publishing, 2012.
- 3 John T. Hancock. “Cell Signalling”. Oxford University Press, 2017.

REFERENCE BOOK(S) / WEB LINKS:

- 1 Pamela.C.Champe & Richard.A.Harvey, “Lippincott Biochemistry Lippincott’s Illustrated Reviews”, 6th Edition, LWW publishers, 2013.
- 2 David L. Nelson, Michael M. Cox, “Lehninger Principles of Biochemistry”, 8th Edition, W H Freeman & Co Publisher, 2021.
- 3 Donald Voet, Judith G. Voet, Charlotte W. Pratt, “Voet’s Principles of Biochemistry”, 5th Edition, Wiley Publication, 2018.

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	2	1	2	-	2	1	1	-	2	-	-	3	2	1
CO 2	3	2	1	2	-	2	1	1	-	2	-	-	3	2	1
CO 3	3	2	1	2	-	2	1	1	-	2	-	-	3	2	1
CO 4	3	2	1	2	-	2	1	1	-	2	-	-	3	2	1
CO 5	3	2	1	2	-	2	1	1	-	2	-	-	3	2	1
AVG.	3	2	1	2		2	1	1		2			3	2	1

BM23331	ELECTRONIC DEVICES & CIRCUITS	Category	L	T	P	C
		PC	3	0	2	4

OBJECTIVES

- To Understand the V-I Characteristics of low-power semiconductor devices.
- To Understand the working of high-power devices and semiconductor devices.
- To Understand the nuances of small signal model of BJT and FET.
- To study the working of feedback amplifiers and oscillators.
- To Understand the medical applications of Amplifiers and Oscillators.

UNIT-I DIODES, RECTIFIERS AND IC REGULATORS 9

Semiconductor Devices-Types, PN Diode and Zener Diode-VI Characteristics, Rectifiers – Half wave – Full wave – Bridge - with and without capacitor filter – Voltage multiplier circuits – Voltage regulation – Shunt Regulators – Series Regulators – Current limiting technique – Three terminal IC regulators (78XX and 79XX). Design and analysis of rectifier and regulator circuits.

UNIT-II BJT AND FET - CONFIGURATIONS 9

JT-NPN Transistor-PNP Transistor-Configurations-Characteristics, JFET – Drain and Transfer Characteristics- Differences between BJT and FET, MOSFET- EMOSFET-DEMOSFET.

UNIT-III HIGH POWER DEVICES AND SPECIAL SEMICONDUCTOR DEVICES 9

UJT, SCR, DIAC, TRIAC, Power BJT- Power MOSFET- DMOS-VMOS, IGBT, VARACTOR diode –Tunnel diode-, LED and 7-segment display. LASER diode, LDR and its Biomedical

Applications.

UNIT-IV BIASING AND SMALL SIGNAL ANALYSIS OF BJT AND FET 9

BJT – Biasing of BJT – Fixed Bias – Voltage Divider Bias – Emitter bias - Two port network Analysis of BJT–parameters - small signal analysis of BJT for CE configuration - Frequency response of, BJT for CE configuration, JFET— Biasing of FET – Fixed Bias – Self Bias – Voltage Divider Bias - Small signal analysis of JFET for CS configuration – Frequency response of FET.

UNIT-V AMPLIFIERS AND OSCILLATORS – BIOMEDICAL APPLICATIONS 9

Basics of Feedback system - Types of Feedback Amplifiers (Block diagram approach), Types of Power Amplifiers – Class A (series fed and transformer-coupled), Principle of oscillators – Condition for oscillation – Audio Oscillators – RC Phase shift and Wien Bridge oscillators RF oscillators-Hartley and Colpitts, Multivibrators – Astable and Monostable - Blood Volume measurement using Photoresistor and Phototransistor Biotelemetry – Hearing Aids – EMG Amplifier

Mini Project on Biomedical applications using Transistors, Amplifiers and Oscillators.

Contact Hours : 45

LIST OF EXPERIMENTS

- 1 V-I Characteristics of PN Junction and Zener Diodes.
- 2 Zener Diode – Line and Load Regulation.
- 3 NPN Transistor – CE Configuration.
- 4 NPN Transistor – CB Configuration.
- 5 Drain and Transfer Characteristics of JFET.
- 6 Half Wave Rectifier – Center Tapped Full Wave Rectifier– Bridge Rectifier – Construction and Working.
- 7 Analysis of the Stability factors of Fixed Bias, Emitter Bias, and Voltage Divider Bias of BJT.
- 8 Design of RC Phase Shift Oscillator.
- 9 Design and Analysis of Astable and Monostable Multivibrator Circuit.
- 10 Design and Analysis of Class A Power Amplifier.

Contact Hours : 30

Total Contact Hours : 75

COURSE OUTCOMES:

On completion of the course, the students will be able to

- Analyse the V-I Characteristics of low-power semiconductor devices
- Analyse the working of high-power devices and semiconductor devices
- Analyse the nuances of small signal model of BJT and FET
- Analyse the working of feedback amplifiers and oscillators
- Analyse the medical applications of Amplifiers and Oscillators

TEXT BOOK(S):

- 1 Robert L. Boylestead, Louis Nashelsky, “Electronic Devices and circuit Theory”, Prentice Hall of India, 2004
- 2 Donald A Neaman, “Semiconductor Physics and Devices”, Fourth Edition, Tata Mc GrawHill Inc. 2012.
- 3 William H. HaytJr, Jack E. Kemmerly and Steven M. Durbin, “Engineering Circuits Analysis”, Tata McGraw Hill publishers, 6th edition, New Delhi, 2003

- Jacob Millman, Christos C Haikas, Satyabrata Jit, "Electronic Devices and Circuits", Tata
4 McGraw Hill publishers, 4th edition, New Delhi, 2015.

