RAJALAKSHMI ENGINEERING COLLEGE

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

DEPARTMENT OF BIOMEDICAL ENGINEERING
CURRICULUM AND SYLLABUS REGULATIONS 2017
B.E BIOMEDICAL ENGINEERING

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 explode 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 instil 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)

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

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

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

CURRICULUM AND SYLLABUS

SEMESTER I

Sl.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	HS17151	Communicative English	HS	3	3	0	0	3
2.	MA17151	Engineering Mathematics I	BS	5	3	2	0	4
3.	PH17151	Engineering Physics	BS	3	3	0	0	3
4.	CY17151	Engineering Chemistry	BS	3	3	0	0	3
5.	GE17151	Problem Solving and Python Programming	ES	3	3	0	0	3
6.	GE17152	Engineering Graphics	ES	6	2	0	4	4
PRACTICALS								
7.	GE17161	Problem Solving and Python Programming Laboratory	ES	4	0	0	4	2
8.	GE17162	Physics and Chemistry Laboratory	BS	4	0	0	4	2
			TOTAL	**31**	**17**	**2**	**12**	**24**

SEMESTER II

Sl.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	HS17251/ HS17252	Technical English/ Professional English Communication	HS	3	3	0	0	3
2.	MA17251	Engineering Mathematics II	BS	5	3	2	0	4
3.	PH17252	Physical science for Biomedical Engineers	BS	3	3	0	0	3
4.	ME17202	Engineering Mechanics for Biomedical Engineers	ES	4	2	2	0	3
5.	EC17201	Electron Devices	PC	3	3	0	0	3
6.	EE17202	Electric Circuit Theory	PC	4	4	0	0	4
PRACTICALS								
7.	GE17261	Engineering Practices Laboratory	ES	4	0	0	4	2
8.	EC17211	Circuits and Devices Laboratory	PC	4	0	0	4	2
			TOTAL	**30**	**18**	**4**	**8**	**24**

SEMESTER III

Sl No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	MA17352	Linear Algebra and Partial Differential Equations	BS	5	3	2	0	4
2	BM17301	Human Anatomy and Physiology	PC	3	3	0	0	3
3	BM17302	Sensors and Measurements	PC	4	2	0	2	3
4	BM17303	Electric fields and Machines	PC	4	2	0	2	3
5	BM17304	Electronic Circuits	PC	4	4	0	0	4
6	BM17305	Biochemical Science	PC	3	3	0	0	3
PRACTICALS								
7	BM17311	Biochemistry and Physiology Laboratory	PC	4	0	0	4	2
8	BM17312	Electronic Circuits Laboratory	PC	4	0	0	4	2
9	BM17313	PCB Design Laboratory	PC	2	0	0	2	1
			TOTAL	**33**	**17**	**2**	**14**	**25**

SEMESTER IV

Sl No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	MA17353	Probability and statistics	BS	5	3	2	0	4
2	CY17251	Environmental Science and Engineering	HS	3	3	0	0	3
3	BM17401	Biomedical Instrumentation	PC	3	3	0	0	3
4	BM17402	Analog and Digital Integrated Circuits	PC	4	4	0	0	4
5	CS17201	Data Structures	ES	3	3	0	0	3
6	BM17403	Pathology and Microbiology	PC	3	3	0	0	3
PRACTICALS								
7	CS17211	Data Structures Laboratory	ES	4	0	0	4	2
8	BM17411	Analog and Digital Integrated Circuits Laboratory	PC	4	0	0	4	2
9	BM17412	Pathology and Microbiology Laboratory	PC	2	0	0	2	1
			TOTAL	**31**	**19**	**2**	**10**	**25**

SEMESTER V

Sl No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	BM17501	Principles of Communication Systems	PC	3	3	0	0	3
2	BM17502	Biocontrol Systems	PC	3	3	0	0	3
3	BM17503	Signals and Systems Analysis	PC	5	3	0	2	4
4	BM17504	Microprocessor, Microcontroller and System Design	PC	3	3	0	0	3
5	BM17505	Hospital Engineering and Management	PC	3	3	0	0	3
6		Open Elective –I	OE	3	3	0	0	3
PRACTICALS								
7	BM17511	Microprocessor, Microcontroller and System Design Laboratory	PC	4	0	0	4	2
8	BM17512	Biomedical Instrumentation Laboratory	PC	4	0	0	4	2
9	HS17361	Interpersonal Skills/ Listening and Speaking	HS	2	0	0	2	1
			TOTAL	**30**	**18**	**0**	**12**	**24**

SEMESTER VI

Sl No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	BM17601	Digital Signal Processing Techniques	PC	5	3	2	0	4
2	BM17602	Diagnostic Equipment	PC	3	3	0	0	3
3	BM17603	Biomechanics	PC	3	3	0	0	3
4	BM17604	Medical Physics	PC	3	3	0	0	3
5	BM17605	Therapeutic Equipment	PC	3	3	0	0	3
6		Open Elective –II	OE	3	3	0	0	3
PRACTICALS								
7	BM17611	Digital Signals and Processing Laboratory	PC	4	0	0	4	2
8	BM17612	Diagnostic and Therapeutic Equipment Laboratory	PC	4	0	0	4	2
9	BM17613	Medical Industrial Training	EEC	2	0	0	2	1
			TOTAL	**30**	**18**	**2**	**10**	**24**

SEMESTER VII

Sl No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	BM17701	Physiological Modeling	PC	4	2	0	2	3
2	BM17702	Digital Image Processing Techniques	PC	3	3	0	0	3
3	BM17703	Radiological Equipment	PC	3	3	0	0	3
4	BM17704	Biomaterials and Applications	PC	3	3	0	0	3
5	BM17EXX	Professional Elective - I	PE	3	3	0	0	3
6	BM17EXX	Professional Elective - II	PE	3	3	0	0	3
PRACTICALS								
7	BM17711	Digital Image Processing Laboratory	PC	4	0	0	4	2
8	BM17712	Hospital Training	PC	2	0	0	2	1
9	BM17713	Comprehension	EEC	2	0	0	2	1
			TOTAL	**27**	**17**	**0**	**10**	**22**

SEMESTER VIII

Sl No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	BM17EXX	Professional Elective - III	PE	3	3	0	0	3
2	BM17EXX	Professional Elective - IV	PE	3	3	0	0	3
PRACTICALS								
3	BM17811	Project Work	EEC	16	0	0	16	8
			TOTAL	**22**	**6**	**0**	**16**	**14**

TOTAL CREDITS: 182

PROFESSIONAL ELECTIVES (PE)

Student has to earn six credits from each of the following group

SEMESTER VII

Professional Elective I and II

Sl No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	BM17E10	Medical Optics	PE	3	3	0	0	3
2	BM17E11	Soft Computing methods	PE	3	3	0	0	3
3	BM17E12	Nanotechnology and Applications	PE	3	3	0	0	3
4	BM17E13	Rehabilitation Engineering	PE	3	3	0	0	3
5	BM17E14	Medical Safety and Quality Assurance	PE	2	2	0	0	2
6	BM17E15	Medical Robotics	PE	2	2	0	0	2
7	BM17E16	Biometric systems	PE	2	2	0	0	2
8	BM17E17	Medical Textiles	PE	1	1	0	0	1
9	BM17E18	Entrepreneurship in Biomedical Engineering	PE	1	1	0	0	1
10	BM17E19	Human Values and Medical Ethics	PE	1	1	0	0	1

SEMESTER VIII

Professional Elective III and IV

Sl No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	BM17E20	Neural Engineering	PE	3	3	0	0	3
2	BM17E21	BIOMEMS	PE	3	3	0	0	3
3	BM17E22	Medical Informatics	PE	3	3	0	0	3
4	BM17E23	Healthcare Product Development	PE	3	3	0	0	3
5	BM17E24	Embedded Systems and Application Development	PE	3	3	0	0	3
6	BM17E25	Bioelectromagnetism and Compatibility	PE	2	2	0	0	2
7	BM17E26	Virtual Reality in Medical Applications	PE	2	2	0	0	2
8	BM17E27	Wearable Systems	PE	2	2	0	0	2
9	BM17E28	Telehealth Technology	PE	1	1	0	0	1
10	BM17E29	Internet of Things in medicine	PE	1	1	0	0	1

OPEN ELECTIVES

Sl. No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	OAE1701	Introduction to Aeronautical Engineering	OE	3	3	0	0	3
2	OAE1702	Fundamentals of Jet Propulsion	OE	3	3	0	0	3
3	OAE1703	Introduction to space flight	OE	3	3	0	0	3
4	OAE1704	Industrial Aerodynamics	OE	3	3	0	0	3
5	OAT1701	Automotive Systems	OE	3	3	0	0	3
6	OAT1702	Automotive Sensors and Actuators	OE	3	3	0	0	3
7	OAT1703	Elements of Electric and Hybrid vehicles	OE	3	3	0	0	3
8	OAT1704	Fundamentals of Automotive Electronics	OE	3	3	0	0	3
9	OBT1701	Basic Bioinformatics	OE	3	3	0	0	3
10	OBT1702	Biotechnology in Product Development	OE	3	3	0	0	3
11	OBT1703	Food and Nutrition	OE	3	3	0	0	3
12	OBT1705	Applications of Biotechnology for Environmental protection	OE	3	3	0	0	3
13	OBT1706	Fermentation Technology	OE	3	3	0	0	3
14	OCH1701	Introduction to Fertilizer Technology	OE	3	3	0	0	3
15	OCH1702	Introduction to Petroleum Technology	OE	3	3	0	0	3
16	OCH1703	Unit operations in Environmental Engineering	OE	3	3	0	0	3
17	OCH1704	Process Technology	OE	3	3	0	0	3
18	OCH1705	Petrochemical Processing	OE	3	3	0	0	3
19	OCH1706	Recent trends in water treatment	OE	3	3	0	0	3
20	OCE1701	Disaster Management	OE	3	3	0	0	3
21	OCE1702	Coastal Zone Management	OE	3	3	0	0	3
22	OCE1703	Smart Structures and Smart Materials	OE	3	3	0	0	3
23	OCE1704	Non Destructive Testing of Materials	OE	3	3	0	0	3
24	OCE1705	Basics of Architecture	OE	3	3	0	0	3
25	OCE1706	Global Warming and Climate Change	OE	3	3	0	0	3
26	OCS1701	Web Design and Management	OE	3	3	0	0	3
27	OCS1702	Mobile Application Development	OE	3	3	0	0	3
28	OCS1703	Fundamentals of Database	OE	3	3	0	0	3
29	OCS1704	Web Programming with XML	OE	3	3	0	0	3
30	OCS1705	IoT and its Applications	OE	3	3	0	0	3

31	OCS1706	Programming in C	OE	4	2	0	2	3
32	OCS1707	Programming in C++	OE	4	2	0	2	3
33	OCS1708	Java Programming	OE	4	2	0	2	3
34	OCS1709	Computer Programming	OE	4	2	0	2	3
35	OEE1701	Renewable power generation systems	OE	3	3	0	0	3
36	OEE1702	Electrical safety and quality assurance	OE	3	3	0	0	3
37	OEE1704	Electric power utilization	OE	3	3	0	0	3
38	OEC1701	MEMS and its applications	OE	3	3	0	0	3
39	OEC1702	Consumer Electronics	OE	3	3	0	0	3
40	OIT1701	Data Science	OE	3	3	0	0	3
41	OIT1702	Advanced Python Programming	OE	3	3	0	0	3
42	OIT1703	Business Intelligence	OE	3	3	0	0	3
43	OIT1704	Computer Vision	OE	3	3	0	0	3
44	OIT1705	Cyber Security	OE	3	3	0	0	3
45	OIT1706	Machine Learning and R Programming	OE	3	3	0	0	3
46	OMT1701	Industrial Robotics	OE	3	3	0	0	3
47	OMT1702	Elements of Automation	OE	3	3	0	0	3
48	OMT1704	CNC Systems-Design and Applications	OE	3	3	0	0	3
49	OMT1705	Mobile Robotics	OE	3	3	0	0	3
50	OME1701	Design of Experiments	OE	3	3	0	0	3
51	OME1702	Industrial Safety	OE	3	3	0	0	3
52	OME1703	Quality Concept	OE	3	3	0	0	3
53	OME1704	Fundamentals of Production Engineering	OE	3	3	0	0	3
54	OME1705	Supply Chain and Logistics Management	OE	3	3	0	0	3
55	OME1706	Fundamentals of Mechanical Engineering	OE	3	3	0	0	3
56	OMA1701	Computer based Numerical methods	OE	4	2	0	2	3
57	OMA1702	Number theory and applications	OE	3	3	0	0	3
58	OPH1701	Materials Synthesis and Characterization Techniques	OE	3	3	0	0	3
59	OPH1702	Nanophysics	OE	3	3	0	0	3
60	OCY1701	Green Chemistry in Energy and Environment	OE	3	3	0	0	3
61	OCY1702	Interface Chemistry and Engineering	OE	3	3	0	0	3
62	OGE1701	Human Rights	OE	3	3	0	0	3
63	OGE1702	Foreign Language-Japanese	OE	3	3	0	0	3
64	OGE1703	Foreign Language-German	OE	3	3	0	0	3
65	OGE1704	Foreign Language-French	OE	3	3	0	0	3

VALUE ADDED COURSES

Sl No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	BM17V11	Instrumentation and System Design Laboratory	EEC	2	0	0	2	1
2	BM17V12	Introduction to SCI Lab	EEC	2	0	0	2	1
3	BM17V13	Introduction to R-Lab	EEC	2	0	0	2	1

HS17151 COMMUNICATIVE ENGLISH L T P C
3 0 0 3

OBJECTIVES

- To develop the basic reading and writing skills of first year engineering and technology students.
- To help learners develop their listening skills, which will enable them listen to lectures and comprehend them by asking questions; seeking clarifications.
- To help learners develop their speaking skills and speak fluently in real contexts.
- To help learners develop vocabulary of a general kind by developing their reading skills

UNIT I SHARING INFORMATION RELATED TO ONESELF/FAMILY& FRIENDS 9

Reading- short comprehension passages, practice in skimming-scanning and predicting. Writing- completing sentences- developing hints. Listening- short texts- short formal and informal conversations. Speaking- introducing oneself - exchanging personal information- Language development- Wh Questions- asking and answering yes or no questions. Subject - Verb agreement – regular and irregular verbs. Vocabulary development- prefixes- suffixes- articles.

UNIT II GENERAL READING AND FREE WRITING 9

Reading - comprehension-pre-reading-post reading- comprehension questions (multiple choice questions and /or short questions/ open-ended questions)-inductive reading- short narratives and descriptions from newspapers including dialogues and conversations (also used as short Listening texts)- register. Writing – paragraph writing- topic sentence- main ideas- free writing, short narrative descriptions using some suggested vocabulary and structures. Listening - telephonic conversations. Speaking – sharing information of a personal kind— greeting – taking leave. Language development – prepositions, conjunctions. Vocabulary development - guessing meanings of words in context.

UNIT III GRAMMAR AND LANGUAGE DEVELOPMENT 9

Reading - short texts and longer passages (close reading). Writing- understanding text structure - use of reference words and discourse markers-coherence-jumbled sentences. Listening – listening to longer texts and filling up the table- product description- narratives from different sources. Speaking- asking about routine actions and expressing opinions. Language development- degrees of comparison- pronouns- direct vs indirect questions. Vocabulary development – single word substitutes- adverbs.

UNIT IV READING AND LANGUAGE DEVELOPMENT 9

Reading - comprehension-reading longer texts - reading different types of texts - magazines. Writing- letter writing, informal or personal letters-emails-conventions of personal email. Listening- listening to dialogues or conversations and completing exercises based on them. Speaking- speaking about oneself- speaking about one's friend. Language development- Tenses- simple present-simple past- present continuous and past continuous. Vocabulary development- synonyms-antonyms- phrasal verbs

UNIT V EXTENDED WRITING 9

Reading- longer texts- close reading. Writing- brainstorming -writing short essays – developing an outline - identifying main and subordinate ideas- dialogue writing. Listening – listening to talks- conversations. Speaking – participating in conversations- short group conversations. Language development-modal verbs- present/ past perfect tense. Vocabulary development-collocations.

TOTAL: 45 PERIODS

OUTCOMES:

On completion of the course students will be able to:

- Read articles of a general kind in magazines and newspapers.
- Participate effectively in informal conversations; introduce themselves and their friends and express opinions.
- Comprehend conversations and short talks delivered in English
- Express ideas about oneself freely
- Write short essays of a general kind and personal letters and emails in English.

TEXT BOOKS:

1. Board of Editors. Using English A Course book for Undergraduate Engineers and Technologists. Orient BlackSwan Limited, Hyderabad: 2015.
2. Richards, C. Jack. Interchange Students' Book-2 New Delhi: CUP, 2015.

REFERENCES:

1. Bailey, Stephen. Academic Writing: A practical guide for students. New York: Rutledge,2011.
2. Means,L. Thomas and Elaine Langlois. English & Communication For Colleges. Cengage Learning ,USA: 2007
3. Redston, Chris &Gillies Cunningham Face2Face (Pre-intermediate Student's Book& Workbook) Cambridge University Press, New Delhi: 2005
4. Comfort, Jeremy, et al. Speaking Effectively: Developing Speaking Skills for Business English. Cambridge University Press, Cambridge: Reprint 2011
5. Dutt P. Kiranmai and RajeevanGeeta. Basic Communication Skills, Foundation Books: 2013

MA17151 ENGINEERING MATHEMATICS – I L T P C
3 2 0 4

OBJECTIVES

- To learn the basics and concepts of traditional calculus.
- To provide the basic tools of calculus mainly for the purpose of modelling the engineering problems mathematically and obtaining solutions.
- To understand the concepts of single variable and multivariable calculus that plays an important role in the field of science, engineering & technology.

UNIT I MATRICES 15

Eigen values and Eigenvectors of a real matrix – Characteristic equation – Properties of Eigen values and Eigenvectors – Cayley-Hamilton theorem – Diagonalization of matrices – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms.

UNIT II DIFFERENTIAL CALCULUS 15

Representation of functions - Limit of a function - Continuity - Derivatives - Differentiation rules - Maxima and Minima of functions of one variable.

UNIT III FUNCTIONS OF SEVERAL VARIABLES 15

Partial differentiation – Homogeneous functions and Euler's theorem – 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 IV INTEGRAL CALCULUS **15**

Definite and Indefinite integrals - Substitution rule - Techniques of Integration - Integration by parts – Bernoulli's formula, Trigonometric integrals, Trigonometric substitutions, Integration of rational functions by partial fraction, Integration of irrational functions - Improper integrals.

UNIT V MULTIPLE INTEGRALS **15**

Double integrals – Change of order of integration – Double integrals in polar coordinates – Area enclosed by plane curves – Triple integrals – Volume of solids – Change of variables in double and triple integrals.

TOTAL: 75 PERIODS

OUTCOMES:

On completion of the course students will be able to:

- Apply the concept of Eigen values and eigenvectors, diagonalization of a matrix, Symmetric matrices, Positive definite matrices and similar matrices for solving problems
- Use the techniques of differentiation to differentiate functions and to apply the concept of differentiation to solve maxima and minima problems.
- To apply the concept of Partial differentiation for functions two or more variables and use different techniques for solving problems.
- Solve problems involving integration using different methods such as substitution, partial fractions, by parts .
- Apply integration to compute multiple integrals, area, volume, integrals in polar coordinates, in addition to change of order and change of variables.

TEXT BOOKS:

1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 43rd Edition, 2014.
2. James Stewart, "Calculus: Early Transcendentals", Cengage Learning, 7th Edition, New Delhi, 2015.