REFERENCE BOOK(S) / WEB LINKS:

- 1 David A. Bell, "Electronic Devices and Circuits", 4th Edition Prentice Hall of India, 2003.
- 2 Millman Haykins, "Electronic Devices and Circuits", 2nd Edition Tata MC Graw Hill 2007.
- 3 John G. Webster, —Medical Instrumentation Application and DesignII, 4th edition, Wiley India Pvt Ltd, New Delhi, 2015
- 4 Leslie Cromwell, —Biomedical Instrumentation and measurement, 2nd edition, Prentice hall of India, New Delhi, 2015
- 5 Joseph J. Carr and John M. Brown, —Introduction to Biomedical Equipment Technology, Pearson Education, 2004.

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	3	1	-	1	-	1	-	-	-	-	-	-	3	-
CO 2	3	3	3	2	2	-	2	-	-	-	-	-	-	3	-
CO 3	3	3	3	3	3	-	3	-	-	-	-	-	-	3	-
CO 4	3	3	3	3	3	-	3	-	-	-	-	-	-	3	-
CO 5	3	3	3	3	3	-	3	-	2	1	3	3	3	3	3
AVG.	3	3	2.6	2.7	2.4	-	2.4	-	2	1	3	3	3	3	3

BM23332**SENSORS AND MEASUREMENTS****Category L T P C****PC 2 0 2 3****OBJECTIVES**

- To know about the types of transducers available and their applications in different fields.
- To understand the concepts of photo sensors and its functions.
- To study chemical biosensors.
- To get exposure in biopotential sensors.
- To get an idea about the various biological sensors.

UNIT-I TRANSDUCERS AND SENSORS**9**

Resistive Transducers: Strain Gauge: Gauge factor, sensing elements, configuration, biomedical applications; strain gauge as displacement & pressure transducers, RTD materials & range, Characteristics, thermistor characteristics, biomedical applications of Temperature sensors Capacitive transducer, Inductive transducer, LVDT, Active type: Thermocouple –characteristics.

UNIT-II PHOTOELECTRIC AND PIEZOELECTRIC SENSORS**9**

Phototube, scintillation counter, Photo Multiplier Tube (PMT), photovoltaic, Photo conductive cells, photo diodes, phototransistor, comparison of photoelectric transducers, spectrophotometric applications of photo electric transducers. Piezoelectric active transducer and biomedical

applications as pressure & Ultrasound transducer.

UNIT-III CHEMICAL BIOSENSORS 9

Blood gas and Acid-Base Physiology, Electrochemical sensors, reference electrode, pH, pO₂, pCO₂ electrodes, Ion-Selective Field-Effect Transistor (ISFET), Non-invasive Blood-Gas Monitoring, Blood Glucose Sensors. Transcutaneous arterial oxygen tension and carbon dioxide tension monitoring enzyme electrode.

UNIT-IV BIO POTENTIAL ELECTRODES 9

Action Potential, Electrode electrolyte interface, polarization, polarizable and nonpolarizable electrodes, Electrode Behavior and, Circuit Models, Electrode-skin Interface and Motion Artifact, Body-Surface Recording Electrodes, Internal Electrodes: Needle and wire electrodes, Electrode Arrays, Microelectrodes: Metal supported metal, micropipette (metal filled glass and glass micropipette electrodes), microelectronic, properties of microelectrodes. Electrodes for Electric Stimulation of Tissue (i.e. for ECG, EMG and EEG).

UNIT-V BIOLOGICAL SENSORS 9

Sensors / receptors in the human body, basic organization of nervous system-neural mechanism, Chemoreceptor: hot and cold receptors, baroreceptors, sensors for smell, sound, vision, Ion exchange membrane electrodes, enzyme electrode, glucose sensors, immunosensors, Basic principles of MOSFET biosensors and BIOMEMS, basic idea about Smart sensors.

Contact Hours : 45

LIST OF EXPERIMENTS

- 1 Temperature measurement using AD590 IC sensor
- 2 Displacement measurement by using a capacitive transducer
- 3 Study of the characteristics of a LDR
- 4 Pressure and displacement measurement by using LVDT
- 5 Study of a load cell with tensile and compressive load
- 6 Torque measurement Strain gauge transducer
- 7 Study and characterize Bio transducers – Pressure, Temperature, Humidity
- 8 Study and characterize Bioelectrodes – ECG, EMG, EEG
- 9 Study and Characterize pH electrodes
- 10 Characteristics of Ultrasound Transducer and Phono Transducer.
- 11 Determination of characteristics of Polarized Electrodes, Non-polarized Electrodes and Multi Point Electrodes

Contact Hours : 30

Total Contact Hours : 75

COURSE OUTCOMES:

On completion of the course, the students will be able to

- Understand various sensors and transducers available for physiological measurements.
- Apply fundamental transduction and photo sensing principles.
- Interpret various chemical sensors used in physiological measurements.
- Analyse different types of recording physiological signals using various bio potential electrodes.
- Review the application area of biological sensors.

TEXT BOOK(S):

- 1 A.K.Sawhney, "A Course in Electrical and Electronic measurements and Instruments", Dhanpat Rai and Sons, 2010.

- 2 Prof. Ping Wang and Dr.Qingjun Liu, “Biomedical Sensors and Measurement “,First Edition, Springer Publications”, 2011.
- 3 Tatsuo Togawa ,Toshiyo Tamura andAke Oberg, “ Biomedical Sensors and Instruments”, Second Edition, CRC Press Taylor and Francis Group, 2011.

REFERENCE BOOK(S) / WEB LINKS:

- 1 R.Anandanatarajan, “Biomedical Instrumentation and measurements”, Second Edition, PHI Learning, December 2015.
- 2 Ernest O Doebelin and Dhanesh N Manik, “Measurement Systems, Applications and Design”, Fifth edition MC Graw-Hill, 2011.
- 3 Michael J. McGrath, Clíodhna Ní Scanaill, “Sensor Technologies: Healthcare, Wellness and Environmental Applications, Apress, 2013.
- 4 Richard S.C. Cobbold, “Transducers for Biomedical Measurements: Principles and Applications “, John Wiley and Sons, 2004.
- 5 Nandini K. Jog, “Electronics in Medicine and Biomedical Instrumentation “, Second Edition, PHI, 2013.

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	3	3	3	2	-	-	-	-	-	-	1	3	2	-
CO 2	2	3	3	3	3	-	-	1	-	-	-	1	3	2	-
CO 3	3	3	3	-	3	-	-	1	-	-	-	1	3	2	-
CO 4	3	3	3	-	3	-	-	-	-	-	-	1	3	2	-
CO 5	3	3	3	2	3	-	-	-	-	-	-	1	3	2	-
AVG.	2.8	3	3	2.7	2.8	-	-	1	-	-	-	1	3	2	-

BM23321 BIOCHEMISTRY AND PHYSIOLOGY LABORATORY Category L T P C
PC 0 0 4 2

OBJECTIVES

- To study how biochemical knowledge can be applied to a range of medical investigations
- To learn the laboratory analysis of carbohydrates, lipids and proteins qualitatively and quantitatively
- To learn fundamental approaches for experimentally investigating biochemical problems
- To provide basic training in biochemical techniques such as chromatography and electrophoresis
- To study about the appropriate laboratory techniques and scientific methodology to determine the physiological status of the body.

LIST OF EXPERIMENTS

- 1 General guidelines for working and functional component of biochemistry lab
- 2 General tests for carbohydrates, proteins and lipids

- 3 Preparation of serum and plasma from blood
- 4 Estimation of blood glucose
- 5 Estimation of creatinine
- 6 Estimation of urea
- 7 Assay of SGOT/SGPT
- 8 Separation of proteins by SDS electrophoresis(Demo)
- 9 Separation of amino acids by thin layer chromatography
- 10 Separation of plant pigments by thin layer chromatography
- 11 Identification of Blood groups
- 12 Estimation of Hemoglobin
- 13 Determination of ESR
- 14 Physical examination of urine
- 15 Chemical examination of urine - Protein, Glucose, Ketone bodies, Blood, Bilirubin and Urobilinogen

Contact Hours : 60

COURSE OUTCOMES:

On completion of the course, the students will be able to

- Demonstrate proficiency in qualitative and quantitative procedures for major biomolecules, including carbohydrates, lipids, and proteins
- Exhibit competency in basic analytical techniques relevant to biochemical applications.
- Recognize and describe the fundamental features of electrophoresis.
- Compare and contrast normal physiological states, non-pathological variant states, and pathophysiological conditions.
- Apply the knowledge gained in biochemistry and physiology to address real-world scenarios and problem-solving exercises.

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	2	1	2	-	2	1	1	-	2	-	-	3	2	1
CO 2	3	2	1	2	-	2	1	1	-	2	-	-	3	2	1
CO 3	3	2	1	2	-	2	1	1	-	2	-	-	3	2	1
CO 4	3	2	1	2	-	2	1	1	-	2	-	-	3	2	1
CO 5	3	2	1	2	-	2	1	1	-	2	-	-	3	2	1
AVG.	3	2	1	2	-	2	1	1	-	2	-	-	3	2	1

BM23322 BIOMEDICAL INSTRUMENTATION LABORATORY Category L T P C
PC 0 0 4 2

OBJECTIVES

- To record the biosignals and analyze it.
- To study the different modules used for amplifying the biosignals.
- To impart knowledge about the measurements and recordings of bioelectric and biochemical signals.

- To measure various physiological signals and the isolation concepts involved.
- To simulate and interpret the Diagnostic and respiratory equipment.

LIST OF EXPERIMENTS

- 1 Acquisition of ECG signals using 3 channel and 12 channel ECG machine
- 2 Real time EEG Acquisition and Measurement of Evoked Potential.
- 3 Recording and Analysis of EMG.
- 4 Construction and testing of pre amplifier to acquire bio signal
- 5 Measurement of Blood Flow Velocity using Ultrasonic blood flow Monitor
- 6 Study of EMG /ECG Isolation amplifier using analogy circuit
- 7 Study of Galvanic Skin Resistance using GSR System
- 8 Measurement of pH and conductivity.
- 9 To measure the blood pressure levels using Sphygmomanometer
- 10 Simulation of ECG – detection of QRS complex and heart rate
- 11 Design a suitable filter for bio signal Acquisition
- 12 To simulate EEG signal using VI LABS
- 13.a To simulate Pacemaker using VI LABS
- 13.b To simulate Defibrillator using VI LABS

Contact Hours : 60

COURSE OUTCOMES:

On completion of the course, the students will be able to

- Design the pre amplifier and amplifier for Bio signal measurements.
- Apply the concepts of telemetry in physiological signal data transmission.
- Design circuits to record and analyze bio signals.
- Implement biochemical recorders for monitoring the levels of pH in biological fluids.
- Simulate and Analyse diagnostic equipment output waveforms.

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	3	3	3	-	3	-	-	-	-	1	-	-	3	3
CO 2	3	3	3	3	-	3	-	-	-	-	1	-	-	3	3
CO 3	3	3	3	3	-	3	-	-	-	-	1	-	-	3	3
CO 4	3	3	3	3	-	3	-	-	-	-	1	-	-	3	3
CO 5	3	3	3	3	-	3	-	-	-	-	1	-	-	3	3
AVG.	3	3	3	3	-	3	-	-	-	-	1	-	-	3	3

SEMESTER IV

BM23411	ANALOG AND DIGITAL INTEGRATED CIRCUITS	Category	L	T	P	C
		PC	3	0	0	3

OBJECTIVES:

- To understand the basic of number system, Boolean algebra, and design of combinational logic circuits
- To understand the design of different Sequential logic circuits
- To know the basics of operational amplifier and its applications
- To understand the design of Active Filters, oscillators, and timer circuits
- To understand the Biomedical applications of Analog and Digital IC'S.