REFERENCES:

1. Anton, H, Bivens, I and Davis, S, "Calculus", Wiley, 10th Edition, 2016.
2. Jain R.K. and Iyengar S.R.K., "Advanced Engineering Mathematics", Narosa Publications, New Delhi, 3rd Edition, 2007.
3. Narayanan, S. and Manicavachagom Pillai, T. K., "Calculus" Volume I and II, S. Viswanathan Publishers Pvt. Ltd., Chennai, 2007.
4. Srimantha Pal and Bhunia, S.C, "Engineering Mathematics" Oxford University Press, 2015.
5. Weir, M.D and Joel Hass, "Thomas Calculus", 12th Edition, Pearson India, 2016.
6. T. Veerarajan, Engineering Mathematics I & II, McGraw Hill Education, 3rd Edition, 2012.

PH17151 ENGINEERING PHYSICS **L T P C**
3 0 0 3

OBJECTIVE

- To enhance the fundamental knowledge in Physics and its applications relevant to various streams of Engineering and Technology.

UNIT I PROPERTIES OF MATTER **9**

Elasticity – Stress-strain diagram and its uses - factors affecting elastic modulus and tensile strength – torsional stress and deformations – twisting couple - torsion pendulum: theory and experiment - bending of beams –area moment of inertia - bending moment – cantilever -

applications – uniform and non-uniform bending- I-shaped girders - stress due to bending in beams.

UNIT II WAVES AND OPTICS 9

Oscillatory motion – forced and damped oscillations: differential equation and its solution – plane progressive waves – wave equation. Lasers: population of energy levels, Einstein's A and B coefficients derivation – resonant cavity, optical amplification (qualitative) –CO_2 laser - Semiconductor lasers: homojunction and heterojunction – Fiber optics: principle, numerical aperture and acceptance angle - types of optical fibers (material, refractive index, mode) – losses associated with optical fibers - fiber optic sensors: pressure and displacement.

UNIT III THERMAL PHYSICS 9

Transfer of heat energy – thermal expansion of solids and liquids – expansion joints - bimetallic strips - thermal conduction, convection and radiation –rectilinear heat flow – thermal conductivity - Forbe's and Lee's disc method: theory and experiment - conduction through compound media (series and parallel) – thermal insulation – applications: heat exchangers, refrigerators, ovens and solar water heaters.

UNIT IV QUANTUM PHYSICS 9

Black body radiation – Planck's theory (derivation) – Compton effect: theory and experimental verification – wave particle duality – electron diffraction – concept of wave function and its physical significance – Schrödinger's wave equation – time independent and time dependent equations – particle in a one-dimensional rigid box – tunnelling (qualitative) – electron microscope – scanning tunneling microscope.

UNIT V CRYSTAL PHYSICS 9

Single crystalline, polycrystalline and amorphous materials – single crystals: unit cell, crystal systems, Bravais lattices, directions and planes in a crystal, Miller indices – inter-planar distances -reciprocal lattice - coordination number and packing factor for SC, BCC, FCC, and HCP – Polymorphism and allotropy: diamond and graphite structures - crystal imperfections: point defects, line defects – Burger vectors, stacking faults – role of imperfections in plastic deformation - growth of single crystals: solution and melt growth techniques.

TOTAL :45 PERIODS

OUTCOMES:

On completion of the course students will be able to

- Apply the knowledge of basic properties of matter and its applications in Engineering and Technology.
- Use the concepts of waves and optical devices and their applications in fiber optics.
- Use the concepts of thermal properties of materials and their applications in heat exchangers.
- Use the advanced physics concepts of quantum theory and its applications in tunneling microscopes.
- Apply the basics of crystals, their structures and different crystal growth techniques in fabrication of devices.

TEXT BOOKS:

1. Bhattacharya, D.K. & Poonam, T. "Engineering Physics". Oxford University Press, 2015
2. Gaur, R.K. & Gupta, S.L. "Engineering Physics". Dhanpat Rai Publishers, 2012
3. Pandey, B.K. & Chaturvedi, S. "Engineering Physics". Cengage Learning India, 2012.

REFERENCES:

1. Halliday, D., Resnick, R. & Walker, J. "Principles of Physics". Wiley, 2015.
2. Serway, R.A. & Jewett, J.W. "Physics for Scientists and Engineers". Cengage Learning, 2010.
3. Tipler, P.A. &Mosca, G. "Physics for Scientists and Engineers with Modern Physics'. W.H.Freeman, 2007.
4. Arthur Besier and S. RaiChoudhury,Concepts of Modern Physics (SIE), 7th edition, McGraw-Hill Education, 1994.
5. R. Murugeshan and Kiruthiga Sivaprasath, Modern Physics, S.Chand, 2015.

CY17151	ENGINEERING CHEMISTRY	L	T	P	C
		3	0	0	3

OBJECTIVES

- To acquire knowledge on characteristics of boiler feed water and water treatment techniques.
- To develop an understanding on surface chemistry and its applications
- To develop an understanding of the basic concepts of phase rule and its applications towards alloying
- To acquire knowledge on different types of fuels and its characteristics.
- To obtain knowledge on batteries and fuel cell.

UNIT I WATER AND ITS TREATMENT 9

Hardness of water – types – expression of hardness – units– boiler troubles (scale and sludge) – treatment of boiler feed water – Internal treatment (phosphate, colloidal, sodium aluminate and calgon conditioning) - External treatment – ion exchange process, zeolite process – potable water treatment – break point chlorination - desalination of brackish water - Reverse Osmosis – UASB process (Upflow Anaerobic Sludge Blanket).

UNIT II SURFACE CHEMISTRY AND CATALYSIS 9

Adsorption - types of adsorption – adsorption of gases on solids – adsorption of solute from solutions – adsorption isotherms – Freundlich's adsorption isotherm – Langmuir's adsorption isotherm – contact theory – Preparation and applications of activated carbon (up flow and down flow process) -applications of adsorption on pollution abatement. Catalysis – types of catalysis – criteria – autocatalysis – catalytic poisoning and catalytic promoters - acid base catalysis – applications (catalytic convertor) – enzyme catalysis– Michaelis – Menten equation.

UNIT III PHASE RULE, ALLOYS AND COMPOSITES 9

Phase rule - introduction, definition of terms with examples, one component system -water system - reduced phase rule - thermal analysis and cooling curves - two component systems - lead-silver system - Pattinson process. Alloys - definition- properties of alloys- significance of alloying- functions and effect of alloying elements- nichrome and stainless steel (18/8) – heat treatment of steel. Composites- polymer matrix composites -metal matrix composites-ceramic matrix composites.

UNIT IV FUELS AND COMBUSTION 9

Fuels - classification of fuels - coal - analysis of coal (proximate and ultimate) - carbonization - manufacture of metallurgical coke (Otto Hoffmann method) - petroleum - manufacture of synthetic petrol (Bergius process) - knocking - octane number - diesel oil - cetane number - natural gas - compressed natural gas (CNG) - liquefied petroleum gas (LPG) - power alcohol and biodiesel.

Combustion of fuels - introduction - calorific value - higher and lower calorific values- theoretical calculation of calorific value - ignition temperature - spontaneous ignition temperature - explosive range.

UNIT V ENERGY SOURCES AND STORAGE DEVICES 9

Batteries - components – Characteristics – voltage , current , capacity, electrical storage density, energy density, discharge rate – types of batteries – primary battery (dry cell)- secondary battery (lead acid battery, Ni- Cd battery, lithium-ion-battery) .Fuel cells – H_2-O_2 fuel cell, methanol oxygen fuel cell, Proton exchange membrane fuel cell – SOFC and Biofuel cells

TOTAL: 45 PERIODS

OUTCOMES:

On completion of the course students will be able to

- Get familiarized on water treatment techniques.
- Apply adsorption phenomena on various fields.
- Analyse alloying composition based on phase rule concept.
- Apply the role of fuels in day today applications.
- Design batteries and fuel cells.

TEXT BOOKS:

1. P. C. Jain and Monika Jain, "Engineering Chemistry" 17th edition DhanpatRai Publishing Company (P) LTD, New Delhi, 2015
2. S. Vairam, P. Kalyani and Suba Ramesh, "Engineering Chemistry", Wiley India PVT, LTD, New Delhi, 2013

REFERENCES:

1. Friedrich Emich, "Engineering Chemistry", Scientific International PVT, LTD, New Delhi, 2014.
2. PrasantaRath, "Engineering Chemistry", Cengage Learning India PVT, LTD, Delhi, 2015.
3. ShikhaAgarwal, "Engineering Chemistry-Fundamentals and Applications", Cambridge University Press, Delhi, 2015.
4. S. S. Dara and S. S. Umare, "A Textbook of Engineering Chemistry", 12th edition S. Chand & Company LTD, New Delhi, 2015

GE17151 PROBLEM SOLVING AND PYTHON PROGRAMMING L T P C
3 0 0 3

OBJECTIVES

- To know the basics of algorithmic problem solving
- To develop Python programs with conditionals and loops.
- To define Python functions and call them.
- To use Python data structures — lists, tuples, dictionaries.
- To do input/output with files in Python.

UNIT I ALGORITHMIC PROBLEM SOLVING 9

Introduction to computers - characteristics - basic organization of a computer – algorithms - building blocks of algorithms (instructions/statements, state, control flow, functions) - notation (pseudo code, flow chart, programming language) - algorithmic problem solving - simple strategies for developing algorithms (iteration, recursion).

UNIT II DATA, EXPRESSIONS, STATEMENTS AND CONTROL FLOW 9

Python interpreter and interactive mode - values and types - data types – variables – keywords - expressions and statements - python I/O - operators - precedence of operators – comments. Conditionals: conditional (if) - alternative (if-else) - chained conditional (if-elif-else) – nested conditional. Iteration: while – for - break – continue – pass. Illustrative programs: exchange the values of two variables - circulate the values of n variables - test for leap year.

UNIT III FUNCTIONS 9

Function calls – type conversion – math function – composition - definition and use - flow of execution - parameters and arguments. Fruitful functions: return values – parameters - scope: local and global - recursion. Strings: string slices – immutability - string functions and methods - string comparison. Illustrative programs: square root – GCD – exponentiation - sum the array of numbers - linear search - binary search.

UNIT IV COMPOUND DATA: LISTS, TUPLES AND DICTIONARIES 9

Lists - list operations - list slices - list methods - list loop – mutability – aliasing - cloning lists - list parameters. Tuples – immutable - tuple assignment - tuple as return value. Dictionaries: operations and methods – dictionaries and tuples – dictionaries and lists. Advanced list processing - list comprehension. Illustrative programs: Sorting.

UNIT V FILES, MODULES AND PACKAGES 9

Files and exception: file operation - text files - reading and writing files - format operator- command line arguments - errors and exceptions - handling exceptions – writing modules – packages. Illustrative programs: word count - copy file – case studies.

TOTAL: 45 PERIODS

OUTCOMES:

On completion of the course students will be able to

- Develop algorithmic solutions to simple computational problems.
- Structure simple Python programs for solving problems.
- Decompose a Python program into functions.
- Represent compound data using Python lists, tuples and dictionaries.
- Read and write data from/to files in Python programs.

TEXT BOOK:

1. Allen B. Downey, Think Python: How to Think Like a Computer Scientist, Second edition, Updated for Python 3, Shroff/O'Reilly Publishers, 2016 (http://greenteapress.com/wp/think-python/)

REFERENCES:

1. Anita Goel, Ajay Mittal, Computer Fundamentals and programming in C, Pearson India Publisher, First edition, 2013.
2. John V Guttag, Introduction to Computation and Programming Using Python, Revised and expanded Edition, MIT Press, 2013
3. Robert Sedgewick, Kevin Wayne, Robert Dondero, Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016.
4. Timothy A. Budd, Exploring Python, Mc-Graw Hill Education (India) Private Ltd. 2015.
5. Kenneth A. Lambert, Fundamentals of Python: First Programs, CENGAGE Learning, 2012.
6. Charles Dierbach, Introduction to Computer Science using Python: A Computational Problem-Solving Focus, Wiley India Edition, 2013.
7. The Python Tutorial, https://docs.python.org/2.7/tutorial/

GE17152	ENGINEERING GRAPHICS	L T P C 2 0 4 4

OBJECTIVES

- To develop in students, graphic skills for communication of concepts, ideas and design of Engineering products.
- To expose them to existing national standards related to technical drawings.
- To study different type of projections, and practice him on free hand sketching.

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.

UNIT I PLANE CURVES AND FREE HAND SKETCHING 7+12

Basic Geometrical constructions, Curves used in engineering practices: Conics – Construction of ellipse, parabola and hyperbola by eccentricity method – Construction of cycloid – construction of involutes of square and circle – Drawing of tangents and normal to the above curves – Construction of helical curve.

Visualization concepts and Free Hand sketching: Visualization principles –Representation of Three Dimensional objects – Layout of views- Freehand sketching of multiple views from pictorial views of objects

UNIT II PROJECTION OF POINTS, LINES AND PLANE SURFACE 6+12

Orthographic projection- principles-Principal planes-First angle projection-projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method and traces Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.

UNIT III PROJECTION OF SOLIDS 5+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.

UNIT IV PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES 5+12

Sectioning of above solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other – obtaining true shape of section. Development of lateral surfaces of simple and sectioned solids – Prisms, pyramids cylinders and cones. Development of lateral surfaces of solids with cut-outs and holes

UNIT V ISOMETRIC AND PERSPECTIVE PROJECTIONS 6+12

Principles of isometric projection – isometric scale –Isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions - Perspective projection of simple solids-Prisms, pyramids and cylinders by visual ray method .

TOTAL: 90 PERIODS

OUTCOMES:

On completion of the course students will be able to

- perform freehand sketching of basic geometrical constructions and multiple views of objects.

- do the conic curves and special curves.
- do orthographic projection of lines and plane surfaces.
- draw projections of solids and development of surfaces.
- draw isometric and perspective projections of simple solids.

TEXT BOOKS:

1. Bhatt N.D. and Panchal V.M., "Engineering Drawing", Charotar Publishing House, 50th Edition, 2010.
2. Natrajan K.V., "A text book of Engineering Graphics", Dhanalakshmi Publishers, Chennai, 2009.

REFERENCES:

1. Basant Agarwal and Agarwal C.M., "Engineering Drawing", Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.
2. Gopalakrishna K.R., "Engineering Drawing" (Vol. I&II combined), Subhas Stores, Bangalore, 2007.
3. Luzzader, Warren.J. and Duff,John M., "Fundamentals of Engineering Drawing with an introduction to Interactive Computer Graphics for Design and Production, Eastern Economy Edition, Prentice Hall of India Pvt. Ltd, New Delhi, 2005.
4. Venugopal K. and Prabhu Raja V., "Engineering Graphics", New Age International (P) Limited, 2008.
5. Shah M.B., and Rana B.C., "Engineering Drawing", Pearson, 2nd Edition, 2009.

Publication of Bureau of Indian Standards:

1. IS 10711 – 2001: Technical products Documentation – Size and lay out of drawing sheets.
2. IS 9609 (Parts 0 & 1) – 2001: Technical products Documentation – Lettering.
3. IS 10714 (Part 20) – 2001 & SP 46 – 2003: Lines for technical drawings.
4. IS 11669 – 1986 & SP 46 – 2003: Dimensioning of Technical Drawings.
5. IS 15021 (Parts 1 to 4) – 2001: Technical drawings – Projection Methods.

Assessment:

Special points applicable to University Examinations on Engineering Graphics:

1. There will be five questions, each of either or type covering all units of the syllabus.
2. All questions will carry equal marks of 20 each making a total of 100.
3. The answer paper shall consist of drawing sheets of A3 size only. The students will be permitted to use appropriate scale to fit solution within A3 size.
4. The examination will be conducted in appropriate sessions on the same day

GE17161 PROBLEM SOLVING AND PYTHON PROGRAMMING LABORATORY

L	T	P	C
0	0	4	2

OBJECTIVES

- To be familiar with the use of office package exposed to presentation and visualization tools.
- To implement Python programs with conditionals and loops.
- To use functions for structuring Python programs.
- To represent compound data using Python lists, tuples and dictionaries.
- To read and write data from/to files in Python.

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LIST OF PROGRAMS

1. Search, generate, manipulate data using Open Office
2. Presentation and Visualization – graphs, charts, 2D, 3D
3. Problem formulation, Problem Solving and Flowcharts
4. Compute the GCD of two numbers.
5. Find the square root of a number (Newton's method)
6. Exponentiation (power of a number)
7. Linear search and Binary search
8. First n prime numbers
9. Find the maximum of a list of numbers
10. Sorting
11. Removing all the duplicate elements in a list
12. Multiply matrices
13. Programs that take command line arguments (word count)
14. Find the most frequent words in a text read from a file
15. Mini Project

TOTAL: 60 PERIODS

Platform needed

Hardware : PC with 2 GB RAM, i3 Processor
Software : Python 3 interpreter for Windows/Linux

OUTCOMES:

On completion of the course students will be able to

- Develop documentation, presentation and visualization charts.
- Implement Python programs with conditionals and loops.
- Develop Python programs stepwise by defining functions and calling them.
- Use Python lists, tuples and dictionaries for representing compound data.
- Read and write data from/to files in Python

GE17162	PHYSICS AND CHEMISTRY LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES

- To introduce different experiments to test basic understanding of physics concepts applied in optics, thermal physics, and properties of matter.
- To impart practical skills in water quality parameter analysis, spectrophotometry, flame photometry and corrosion rate determination.

LIST OF EXPERIMENTS: PHYSICS LABORATORY (Any 5 Experiments)

1. Determination of rigidity modulus – Torsion pendulum
2. Determination of Young's modulus by non-uniform bending method
3. (a) Determination of wavelength, and particle size using Laser
   (b) Determination of acceptance angle in an optical fiber.
4. Determination of thermal conductivity of a bad conductor – Lee's Disc method.
5. Determination of velocity of sound and compressibility of liquid – Ultrasonic interferometer
6. Determination of wavelength of mercury spectrum – spectrometer grating
7. Determination of thickness of a thin wire – Air wedge method

TOTAL: 30 PERIODS

LIST OF EXPERIMENTS: CHEMISTRY LABORATORY (Any 7 Experiments)

1. Estimation of HCl using Na_2CO_3 as primary standard and Determination of alkalinity in water sample.
2. Determination of total, temporary & permanent hardness of water by EDTA method.
3. Determination of DO content of water sample by Winkler's method.
4. Determination of chloride content of water sample by argentometric method.
5. Determination of strength of given hydrochloric acid using pH meter.
6. Estimation of iron content of the given solution using potentiometer.
7. Conductometric titration of strong acid vs strong base.
8. Determination of strength of acids in a mixture of acids using conductivity meter.
9. Estimation of copper content of the given solution by Iodometry.
10. Estimation of iron content of the water sample using spectrophotometer (1, 10-Phenanthroline / thiocyanate method).
11. Estimation of sodium and potassium present in water using flame photometer.
12. Corrosion experiment-weight loss method.

TOTAL: 30 PERIODS

OUTCOMES:

On completion of the course students will be able to

- Calculate elastic properties of materials, such as Young's modulus & Rigidity modulus (of solids) and Bulk modulus (through compressibility of liquids).
- Measure various optical and thermal properties of materials (such as wavelengths of spectral lines & Laser source, acceptance angle &numerical aperture of fiber optical cable and thermal conductivity of media).
- Analyse water quality parameters.
- Be familiar in the use of instruments for chemical analysis.
- Measure the corrosion rate in metals.

TEXTBOOK:

1. Vogel's Textbook of Quantitative Chemical Analysis (8^{TH} edition, 2014)

HS17251	TECHNICAL ENGLISH	L	T	P	C
		3	0	0	3

OBJECTIVES

- Develop strategies and skills to enhance their ability to read and comprehend engineering and technology texts.
- Foster their ability to write convincing job applications and effective reports.
- Develop their speaking skills to make technical presentations, participate in group discussions.
- Strengthen their listening skill which will help them comprehend lectures and talks in their areas of specialization.