UNIT-I INTRODUCTION TO NUMBER SYSTEM AND COMBINATIONAL LOGIC CIRCUITS 9

Introduction to number system and conversion, Boolean algebra; Boolean identities, basic logic functions, standard form, Minimization of Boolean functions using K map, Combinational Logic Circuits; Arithmetic circuits, decoders, encoders, multiplexers, de-multiplexers, Magnitude Comparator.

9

UNI -II SEQUENTIAL CIRCUITS

Latches and Flip Flops (SR, JK, D, T), Timing in sequential circuits; Shift register; Counters – synchronous, asynchronous; Basic concepts and design of Moore and Mealy machines examples; State minimization/reduction, state assignment; Semiconductor Memories – ROM, SRAM, DRAM.

Case Study: Real time usage of Moore and Mealy machines.

UNIT-III OPAMP BASICS AND APPLICATIONS 9

Basic OPAMP configurations and characteristics, Linear & Non Linear Applications – Non inverting and Inverting amplifier-difference amplifier, adder, subtractor, integrator, differentiator, instrumentation amplifier, buffer, precision amplifier, logarithmic amplifier, square-root amplifier, comparators, Schmitt trigger using OPAMP.

Case Study: Real time usage of Linear & Non Linear Applications of OPAMP.

UNIT- IV ACTIVE FILTERS, OSCILLATORS AND TIMERS 9

Active 1st order LPF, HPF, BPF, BSF circuits using IC741, Introduction to higher order filters. Oscillators – criteria for oscillation, RC and Wein Bridge Oscillators, Timers; internal structure of 555 and its operations, Astable and monostable multivibrator circuits using IC 555, clock circuits.

UNIT- V BIOMEDICAL APPLICATIONS OF ANALOG & DIGITAL IC'S 9

Digital stethoscope, Digital blood pressure monitor, Digital blood glucose monitor, Digital thermometer, Rejection of power line interference using notch filter, Drug Delivery System using 555 timer.

Contact Hours : 45

COURSE OUTCOMES:

On completion of the course, the students will be able to

- Solve Boolean equations using Boolean algebra and Karnaugh Map
- Design encoder, decoder, Multiplexer, Demultiplexer, Counters and Shift Registers circuits
- Design Non inverting, inverting, integrator, Differentiator amplifier circuits using op-amp
- Design 1st order Active filter LPF,HPF,BPF,BSF and oscillator using op-amp and timer

- circuits
- Develop circuits using analog and Digital ICS for biomedical applications

TEXT BOOK(S):

- 1 M.Morris Mano, “Digital logic and Computer design“ Prentice Hall 1994.
- 2 Ramakant A. Gayakwad, “OP AMP and linear IC’S” Prentice Hall, 1994

REFERENCE BOOK(S) / WEB LINKS:

- 1 Robert B.Northrop, “Analysis and application of analog Electronic circuits” to bio medical instrumentation, CRC Press, 2004
- 2 Sergio Franco, Design with Operational amplifiers and analog integrated circuits, Mc Graw-Hills
- 3 Millman, J.Halkis.C. “Integrated Electronics”, MCGrawHill, 1972 John. F. Wakerly, Digital design principles and practices”, Pearson Education, Fourth Edition, 2007
- 4 Charles H.Roth, Jr, “Fundamentals of Logic design”, Fourth Edition, Jaico Books, 2002
- 5 https://www.researchgate.net/publication/236060168_Recent_technologies_in_pulsatile_drug_delivery_systems
- 6 https://www.researchgate.net/publication/260668963_Digital_stethoscope_system_The_feasibility_of_cardiac_auscultation

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	3	3	2	-	-	-	-	2	-	2	-	2	3	-
CO 2	3	3	3	2	-	-	-	-	3	-	3	-	2	3	-
CO 3	3	3	3	3	-	-	-	-	2	-	3	-	3	3	-
CO 4	3	2	3	3	-	-	-	-	2	-	3	-	3	3	-
CO 5	3	2	3	3	-	-	-	-	2	-	2	-	3	3	-
AVG.	3	2.4	3	2.6	-	-	-	-	2.2	-	2.6	-	2.6	3	-

BM23412 COMMUNICATION SYSTEMS AND STANDARDS Category L T P C
PC 3 0 0 3

OBJECTIVES:

- To understand the concepts of various analog modulation schemes.
- To understand the fundamentals of various digital modulation techniques.
- To gain knowledge on multi-user radio communication and pulse modulation techniques.
- To impart the key principle of Bio-Telemetry System.
- To be familiarized with Medical device communication standards.

UNIT-I ANALOG MODULATION

9

Introduction to Communication Systems - Modulation –Types - Need for Modulation, Theory of Amplitude Modulation -Evolution and Description of SSB Techniques - Generation of FM-Varactor diode Modulator-Armstrong modulator, FM detection using PLL-Phase Modulation–Comparison of Analog Communication Systems (AM –FM –PM).

UNIT-II DIGITAL MODULATION**9**

Amplitude Shift Keying (ASK) – Frequency Shift Keying (FSK) Minimum Shift Keying (MSK) – Phase Shift Keying (PSK) – BPSK – QPSK – 8 PSK – 16 PSK – Quadrature Amplitude Modulation (QAM) – 8 QAM – 16 QAM – Bandwidth Efficiency– Comparison of various Digital Communication System (ASK – FSK – PSK – QAM).

Case Study: Exploration of modulation techniques adopted in Biomedical applications.

UNIT-III PULSE MODULATION AND MULTI USER COMMUNICATION**9**

Pulse Modulation: Types of Pulse modulation, PAM (Single polarity, double polarity) PWM: Generation and demodulation of PWM, PPM, Generation and demodulation of PPM, Application of PM techniques, TDMA, FDMA, CDMA, Global System for Mobile Communications (GSM), Cellular Concept and Frequency Reuse - Channel Assignment and Hand off.