UNIT I INTRODUCTION TO TECHNICAL ENGLISH 9

Listening- listening to talks mostly of a scientific/technical nature and completing information-gap exercises. Speaking –asking for and giving directions. Reading – reading short technical texts from

journals- newspapers. Writing- purpose statements – extended definitions – issue- writing instructions – checklists-recommendations. Vocabulary Development- technical vocabulary. Language Development –subject verb agreement - compound words.

UNIT II READING AND STUDY SKILLS 9

Listening- listening to longer technical talks and completing exercises based on them. Speaking – describing a process. Reading – reading longer technical texts- identifying the various transitions in a text- paragraphing. Writing- interpreting charts, graphs. Vocabulary Development-vocabulary used in formal letters/emails and reports. Language Development- impersonal passive voice, numerical adjectives.

UNIT III TECHNICAL WRITING AND GRAMMAR 9

Listening- listening to classroom lectures/ talks on engineering/technology. Speaking – introduction to technical presentations. Reading – longer texts both general and technical, practice in speed reading. Writing-Describing a process, use of sequence words. Vocabulary Development-sequence words. Misspelled words. Language Development- embedded sentences

UNIT IV REPORT WRITING 9

Listening- listening to documentaries and making notes. Speaking – mechanics of presentations. Reading – reading for detailed comprehension. Writing- email etiquette- job application – cover letter. Résumé preparation (via email and hard copy)- analytical essays and issue based essays. Vocabulary Development- finding suitable synonyms-paraphrasing. Language Development-clauses- if conditionals.

UNIT V GROUP DISCUSSION AND JOB APPLICATIONS 9

Listening- TED talks; Speaking –participating in a group discussion. Reading– reading and understanding technical articles. Writing– writing reports- minutes of a meeting- accident and survey. Vocabulary Development- verbal analogies, foreign words and phrases Language Development- reported speech, common errors in English.

TOTAL: 45 PERIODS

OUTCOMES:

On completion of the course students will be able to

- Read technical texts and write area- specific texts effortlessly.
- Listen and comprehend lectures and talks in their area of specialization successfully.
- Speak appropriately and effectively in varied formal and informal contexts.
- Write reports and winning job applications.
- Write error free language.

TEXT BOOKS:

1. Board of editors. Fluency in English A Course book for Engineering and Technology. Orient Blackswan, Hyderabad: 2016
2. Sudharshana.N.P and Saveetha. C. English for Technical Communication. Cambridge University Press: New Delhi, 2016.

REFERENCES:

1. Raman, Meenakshi and Sharma, Sangeetha- Technical Communication Principles and Practice.Oxford University Press: New Delhi,2014.
2. Kumar, Suresh. E. Engineering English. Orient Blackswan: Hyderabad,2015
3. Booth-L. Diana, Project Work, Oxford University Press, Oxford: 2014.
4. Grussendorf, Marion, English for Presentations, Oxford University Press, Oxford: 2007

5. Means, L. Thomas and Elaine Langlois, English & Communication For Colleges. Cengage Learning, USA: 2007
   Students can be asked to read Tagore, Chetan Bhagat and for supplementary reading.

HS17252 PROFESSIONAL ENGLISH COMMUNICATION L T P C
3 0 0 3

OBJECTIVES

- To prepare students to be competent in a global business environment.
- To think accurately, clearly and deeply in communicative contexts.
- To improve career opportunities – get English language skills that are needed to be successful.

UNIT I CRITICAL/ INFORMATIONAL LISTENING 9

Short conversations or Monologues – Listening for specific information- Conversations or Monologues with factual information- listen to fill up missing information- business related discussions or interview (two or more speakers).

UNIT II CONVERSATIONAL/ PRESENTATION SKILLS 9

Speak about oneself - Face-to-face speaking for real-life context – pick and talk - personal opinion on business related topics- mini presentations on a business theme- discussion with another candidate on business related topics.

UNIT III INTENSIVE/ EXTENSIVE READING AND INTERPRETING 9

Short texts (signs, messages, emails, labels and notes) -Short descriptions-graph or chart. Reading to find factual information- decision making from a written text- a leaflet or a newspaper-magazine or article- reading to understand correct grammar, contextually- reading to understand the structure of a text-read and transfer information from memos, advertisements, notices.

UNIT IV FORMAL COMMUNICATION 9

Business Correspondence - writing business letters to people outside the company. Internal Company Communication- a note, a message, a memo or an email.

UNIT V VERBAL ABILITY/ FUNCTIONAL GRAMMAR 9

Grammar – tenses – concord- prepositions – articles- punctuations. Vocabulary – advanced vocabulary – synonyms and antonyms. Sentence correction – sentence completion - cloze passage - verbal reasoning: analogies, meaning - usage match.

TOTAL: 45 PERIODS

OUTCOMES:

On completion of the course students will be able to

- Listen to, understand and give opinions in meetings.
- Apply for new jobs and develop their career.
- Write short business messages and reports.
- Use language in both official and unofficial contexts.
- Speak effectively in business communication

TEXT BOOK:

1. Board of Editors. Sure Outcomes. A Communication Skills Course for Undergraduate Engineers and Technologists. Orient Black Swan Limited, Hyderabad, 2013.

REFERENCES:

1. Hartley, Mary. "The Power of Listening," Jaico Publishing House; First Edition (2015).
2. Chambers, Harry. "Effective Communication Skills for Scientific and Technical Professionals," Persues Publishing, Cambridge, Massachusetts, 2000.
3. Lesikar V. Raymond, Flatley E. Marie, Rentz, Kathryn and Pande, Neerja. "Business Communication," Eleventh Edition, Tata McGraw Hill Education Private Limited

MA17251 ENGINEERING MATHEMATICS – II L T P C
3 2 0 4

OBJECTIVES

- To handle practical problems arising in the field of engineering and technology.
- To solve problems using the concept of Matrices, Vectors calculus, complex analysis, Laplace transforms.

UNIT I DIFFERENTIAL EQUATIONS 15

Higher order linear differential equations with constant coefficients - Method of variation of parameters – Homogenous equation of Euler's and Legendre's type – System of simultaneous linear differential equations with constant coefficients - Method of undetermined coefficients.

UNIT II VECTOR CALCULUS 15

Gradient and directional derivative – Divergence and curl - Vector identities – Irrotational and Solenoidal vector fields – Line integral over a plane curve – Surface integral - Area of a curved surface - Volume integral - Green's, Gauss divergence and Stoke's theorems – Verification and application in evaluating line, surface and volume integrals (cubes and parallelepipeds).

UNIT III ANALYTIC FUNCTIONS 15

Analytic functions – Necessary and sufficient conditions for analyticity in Cartesian and polar coordinates - Properties – Harmonic conjugates – Construction of analytic function - Conformal mapping – Mapping by functions $w = z + c, cz, \frac{1}{z}, z^2$ - Bilinear transformation.

UNIT IV COMPLEX INTEGRATION 15

Cauchy's integral theorem – Cauchy's integral formula – Taylor's and Laurent's series – Singularities – Residues – Residue theorem – Application of residue theorem for evaluation of real integrals – Use of circular contour and semicircular contour.

UNIT V LAPLACE TRANSFORMS 15

Existence conditions – Transforms of elementary functions – Transform of unit step function and unit impulse function – Basic properties – Shifting theorems -Transforms of derivatives and integrals – Initial and final value theorems – Inverse transforms – Convolution theorem – Transform of periodic functions – Application to solution of linear second order ordinary differential equations with constant coefficients.

TOTAL: 75 PERIODS

OUTCOMES :

On completion of the course students will be able to:

- Apply various techniques in solving differential equations.

- Use the concept of Gradient, divergence and curl of a vector point function and related identities in different areas of Engineering.
- Evaluate line, surface and volume integrals using Gauss, Stokes and Green's theorems and their verification.
- Use the concept of Analytic functions, conformal mapping and complex integration for solving problems.
- Use Laplace transform and inverse transform techniques in solving differential equations.

TEXT BOOKS:

1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 43rd Edition, 2014.
2. Kreyszig Erwin, "Advanced Engineering Mathematics ", John Wiley and Sons, 10th Edition, New Delhi, 2016.

REFERENCES:

1. Bali N., Goyal M. and Watkins C., "Advanced Engineering Mathematics", Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), New Delhi, 7th Edition, 2009.
2. Jain R.K. and Iyengar S.R.K., " Advanced Engineering Mathematics ", Narosa Publications, New Delhi , 3rd Edition, 2007.
3. O'Neil, P.V. "Advanced Engineering Mathematics", Cengage Learning India Pvt., Ltd, New Delhi, 2007.
4. Sastry, S.S, "Engineering Mathematics", Vol. I & II, PHI Learning Pvt. Ltd, 4th Edition, New Delhi, 2014.
5. Wylie, R.C. and Barrett, L.C., "Advanced Engineering Mathematics "Tata McGraw Hill Education Pvt. Ltd, 6th Edition, New Delhi, 2012.
6. T. Veerarajan, Engineering Mathematics I & II, McGraw Hill Education, 3rd Edition, 2012.

PH17252	PHYSICAL SCIENCE FOR BIOMEDICAL ENGINEERS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the essential principles of Physics of semiconductor device and Electron transport properties.
- To become proficient in magnetic, dielectric properties of materials.
- To get basic knowledge in chemical properties related to biomedical applications

UNIT I ELECTRICAL PROPERTIES OF MATERIALS 9

Classical free electron theory - Expression for electrical conductivity – Thermal conductivity, expression - Wiedemann-Franz law – Success and failures - electrons in metals – Particle in a three dimensional box – degenerate states – Fermi- Dirac statistics – Density of energy states – Electron in periodic potential: Bloch theorem – metals and insulators - Energy bands in solids– tight binding approximation - Electron effective mass – concept of hole.

UNIT II SEMICONDUCTOR PHYSICS 9

Intrinsic Semiconductors – Energy band diagram – direct and indirect semiconductors – Carrier concentration in intrinsic semiconductors – extrinsic semiconductors - Carrier concentration in N-type & P-type semiconductors – Carrier transport: Velocity-electric field relations – drift and diffusion transport - Einstein's relation – Hall effect and devices – Zener and avalanche breakdown in p-n junctions - Ohmic contacts – tunnel diode - Schottky diode – MOS capacitor - power transistor.

UNIT III MAGNETIC AND DIELECTRIC PROPERTIES OF MATERIALS 9

Magnetism in materials – magnetic field and induction – magnetization - magnetic permeability and susceptibility–types of magnetic materials – microscopic classification of magnetic materials - Ferromagnetism: origin and exchange interaction- saturation magnetization and Curie temperature – Domain Theory. Dielectric materials: Polarization processes – dielectric loss – internal field – Clausius-Mosotti relation- dielectric breakdown – high-k dielectrics.

UNIT IV ELECTROCHEMISTRY AND CORROSION 9

Electrochemical cell - redox reaction, electrode potential- origin of electrode potential- oxidation potential- reduction potential, measurement and applications - electrochemical series and its significance - Nernst equation (derivation and problems). Corrosion- causes- factors- types- chemical, electrochemical corrosion (galvanic, differential aeration), corrosion control - material selection and design aspects - electrochemical protection – sacrificial anode method and impressed current cathodic method. Paints- constituents and function. Electroplating of Copper and electroless plating of nickel.

UNIT V FUNDAMENTALS OF NUCLEAR SCIENCE 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 - applications of radioisotopes as tracers - chemical investigations, analytical applications, agricultural and industrial applications - neutron activation analysis - carbon dating - use of nuclear reactions - radioisotopes as source of electricity - nuclear medicines.

TOTAL : 45 PERIODS

OUTCOMES:

On completion of the course students will able to

- Apply the knowledge of classical, quantum theories and energy band structures in electronic devices.
- Understand and apply the knowledge of semiconductor physics in electronic devices.
- Apply the knowledge of magnetic and dielectric properties of materials in biomedical instruments.
- Analyze the corrosive behaviour of materials in bioimplants.
- Identify radioactive materials for nuclear medicine.

TEXT BOOKS:

1. Kasap, S.O. "Principles of Electronic Materials and Devices", McGraw-Hill Education, 2007.
2. Umesh K Mishra &Jasprit Singh, "Semiconductor Device Physics and Design", Springer, 2008.
3. Wahab, M.A. "Solid State Physics: Structure and Properties of Materials". Narosa Publishing House, 2009.

REFERENCES:

1. Garcia, N. & Damask, A. "Physics for Computer Science Students". Springer-Verlag, 2012.
2. Ashima Srivastava and Janhavi N N., "Concepts of Engineering Chemistry", ACME Learning Private Limited., New Delhi., 2010.
3. RenuBapna and Renu Gupta., "Engineering Chemistry", Macmillan India PublisherLtd., 2010.
4. W. Loveland, D. Morrissey, G. Seaborg. Modern Nuclear Chemistry, Wiley-Interscience, Hoboken, NJ, 2006

5. Arnikar, H. J., Essentials of Nuclear Chemistry, 4th Edn., New Age International Publishers Ltd., New Delhi, 1995
6. Charles Kittel, Introduction to Solid State Physics, 8th Edition, Willey India Pvt.Ltd, 2005.
7. S. O. Pillai, Solid state physics, New Age International, 2015.
8. Arthur Besier and S. RaiChoudhury,Concepts of Modern Physics (SIE), 7th edition, McGraw-Hill Education, 1994.
9. J.B.Rajam, Atomic Physics, 7th edition, S.Chand, 2010.
10. B.L.Theraja, Modern Physics, 16th edition, S.Chand, 2012.

ME17202 ENGINEERING MECHANICS FOR BIOMEDICAL ENGINEERS

L	T	P	C
2	2	0	3

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

OUTCOMES:

On completion of the course students will be able to

- Use scalar and vector analytical techniques for analysing 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 BOOKS:

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.
3. Ramamrutham S and Narayanan R, "Strength of Materials" Dhanpat Rai Publications, 2011

REFERENCES:

1. Vela Murali, "Engineering Mechanics", Oxford University Press (2010).
2. Frank Bell, "Principles of Mechanics and Biomechanics", Stanley Thorne (Publishers) Ltd., 1998.
3. Lee Waite, "Biofluid Mechanics in Cardiovascular Systems", The McGraw-Hill Companies, 2006.

EC17201	ELECTRON DEVICES	L	T	P	C
		3	0	0	3

OBJECTIVES

- To study the construction, theory and operation of basic electronic devices such as PN junction diode
- To study in detail about the operation and characteristic features of BJT
- To introduce the structure and terminal characteristics of FET and MOSFET
- To allow the students to acquire knowledge about special semiconductor devices
- To study the extension of semiconductor devices on power and display devices

UNIT I SEMICONDUCTOR DIODE 9

PN junction diode, current equations, energy band diagram, diffusion and drift current densities, forward and reverse bias characteristics, Transition and Diffusion capacitances, Switching characteristics, Breakdown in PN junction diodes, applications of PN diode.

UNIT II BIPOLAR JUNCTION TRANSISTORS 9

NPN & PNP Configurations -operations-Early effect-current equations – input and output characteristics of CE, CB, CC - h-parameter model -Hybrid -π model - Eber's Moll model- Multi emitter transistor.

UNIT III FIELD EFFECT TRANSISTORS 9

JFET–drain and transfer characteristics,-current equations-Pinch off voltage and its significance-MOSFET- threshold voltage -channel length modulation, D-MOSFET, E-MOSFET- characteristics – comparison of MOSFET with JFET.

UNIT IV SPECIAL SEMICONDUCTOR DEVICES 9

Metal semiconductor Junction- MESFET, FINFET, PINFET, CNTFET, DUAL GATE MOSFET- Schottky barrier diode-Zener diode-Varactor diode –Tunnel diode- Gallium Arsenide device, LASER diode, LDR – Characteristics curve and its advantages

UNIT V POWER DEVICES AND DISPLAY DEVICES 9

UJT, SCR, Diac, Triac, Power BJT- Power MOSFET- DMOS-VMOS. Opto electronic and display devices-characteristics.

TOTAL: 45 PERIODS

OUTCOMES:

On completion of the course students will be able to

- Describe the essence of the diode functions and its characteristics
- Analyze the BJT terminal characteristics and its utilization in circuit models
- Develop a high degree of familiarity with the FET and MOSFET
- Analyze the characteristics of special semiconductor devices for their suitable applications
- Analyze the components associated with power control and opto-electronic devices

TEXT BOOKS:

1. Donald A Neaman, “Semiconductor Physics and Devices”, Fourth Edition, Tata Mc GrawHill Inc. 2012.
2. Salivahanan. S, Suresh Kumar. N, Vallavaraj.A, “Electronic Devices and circuits”, Third Edition, Tata McGraw- Hill, 2008.

REFERENCES:

1. Boylestad and Louis Nashelsky, “Electron Devices and Circuit Theory” Pearson Prentice Hall, 10th edition, July 2008.
2. S.Sedha, “A Text Book of Applied Electronics” S.Chand Publications, 2006.
3. Yang, “Fundamentals of Semiconductor devices”, McGraw Hill International Edition, 1978.

EE17202	ELECTRIC CIRCUIT THEORY	L	T	P	C
		4	0	0	4

OBJECTIVES

- To introduce electric circuits and its analysis.
- To provide knowledge on solving circuits using network theorems
- To introduce the phenomenon of resonance in series and parallel circuits.
- To impart knowledge on obtaining the transient response of RC, RL and RLC circuits.
- To provide knowledge on three phase circuits.

UNIT I DC CIRCUITS ANALYSIS 12

Ohm’s Law – Kirchoff’s laws – Resistors in series and parallel circuits – Mesh current and node voltage method of analysis, Source transformation, voltage and current division method - Network reduction using circuit theorems- Thevenin’s and Norton’s Theorem – Superposition Theorem – Maximum power transfer theorem – Reciprocity Theorem.

UNIT II AC CIRCUIT ANALYSIS 12

Series and Parallel RL, RC and RLC circuits, Phasor Diagram – Power, Power Factor - star delta conversion – Network reduction using circuit theorems for AC circuits.

UNIT III RESONANCE AND COUPLED CIRCUITS 12

Series and parallel resonance –frequency response – Quality factor and Bandwidth - Self and mutual inductance – Coefficient of coupling –Tuned Circuits-Single Tuned Circuits

UNIT IV TRANSIENT RESPONSE FOR DC AND AC CIRCUITS 12

Transient response of RL, RC and RLC Circuits using Laplace transform for DC input and A.C. sinusoidal input.

UNIT V THREE PHASE CIRCUITS 12

Three phase balanced / unbalanced voltage sources – analysis of three phase 3-wire and 4-wire circuits with star and delta connected loads, balanced & unbalanced - phasor diagram of voltages and currents – power and power factor measurements in three phase circuits.

TOTAL: 60 PERIODS

OUTCOMES:

On completion of this course students will be able to:

- analyse the DC circuits
- realise the working of AC circuits
- apply circuit theorems for DC and AC circuits
- analyse the transient response of DC and AC Circuits
- realise the concepts of three phase AC circuits

TEXT BOOKS:

1. William H. HaytJr, Jack E. Kemmerly and Steven M. Durbin, “Engineering Circuits Analysis”, Tata McGraw Hill publishers, 6th edition, New Delhi, 2003.
2. Joseph A. Edminister, MahmoodNahri, “Electric circuits”, Schaum’s series, Tata McGraw-Hill, New Delhi, 2001.

REFERENCES:

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. Charles K. Alexander, Mathew N.O. Sadiku, “Fundamentals of Electric Circuits”, Second Edition, McGraw Hill, 2003.
4. Paranjothi SR, “Electric Circuits Analysis,” New Age International Ltd., New Delhi, 1996.
5. J. David Irwin, R. Mark Nelms with Amalendu Patnaik. “Engineering Circuit Analysis”, 11th Edition, Wiley Publishers, April 2015,

GE17261 ENGINEERING PRACTICES LABORATORY L T P C
0 0 4 2

OBJECTIVES

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

GROUP A (CIVIL & MECHANICAL)

I CIVIL ENGINEERING PRACTICE 15

BUILDINGS:

(a) Study of plumbing and carpentry components of residential and industrial buildings. Safety aspects.