UNIT-IV BIOTELEMETRY**9**

Bio-Telemetry System: Components of telemetry system, bio-telemetry and its importance, single and multi-channel biotelemetry, ECG telemetry system, temperature telemetry system, telemetry of ECG and respiration, sports telemetry, multi-patient telemetry, ambulatory patient monitoring, implantable telemetry systems, transmission of physiological signals over telephone line, telemedicine and applications.

UNIT-V MEDICAL DEVICES COMMUNICATION STANDARDS**9**

Introduction to Medical device communication standard - ISO/IEEE 11073. Wireless communication- ZigBee, Wi-Fi, Satellite communication. FCC Regulation of medical devices, FDA standards for health care facilities and wireless medical devices. Case Study: Medical devices for biomedical signal processing using CDMA and FDMA.

Case study: Wearable and IoT device communication standards

Contact Hours : 45**COURSE OUTCOMES:**

On completion of the course, the students will be able to

- Analyse and explain various analog modulation schemes.
- Describe various digital modulation and pulse modulation techniques.
- Compare and contrast the strengths and weaknesses of various communication systems.
- Apply modern communication systems in Bio-Telemetry System.
- Describe the Medical device communication standards.

TEXT BOOK(S):

- 1 Wayne Tomasi, “Advanced Electronic Communication Systems”, 5th Edition, Pearson Education, 2009.
- 2 H Taub & D. Schilling, Gautam Sahe, “Principles of Communication Systems” - TMH, 2007, 3rd Edition.
- 3 Simon Haykin, “Communication Systems” - 2 Ed, Wiley Publications.
- 4 S. Khandpur; “Handbook of Bio-Medical Instrumentation”, 2nd Ed.; TMH

REFERENCE BOOK(S) / WEB LINKS:

- 1 B.P. Lathi, “Communication Systems” –BS Publication, 2004.
- 2 George Kennedy and Bernard Davis, “Electronics & Communication System”, TMH 2004.
- 3 Dennis Roddy and John Coolean, “Electronic Communications” - 4th Edition, PEA, 2004.
- 4 Robert J. Schoenbeck, “Electronic Communication Systems” - Modulation and Transmission - 2nd Edition, PHI.

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	1	3	3	2	2	2	-	-	2	3	-	2	1	3	3
CO 2	1	2	3	1	2	2	-	-	2	3	-	2	1	2	3
CO 3	1	1	3	3	2	2	-	-	2	3	-	3	1	1	3
CO 4	1	3	3	2	2	2	-	-	2	3	-	2	1	3	3
CO 5	1	3	3	3	2	2	-	-	2	3	-	3	1	3	3
AVG.	1	2.4	3	1.8	2	2	-	-	2	3	-	2.4	1	2.4	3

MA23436	PROBABILITY AND RANDOM PROCESSES	Category	L	T	P	C
		PC	3	0	2	4

OBJECTIVES

- To apply the theoretical discrete and continuous probability distributions in the relevant application areas.
- To provide the required mathematical support in real life problems and develop probabilistic models which can be used in several areas of science and engineering.
- To classify random processes and to know the concepts of strict stationary, wide-sense stationary and ergodicity.
- To provide necessary concepts in spectral densities and correlation analysis.
- To explain linear time invariant systems with random inputs.

UNIT-I ONE DIMENSIONAL RANDOM VARIABLES 9

One dimensional Discrete and continuous random variables – Moments – Moment generating functions – Binomial, Poisson, Geometric, Uniform, Exponential and Normal distributions .

UNIT-II TWO DIMENSIONAL RANDOM VARIABLES 9

Two Dimensional Random Variables: Joint distributions – Marginal and conditional distributions - Moments – Covariance – Correlation and Linear regression – Transformation of random variables-Applications of Central Limit Theorem.

UNIT-III SYSTEMIC PATHOLOGY 9

Classification of Random Process: Stationary process – Binomial process – Gaussian process - Markov process - Poisson process and its properties – Discrete parameter Markov chain – Chapman Kolmogorov Theorem (without proof) – Limiting distributions.

UNIT-IV SPECTRAL DENSITIES 9

Auto correlation functions – Cross correlation functions – Properties – Power spectral density – Cross spectral density – Properties.

UNIT-V LINEAR SYSTEMS WITH RANDOM INPUTS**9**

Linear time invariant system – System transfer function – Linear systems with random inputs – Auto correlation and Cross correlation functions of input and output.

Contact Hours : 45**LIST OF EXPERIMENTS**

- 1 Basic functions in MATLAB
- 2 Mathematical functions in MATLAB
- 3 Plotting data sets using MATLAB
- 4 Control flow -Loops
- 5 Reading and writing data sets – importing data sets
- 6 Probability Distributions - PDF, CDF for Binomial, Poisson, Exponential, Uniform and Normal Distributions.
- 7 Correlation and regression
- 8 Fourier Transform using MATLAB
- 9 Linear system with random inputs
- 10 Analysis of Power spectral density – signal processing tool box.

Contact Hours : 15**Total Contact Hours : 60****COURSE OUTCOMES:**

On completion of the course, the students will be able to

- Apply the basic concepts of probability, one dimensional and two dimensional Random Variables in the engineering and technology problems.
- Analyse the data using correlation and regression in real life situation.
- Classify random processes and to apply the concepts of strict stationary, wide-sense stationary and ergodicity in the solution of complex engineering problems.
- Develop skills in solving problems on power spectral density function relevant to the various branches of engineering.
- Interpret linear time invariant systems with random inputs.

TEXT BOOK(S):

- 1 Veerarajan T, 'Probability, Statistics and Random Processes with Queueing Theory and Queueing Networks'.
- 2 McGraw Hill, 2016. 2 Johnson R.A. and Gupta. C.B., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 7th Edition, 2007.
- 3 Oliver Ibe, "Fundamentals of Applied Probability and Random Processes", Elsevier, 1st Indian Reprint, 2014.
- 4 Peebles. P.Z., "Probability, Random Variables and Random Signal Principles", Tata Mc Graw Hill, second Edition, New Delhi, 2000.

REFERENCE BOOK(S) / WEB LINKS:

- 1 Jhon wiley & Sons .Erwin Kreyszig., "Advanced Engineering Mathematics", Pearson Education, Asia, 7th Edition, 2007.
- 2 Ramana. B.V., "Higher Engineering Mathematics ", McGraw Hill Education Pvt. Ltd, New Delhi, 2016.
- 3 Yates R. D. and Goodman. D.J., "Probability and Stochastic Processes- A Friendly Introduction for Electrical and Computer Engineers ", 2nd Edition, Wiley India Pvt. Ltd., Bangalore, 2014
- 4 Stark H. and Woods. J.W., "Probability and Random Processes with Applications to Signal

Processing", 3rd Edition, Pearson Education, Asia, 2002.

- 5 Miller S.L. and Childers. D.G., "Probability and Random Processes with Applications to Signal Processing and Communications", Academic Press, 2004.

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	2	1	-	-	-	-	-	-	-	-	1	1	1	-
CO 2	3	2	1	-	-	-	-	-	-	-	-	1	1	-	-
CO 3	3	2	1	-	-	-	-	-	-	-	-	-	1	-	-
CO 4	2	2	1	-	-	-	-	-	-	-	-	-	1	-	-
CO 5	3	2	1	-	-	-	-	-	-	-	-	1	1	-	-
AVG.	2.8	2	1	-	-	-	-	-	-	-	-	1	1	1	-

BM23431

PATHOLOGY AND MICROBIOLOGY

Category **L T P C**

PC 2 0 2 3

OBJECTIVES

- To understand the cause, pathogenesis and pathology of diseases
- To learn the fluid and hemodynamic disturbances in the body and to demonstrate bleeding and clotting time
- To gain awareness and knowledge of infectious and life style diseases
- To understand the normal flora of the human body, its routes of infection and growth
To learn the different staining methods and principles of different types of microscopy

UNIT-I CELL DEGENERATION AND REPAIR

9

Cell injury and adaptation- causes and mechanism of cell injury, cellular adaptation to stress. Necrosis and Apoptosis. Neoplasia - Benign and Malignant tumours - carcinogenesis.

UNIT-II FLUID AND HEMODYNAMIC DERANGEMENTS

9

Homeostasis – normal water and electrolyte balance, pressure gradient and fluid exchange. Edema, thrombosis, embolism, shock, Bleeding disorders - vascular abnormality, platelet abnormality, disorders of coagulation factor.

Case study: Analysis of diseased condition associated with bleeding disorder.

UNIT-III SYSTEMIC PATHOLOGY

9

Immunopathology - Overview of hypersensitivity reaction Type I – IV, Cardiovascular pathology – Atherosclerosis and Myocardial Infarction, Respiratory pathology - PCOD, Gastrointestinal Pathology - Reflux gastritis, Renal Pathology - Chronic Kidney Disease.

Case study: Etiology of chronic kidney disease.

UNIT-IV MICROBIOLOGY

9

Normal flora of the human body. Routes of infection and spread; endogenous and exogenous

infections, Morphological features and structural organization of bacteria, growth curve, identification of bacteria.

UNIT-V MICROSCOPY

9

Light microscope – bright field, dark field, and phase contrast, fluorescence. Electron microscope (TEM & SEM) – sample preparation, working principle, instrumentation and application.

Contact Hours : 45

LIST OF EXPERIMENTS

- 1 Demonstration of bright field microscope.
- 2 Simple staining.
- 3 Gram's Staining.
- 4 Acid Fast Bacilli Staining.
- 5 Determination of Bleeding time and clotting time.
- 6 Analysis of leukemia subtypes and malarial parasite types using microscopic images – Study Experiment

Contact Hours : 45

Total Contact Hours : 60

COURSE OUTCOMES:

On completion of the course, the students will be able to

- Comprehend the cause, pathogenesis, and pathology of diseases.
- Demonstrate knowledge of fluid and hemodynamic disturbances, along with bleeding and clotting time assessment.
- Acquire awareness and understanding of infectious and lifestyle-related diseases.
- Analyze the normal human body flora, pathways of infection, and growth characteristics.
- Develop proficiency in different staining methods and principles of various types of microscopy.

TEXT BOOK(S):

- 1 Vinay Kumar, Abul Abbas, Jon C. Aster, "Robbins & Cotran Pathologic Basis of Disease", 10th Edition, Elsevier, 2020.
- 2 Harsh Mohan, "Textbook of Pathology" 8th Edition, Jaypee Brothers Medical Publishers (P) Ltd., 2018.
- 3 Ananthanarayanan & Panicker, "Textbook of Microbiology", University press (India) Private Limited, 10th edition, 2017.

REFERENCE BOOK(S) / WEB LINKS:

- 1 James C. E. Underwood and S. S. Cross, "General and Systematic Pathology", 5th edition, Elsevier Science & Technology Publisher, 2009.
- 2 Gary D. Hammer and Stephen J. McPhee "Pathophysiology of Disease: An Introduction to Clinical Medicine", 8th Edition, Mc Graw Hill Lange publication, 2018.
- 3 Prescott, Harley and Klein, "Microbiology", 10th edition, McGraw Hill, 2017.
- 4 Dubey RC and Maheswari DK. "A Text Book of Microbiology", 4th Edition, Chand & Company Ltd, 2023

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	3	1	1	-	1	2	2	3	-	-	2	2	2	1
CO 2	3	3	1	1	-	1	2	2	3	-	-	2	2	2	1
CO 3	3	3	1	1	-	1	2	2	3	-	-	2	2	2	1
CO 4	3	3	1	1	-	1	2	2	3	-	-	2	2	2	1
CO 5	3	3	1	1	-	1	2	2	3	-	-	2	2	2	1
AVG.	3	2	1	1	-	1	2	2	3	-	-	2	2	2	1

CS23336

INTRODUCTION TO PYTHON PROGRAMMING

Category L T P C

ES 1 0 4 3

OBJECTIVES

- To understand computers, programming languages and their generations and essential skills for a logical thinking for problem solving.
- To write, test, and debug simple Python programs with conditionals, and loops and functions
- To develop Python programs with defining functions and calling them
- To understand and write python programs with compound data-lists, tuples, dictionaries
- To search, sort, read and write data from /to files in Python.