PLUMBING WORKS:

(a) Study of pipeline joints, its location and functions: valves, taps, couplings, unions, reducers, elbows in household fittings.
(b) Study of pipe connections requirements for pumps and turbines.
(c) Preparation of plumbing line sketches for water supply and sewage works.
(d) Hands-on-exercise:
Basic pipe connections – Mixed pipe material connection – Pipe connections with different joining components.
(e) Demonstration of plumbing requirements of high-rise buildings.

CARPENTRY USING POWER TOOLS ONLY:

(a) Study of the joints in roofs, doors, windows and furniture.
(b) Hands-on-exercise:
Wood work, joints by sawing, planing and cutting.

II MECHANICAL ENGINEERING PRACTICE 15

Welding:

(a) Preparation of butt joints, lap joints and T- joints by Shielded metal arc welding.
(b) Gas welding practice

Basic Machining:

(a) Simple Turning and Taper turning
(b) Drilling Practice

Sheet Metal Work:

(a) Forming & Bending:
(b) Model making – Trays and funnels.
(c) Different type of joints.

Machine assembly practice:

(a) Study of centrifugal pump
(b) Study of air conditioner

Demonstration on:

(a) Smithy operations, upsetting, swaging, setting down and bending. Example – Exercise – Production of hexagonal headed bolt.
(b) Foundry operations like mould preparation for gear and step cone pulley.
(c) Fitting – Exercises – Preparation of square fitting and V – fitting models.

GROUP B (ELECTRICAL & ELECTRONICS)

III ELECTRICAL ENGINEERING PRACTICE 15

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 RLC circuit.
5. Measurement of earth resistance.

IV ELECTRONICS ENGINEERING PRACTICE 15

1. Study of electronic components – Resistor measurement using color coding -

measurement of AC signal parameters (peak-peak, rms period, frequency) using CRO.
2. Study of logic gates - AND, OR, EXOR and NOT.
3. Generation of Clock Signal.
4. Soldering practice – Components Devices and Circuits – Using general purpose PCB.
5. Measurement of ripple factor of HWR and FWR.

TOTAL: 60 PERIODS

OUTCOMES:

On completion of the course students will be able to

- fabricate carpentry components
- fit pipe connections including plumbing works.
- use welding equipment's to join the structures.
- construct different types of wiring circuits.
- fabricate electrical and electronic circuits

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

CIVIL

1. Assorted components for plumbing consisting of metallic pipes, plastic pipes, flexible pipes, couplings, unions, elbows, plugs and other fittings.	15 Sets
2. Carpentry vice (fitted to work bench)	15 Nos.
3. Standard woodworking tools	15 Sets.
4. Models of industrial trusses, door joints, furniture joints	5 each
5. Power Tools: (a) Rotary Hammer	2 Nos
(b) Demolition Hammer	2 Nos
(c) Circular Saw	2 Nos
(d) Planer	2 Nos
(e) Hand Drilling Machine	2 Nos
(f) Jigsaw	2 Nos

MECHANICAL

1. Arc welding transformer with cables and holders	5 Nos.
2. Welding booth with exhaust facility	5 Nos.
3. Welding accessories like welding shield, chipping hammer, wire brush, etc.	5 Sets.
4. Oxygen and acetylene gas cylinders, blow pipe and other welding outfit.	2 Nos.
5. Centre lathe	2 Nos.
6. Hearth furnace, anvil and smithy tools	2 Sets.
7. Moulding table, foundry tools	2 Sets.
8. Power Tool: Angle Grinder	2 Nos
9. Study-purpose items: centrifugal pump, air-conditioner	One each.

ELECTRICAL

1. Assorted electrical components for house wiring	15 Sets
2. Electrical measuring instruments	10 Sets
3. Study purpose items: Iron box, fan and regulator, emergency lamp	1 each
4. Megger (250V/500V)	1 No.
5. Power Tools: (a) Range Finder	2 Nos
(b) Digital Live-wire detector	2 Nos

ELECTRONICS

1. Soldering guns	10 Nos.
2. Assorted electronic components for making circuits	50 Nos.
3. Small PCBs	10 Nos.
4. Multimeters	10 Nos.
5. Study purpose items: Telephone, FM radio, low-voltage power supply	

EC17211 CIRCUITS AND DEVICES LABORATORY **L T P C**
0 0 4 2

OBJECTIVES:

- To study the V-I characteristics of diodes, BJT's and FET's
- To analyze and design clipper, clamper and rectifier circuits
- To understand the V-I characteristics of SCR
- To analyze A.C and D.C. circuits using network theorems
- To implement RLC transient and resonant circuits

List of Experiments

1. Characteristics of PN Junction Diode
2. Zener diode Characteristics & Regulator using Zener diode
3. Common Emitter input-output Characteristics
4. Common Base input-output Characteristics
5. FET Characteristics
6. SCR Characteristics
7. Clipper and Clamper & FWR
8. Verifications of Thevinin & Norton theorem
9. Verifications of KVL & KCL
10. Verifications of Super Position Theorem
11. Verifications of maximum power transfer & reciprocity theorem
12. Determination Of Resonance Frequency of Series & Parallel RLC Circuits
13. Transient analysis of RL and RC circuits

TOTAL: 60 PERIODS

OUTCOMES:

On completion of the course students will be able to

- Demonstrate the V-I characteristics of diodes, BJT's and FET's
- Able to construct circuits by using diodes for various applications like clippers, clampers and rectifiers
- Verify the V-I characteristics of SCR
- Apply network theorems over any electrical circuits
- Demonstrate the transient analysis and resonance of the RLC circuits

LABORATORY REQUIREMENTS

BC 107, BC 148, 2N2646, BFW10	- 25 each
1N4007, Zener diodes	- 25 each
Resistors, Capacitors, Inductors	- sufficient quantities
Bread Boards	- 15 Nos
CRO (30MHz)	- 10 Nos.
Function Generators (3MHz)	- 10 Nos.
Dual Regulated Power Supplies (0 – 30V)	- 10 Nos.

SEMESTER – III

MA17352	LINEAR ALGEBRA AND PARTIAL DIFFERENTIAL EQUATIONS	L	T	P	C
		3	2	0	4

OBJECTIVES

- To understand the concepts of basis and dimension in vector spaces.
- To introduce the effective mathematical tools for the solutions of partial differential equations that model physical processes;
- To introduce Fourier series analysis which is central to many applications in engineering apart from its use in solving boundary value problems;

UNIT I VECTOR SPACES 15

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 and dimension theorem.

UNIT II INNER PRODUCT SPACES 15

Inner product and norms - Gram Schmidt orthonormalization process - Modified Gram Schmidt orthonormalization process - QR Factorization.

UNIT III PARTIAL DIFFERENTIAL EQUATIONS 15

Formation of partial differential equations – Singular integrals -- Solutions of standard types of first order pde: $f(p,q) = 0, f(z,p,q) = 0, z = px + qy + f(p,q), f(x,p) = f(y,q)$ - Lagrange's linear equation - Linear partial differential equations of second and higher order with constant coefficients of homogeneous type.

UNIT IV FOURIER SERIES 15

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

UNIT V APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATION 15

Classification of partial differential equations - Solutions of one dimensional wave equation using method of separation of variables – related problems.

TOTAL: 75 PERIODS

OUTCOMES:

On completion of the course students will be able to

- Use concepts of basis and dimension in vector spaces in solving problems.
- Construct orthonormal basis using inner products.
- Develop skills to solve different types of partial differential equations
- Develop skills to construct Fourier series for different periodic functions and to evaluate infinite series.
- Classify different types of PDE and solve boundary value problems.

TEXT BOOKS:

1. Friedberg, A.H., Insel, A.J. and Spence, L., —Linear Algebrall, Prentice - Hall of India, New Delhi, 2004.
2. Veerarajan T, Transforms and Partial differential equation , Mc Graw Hill, New Delhi, 3rd edition, 2016.

REFERENCES:

1. Richard Bronson, “Theory and Problems of Matrix Operations’, McGraw-Hill.
2. Strang, G., “Linear Algebra and its applicationsll,” Thomson (Brooks/Cole), New Delhi, 2005.
3. Kumaresan, S., “Linear Algebra – A geometric approachll”, Prentice – Hall of India, New Delhi, Reprint, 2010.
4. Grewal B.S., “Higher Engineering Mathematicsll”, Khanna Publishers, New Delhi, 43rd Edition, 2014.
5. Erwin kreyszig, “Advanced Engineering Mathematicsll”, John Wiley & Sons, 9th Edition, New Delhi, 2014.
6. Ramana, B.V. “Higher Engineering Mathematicsll”, Tata McGraw Hill, New Delhi, 11th Reprint , 2010.
7. Gilbert Strang, “Introduction to Linear Algebra” by, 5TH Edition, Wellesley College, 2016.

BM17301	HUMAN ANATOMY AND PHYSIOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES

- To identify all the organelles of an animal cell and their function.
- To understand structure and functions of the various types of systems of human body.
- To demonstrate their knowledge of importance of anatomical features and physiology of human systems

UNIT I BASICS OF HUMAN BODY 7

Cell: Different types of cell, Cell Structure and its organelles with functions. Cell Membrane – Transport across Cell Membrane -Membrane Potential – Origin and propagation of potential. Homeostasis. Tissues: Types and functions.

UNIT II SKELETAL AND MUSCULAR SYSTEM 8

Skeletal System: Structure and types of Bone and its functions – Physiology of Bone formation – Division of Skeleton – Types of joints and functions – Types of cartilage and functions. Muscular System: Types and functions of Muscles – Structure and activity of skeletal muscles – Sliding Filament Theory – Types of muscle contraction.