LIST OF EXPERIMENTS

- 1 Study of algorithms, flowcharts and pseudocodes.
- 2 Introduction to Python Programming and Python IDLE/Anaconda distribution.
- 3 Experiments based on Variables, Data types and Operators in Python.
- 4 Coding Standards and Formatting Output.
- 5 Algorithmic Approach: Selection control structures.
- 6 Algorithmic Approach: Iteration control structures.
- 7 Experiments based on Strings and its operations.
- 8 Experiments based on Lists and its operations.
- 9 Experiments based on Tuples and its operations.
- 10 Experiments based on Sets and its operations.
- 11 Experiments based on Dictionary and its operations.
- 12 Functions: Built-in functions.
- 13 Functions: User-defined functions.
- 14 Functions: Recursive functions.
- 15 Searching techniques: Linear and Binary.
- 16 Sorting techniques: Bubble and Merge Sort.
- 17 Experiments based on files and its operations.

Contact Hours : 75**COURSE OUTCOMES:**

On completion of the course, the students will be able to

- Understand the working principle of a computer and identify the purpose of a computer programming language and ability to identify an appropriate approach to solve the problem.

- Write, test, and debug simple Python programs with conditionals and loops.
- Develop Python programs step - wise by defining functions and calling them.
- Use Python lists, tuples, dictionaries for representing compound data.
- Apply searching, sorting on data and efficiently handle data using flat files.

TEXT BOOK(S):

- 1 Allen B. Downey, Think Python: How to Think Like a Computer Scientist, Second edition, Updated for Python3, Shroff/ O'Reilly Publishers, 2016 (<http://greenteapress.com/wp/think-python/>).
- 2 Guido Van Rossum and Fred L. Drake Jr, An Introduction to Python-Revised and updated for Python3.2, Network Theory Ltd., 2011.

REFERENCE BOOK(S) / WEB LINKS:

- 1 JohnVGutttag, Introduction to Computation and Programming Using Python, Revised and expanded Edition, MIT Press, 2013.
- 2 Robert Sedgewick, Kevin Wayne, Robert Dondero, Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd, 2016.
- 3 Timothy A.Budd, Exploring Python, Mc-Graw Hill Education (India) Private Ltd., 2015.
- 4 Kenneth A. Lambert, Fundamentals of Python: First Programs, Cengage Learning, 2012.
- 5 Charles Dierbach, Introduction to Computer Science using Python: A Computational Problem Solving Focus, Wiley India Edition, 2013.
- 6 Paul Gries, Jennifer Campbell and Jason Montojo, Practical Programming: An Introduction to Computer Science using Python3, Second edition, Pragmatic Programmers, LLC, 2013.

BM23421	ANALOG AND DIGITAL INTEGRATED CIRCUITS LABORATORY	CATEGORY	L	T	P	C
		PC	0	0	4	2

OBJECTIVES

The core objective of the course is to make the students to learn circuit simulation and hardware designing of the following circuits

- To design of combinational and sequential logic circuits.
- To design of OPAMP based amplifiers.
- To design of multivibrators
- To design of Oscillator circuits
- To design of Timer circuits for generating Delay

LIST OF EXPERIMENTS

- 1 Design of adder and subtractor circuits
- 2 Design of Encoder
- 3 Design of BCD to 7 segment decoder
- 4 Design of Multiplexer and demultiplexer using digital ICs
- 5 Design of Universal shift register using flip flops
- 6 Design of mod-N counter
- 7 Design of Inverting, non-inverting amplifier and comparator using Multisim or TINA Simulation
- 8 Design of Integrator and Differentiator using Multisim or TINA Simulation
- 9 Active filter – first order and second order LPF and HPF using Multisim or TINA Simulation

- 10 Current to Voltage convertor and Voltage to Current Convertor using Multisim or TINA Simulation
- 11 Instrumentation amplifier using IC741 using Multisim or TINA Simulation
- 12 Wein bridge oscillator using Multisim or TINA Simulation
- 13 Multivibrator using IC555 Timer using Multisim or TINA Simulation

Contact Hours : 60

COURSE OUTCOMES:

On completion of the course, the students will be able to

- Design and build Circuits for applications using Logic gates
- Design and build Circuits for different application using Combinational Logic circuits
- Design and build Circuits for different application using Sequential logic circuits
- Design OPAMP based linear and non-linear circuits
- Design oscillator and waveform generator using ICs

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	3	1	2	-	-	-	-	2	-	2	-	2	3	-
CO 2	2	3	1	2	-	-	-	-	3	-	3	-	2	3	-
CO 3	3	2	3	3	-	-	-	-	2	-	2	-	3	3	-
CO 4	3	2	3	3	-	-	-	-	2	-	2	-	3	3	-
CO 5	3	2	3	3	-	-	-	-	2	-	2	-	3	3	-
AVG.	2.8	2.4	2.2	2.6	-	-	-	-	2.2	-	2.2	-	2.6	2.8	-

BM23422

PCB DESIGN LABORATORY

CATEGORY L T P C

PC 0 0 2 1

OBJECTIVES

- To design PCB layouts of circuits required for medical applications
- To perform appropriate routing of circuit tracks in EAGLE software
- To validate the correctness of the design and circuit
- To perform the Soldering and Desoldering efficiently
- To fabricate PCBs for real-time medical applications

LIST OF EXPERIMENTS

- 1 Introduction to PCB – Trends and Technologies
- 2 Eagle Software – Demonstration on the Creation of effective routing(manual & automatic) and generation of gerber file in EAGLE
- 3 Design of a PCB schematic and layout of a Voltage regulator circuit that regulates 5 V and 12 V DC output from the AC input in EAGLE
- 4 Design of a PCB schematic and layout of Zener Diode – Line and Load Regulation Circuits in EAGLE software
- 5 Design of a PCB schematic and layout of Automatic Dark and Light Detector Circuits in

- EAGLE software
- 6 Design of a PCB schematic and layout of Fixed Bias, Emitter Bias, and Voltage Divider Bias in EAGLE software
 - 7 Design of a PCB schematic and layout of Astable and Monostable Multivibrator Circuits in EAGLE software
 - 8 Introduction – Etching, Soldering and Desoldering in PCBs
 - 9 Hands on Tutorial on Soldering and Desoldering in PCBs
 - 10 Demonstration of fabricating a circuit on PCBs from scratch.

Contact Hours : 30

COURSE OUTCOMES:

On completion of the course, the students will be able to

- Design layouts of circuits for medical applications.
- Perform efficient routing of the tracks in the software.
- Validate the correctness of the design and circuit.
- Perform the Soldering and Desoldering efficiently.
- Fabricate PCBs for real time medical applications.

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	2	3	3	3	-	2	3	1	-	3	3	1	1	1
CO 2	3	2	3	3	3	-	2	3	1	-	3	3	1	1	1
CO 3	3	2	3	3	3	-	2	3	1	-	3	3	1	1	1
CO 4	3	2	3	3	3	-	2	3	1	-	3	3	1	1	1
CO 5	3	2	3	3	3	-	2	3	1	-	3	3	1	1	1
AVG.	3	2	3	3	3	-	2	3	1	-	3	3	1	1	1

GE23421

SOFT SKILLS-I

CATEGORY L T P C

PC 0 0 2 1

PROGRAM LEARNING GOALS

This program will help our students to build confidence and improve their English communication in order to face the corporate world as well as providing them with opportunities to grow within an organization.

OBJECTIVE

- To help students break out of shyness.
- To build confidence.
- To enhance English communication skills.
- To encourage students' creative thinking to help them frame their own opinions.

LEARNING AND TEACHING STRATEGY:

The program is completely student centric where the focus is on activities led by students which include role plays, discussions, debates other games as well. These activities would be supplemented by interactive use of technology and brief trainer input.

Week	Activity Name	Description	Objective
1	Introduction	The trainer and the college facilitator talk to the students about the course and in turn the students introduce themselves.	To set expectations about the course and the students are made aware of the rules and regulations involved in this program
2	If I ruled the world	This is a quick and useful game by getting students to form a circle and provide their point of view. Each student then repeats what the other has said and comes up with their own opinion.	The aim of this activity is to for students to get to know each other and also develop their listening skills as well as learning how to agree and disagree politely.
3	Picture Narrating	This activity is based on several sequential pictures. Students are asked to tell the story taking place in the sequential pictures by paying attention to the criteria provided by the teacher as a rubric. Rubrics can include the vocabulary or structures they need to use while narrating.	The aim of this activity is to make the students develop creative way of thinking.
4	Brainstorming	On a given topic, students can produce ideas in a limited time. Depending on the context, either individual or group brainstorming is effective and learners generate ideas quickly and freely. The good characteristics of brainstorming are that the students are not criticized for their ideas so students will be open to sharing new ideas.	The activity aims at making the students speak freely without the fear of being criticized. It also encourages students to come up with their own opinions.
5	Debate	Is competition necessary in regards to the learning process?	The aim of this activity is to develop the students ability to debate and think out of the box
6	Short Talks	Here the students are given topics for which they take one minute to prepare and two minutes to speak. They can write down points but can't read them out they can only use it as a	The activity aims at breaking the students' shyness and encouraging them to standup in front of the class and speak. It also aims at creating

		reference.	awareness that they are restricted for time so they only speak points that are relevant and important.
7	Debate	Will posting students' grades on bulletin boards publicly motivate them to perform better or is it humiliating?	This activity aims at enhancing the students unbiased thought process when it comes to exams and grades as well as develop their skills to debate
8	The Art of diplomacy	The facilitator proceeds to share multiple concepts of conversation and helps the participants to identify the various methods of being diplomatic and how do deal with misinformation.	The aim of the lesson is to provide an opportunity for the participants to learn about body language and choosing the appropriate words for conversation.
9	Debate	Are humans too dependent on computers?	The aim of this activity is to test the students debating skills and thought process with a topic that affects everybody in daily life.
10	Story Completion	The teacher starts to tell a story but after 2 sentences he/she asks students to work in groups to create the rest of the story which includes the plot and the ending.	This activity aims at building their narrating skills as well as their creativity and ability to work in a team.
11	Role play debate	Students scrutinize different points of view or perspectives related to an issue. For example, a debate about the question "Should students be required to wear uniforms at school?" might yield a range of opinions. Those might include views expressed by a student (or perhaps two students – one representing each side of the issue), a parent, a school principal, a police officer, a teacher, the owner of a clothing store, and others.	The aim of this activity is to get students to speak based on other people's perspective instead of their own. The students take the role of various characters and debate accordingly.
12	I Couldn't	This is a game where students	The aim of this activity is to

	Disagree More	practice rebuttal techniques where one student provides a thought or an idea and the other students starts with the phrase I couldn't disagree more and continues with his opinion	improve general communication skills and confidence.
	Feedback	At the end of the session in the final week (12) the trainer would provide feedback to the students on best practices for future benefits	The aim is to do both give feedback to students as well as obtain feedback on the course from them.

COURSE OUTCOMES:

On completion of the course, students should be able to

- Be more confident.
- Speak in front of a large audience.
- Be better creative thinkers.
- Be spontaneous.
- Know the importance of communicating in English.