UNIT III CARDIOVASCULAR AND RESPIRATORY SYSTEM 11

Blood: Composition – Functions – Hemostasis – Blood groups and typing. Structure of heart – Coronary Circulation – Conduction System of heart – Cardiac Cycle – Cardiac output – Heart sounds. Blood Vessels – Structure and types. Factors regulating blood pressure. Respiratory system: Parts of respiratory system – Respiratory physiology – Lung volumes and capacities – Types of respiration – Gaseous exchange and transport – Regulation of respiration.

UNIT IV NERVOUS AND SPECIAL SENSORY SYSTEM 10

Nervous: Cells of Nervous systems – Types of Neuron and Synapses – Mechanisms of Nerve impulse – Brain: Parts of Brain – Spinal Cord – Tract and Pathways of Spines – Reflex Mechanism – Classification of Nerves - Autonomic Nervous systems and its functions. **Sense Organs**: Skin, Eye and Ear.

Unit V ENDOCRINE, DIGESTIVE AND URINARY SYSTEMS 9

Endocrine: Types of major endocrine glands. **Digestive:** Organs of Digestive system – Digestion and Absorption. **Urinary System**: Structure of urinary system, Kidney and Nephron – Mechanisms of Urine formation – Homeostasis and Acid base Regulation by Urinary System – Micturition reflex.

TOTAL: 45 PERIODS

OUTCOMES:

On completion of the course students will be able to

- Students would be able to explain basic structure and functions of cell
- Students would have learnt about anatomy and physiology of various systems of human body
- Students would be able to explain interconnection of various systems

TEXT BOOK:

1. Elaine.N. Marieb , "Essential of Human Anatomy and Physiology", Eight Edition, Pearson Education, New Delhi

REFERENCES:

1. Frederic H. Martini, Judi L. Nath, Edwin F. Bartholomew, "Fundamentals of Anatomy and Physiology". Tenth Edition, Pearson Publishers
2. Gillian Pocock, Christopher D. Richards, "The human Body – An introduction for Biomedical and Health Sciences", Oxford University Press, USA
3. William F.Ganong, "Review of Medical Physiology", 22nd Edition, Mc Graw Hill, New Delhi.
4. Eldra Pearl Solomon, "Introduction to Human Anatomy and Physiology", 2nd edition, W.B. Saunders Company
5. Guyton & Hall, "Medical Physiology", 13th Edition, Elsevier Saunders

BM17302	SENSORS AND MEASUREMENTS	L	T	P	C
		2	0	2	3

OBJECTIVES

- Understand the purpose & methods of measurements, errors associated with measurements.
- Know the principle of transduction, classifications and the characteristics of different transducers and its biomedical applications.
- Know the different display and recording devices and working of digital voltmeters and multimeters.
- Understand the working of light detectors and its applications.
- Understand the working of strain gauges, transducers which are widely applied in designing in biomedical devices

UNIT I FUNDAMENTALS OF MEASUREMENTS 6

Measurement systems –methods of measurement-direct-deflection and null type, definition of sensor/transducer-classification of sensors/transducers-selection criteria- static characteristics-dynamic characteristics, Errors,

UNIT II RESISTIVE & THERMOELECTRIC TRANSDUCERS 6

Resistive transducers: Resistance potentiometer-loading effect, strain gauge-gauge factor-types of strain gauges-applications, thermoelectric sensors-resistance thermometers-construction, characteristics, thermistor, thermocouples, Semi conductive and IR temperature sensors, Application of Biosensors-Classification, components of biosensors.

UNIT III INDUCTIVE & CAPACITIVE TRANSDUCERS 6

Self-inductance & mutual inductance, LVDT, RVDT, Induction potentiometer, Variable reluctance transducer. Capacitive: Introduction-Variable area type-variable air gap type-variable permittivity type-capacitive pressure sensors-biomedical applications, Hall magnetic sensor-clinical applications.

UNIT IV PIEZOELECTRIC, PHOTOELECTRIC & GAS SENSORS 6

Introduction of piezoelectricity- piezoelectric crystals-clinical applications- Basic characteristics of photoelectric Sensors-types of photo detectors – photo emissive cell photovoltaic cell-photo conductive cell-LDR-characteristics and applications. Gas Sensors-classification-working-applications.

UNIT V MEASUREMENT DEVICES & INTELLIGENT SENSORS 6

Measurement using Bridge circuits- Wheatstone's, Kelvin's, Maxwell's, Hay's, and Schering's Bridges.LCD monitor, PMMC writing systems, Recorders-Magnetic-inkjet-thermal-XY recorder-photographic recorders. Sensors- Smart Vs intelligent sensors.

TOTAL: 30 PERIODS

PRACTICAL EXPERIMENTS

1. Characteristics of Thermocouple.
2. Characteristics of RTD
3. Strain measurement.
4. Characteristics of optical sensor.
5. Measurement of resistance using Wheat Stone and Kelvin's Bridge.
6. Measurement of inductance using Maxwell's & Hay's Bridge.
7. Measurement of Capacitance using Schering's bridge.
8. Demonstration of CRO & DSO.

TOTAL: 30 PERIODS

Lab Requirements for 30 Students:

1. Thermocouple-30 Nos
2. RTD-30 Nos
3. Strain Gauge (bonded and unbounded type)-20 each
4. Optical Sensors-Photovoltaic Cell, Photoconductive Cell, Photo diode—15 Nos each
5. Resistors-Range between 1-0.0001 ohm – 30 Nos/each
6. CRO-10
7. DSO-5

TOTAL: 60 PERIODS

OUTCOMES:

On completion of the course students will be able to

- Knowledge on the fundamentals of measurement systems.
- Identify various sensors for biomedical applications.
- Develop simple medical devices using sensors.
- Demonstrate various sensors and transducers based on their working principle.
- Identify the recording systems suitable for biomedical applications.

TEXT BOOKS:

1. A.K. Sawhney & Puneet Sawhney "A course in mechanical measurements and instrumentation", Dhanpat Rai & Co.,19th edition, 2011.
2. Prof. Ping Wang & Dr. Qingjun Liu, "Biomedical Sensors and Measurement" , Springer Publications, 1st edition ,2011 .
3. Tatsuo Togawa, Toshiyo Tamura & P. Åke Oberg ,"Biomedical Sensors and Instruments", CRC Press Taylor & Francis Group, 2nd edition ,2011

REFERENCES:

1. Ernest O Doebelin and Dhanesh N Manik," Measurement systems, Application and design", Mc Graw-Hill, 5th edition, 2007.

2. Dominique Placko," Fundamentals of Instrumentation and Measurement", ISTE Ltd, 1st edition, 2007.
3. Albert D.Helfrick and William D. Cooper." Modern Electronic Instrumentation and Measurement Techniques", Prentice Hall of India,2007.

BM17303	ELECTRIC FIELDS AND MACHINES	L	T	P	C
		2	0	2	3

OBJECTIVES

- To understand the basics of AC and DC machines
- To study the principles of static Electric and magnetic fields
- To understand the behaviour of electromagnetic field in any medium

UNIT I DC MACHINES 6

Construction of DC machines – theory of operation of DC generators –EMF equation - Types and applications. Operating principle of DC motors – types of DC motors and their characteristics – speed control of DC motors-Applications, Stepper motor and Applications.

UNIT II AC MACHINES 6

Single phase transformer construction and principle of operation – EMF equation of Transformer - Transformer no–load phasor diagram –– Transformer on–load phasor diagram – Effect of load on regulation and efficiency. Introduction to high frequency transformer Construction –Types. Construction of single-phase induction motors – Method of starting, Types – split phase and repulsion.

UNIT III STATIC ELECTRIC FIELD 6

Introduction to Co-ordinate System – Rectangular – Cylindrical and Spherical Coordinate System Definition of Curl, Divergence and Gradient – Electric Field Intensity – Principle of Superposition – Electric Field due to discrete and continuous charge distribution- Relationship between potential and electric field – Electric polarization - Electric Flux Density – Gauss Law

UNIT IV STATIC MAGNETIC FIELD 6

The Biot-Savart Law in vector form – Magnetic Field intensity due to a finite and infinite wire carrying a current I – Magnetic field intensity on the axis of a circular and rectangular loop carrying a current I – Ampere's circuital law and simple applications. Magnetic flux density – The Lorentz force equation for a moving charge and applications – Force on a wire carrying a current I placed in a magnetic field – Torque on a loop carrying a current I – Magnetic moment – Magnetic circuits – B-H relationship.

UNIT V ELECTRIC AND MAGNETIC FIELDS IN MATERIALS 6

Poisson's and Laplace's equation – Nature of dielectric materials and dielectric strength - Definition of Capacitance – Capacitance of various geometries using Laplace's equation – Electrostatic energy and energy density – Boundary conditions for electric fields – Electric current – Current density – point form of ohm's law – Definition of Inductance – loops and solenoids – Energy density in magnetic fields – Nature of magnetic materials – magnetization and permeability - magnetic boundary conditions-Sources and effects of electromagnetic fields-Maxwell's equations (differential and integral form)

TOTAL: 30PERIODS

PRACTICAL EXPERIMENTS:

1. Open circuit and load characteristics of DC shunt generator- critical resistance and critical speed.
2. Load test on DC shunt motor.
3. Speed control of DC shunt motor.
4. No load and load test on single-phase transformer

Equipments required for 30 students

1. DC Generator - 2
2. DC Motor – 2
3. Single transformer – 4
4. Restive load – 4
5. Relevant meters – 20 nos.

TOTAL: 30 + 30 = 60 PERIODS

OUTCOMES:

On completion of the course students will be able to

- Make right choice on the suitability of DC motor for specific purpose
- Use different kinds of AC motor and transformer
- Apply the principles of electric field in real world problems
- Visualize magnetic effect and its relation to electric field.
- Analyze electromagnetic interaction in real time in any medium

TEXT BOOKS:

1. Dr. D P Kothari," ,Prof I J Nagrath Basic Electrical Engineering" , 3rd Edition, Tata McGraw-Hill, 2009.
2. John Daniel Kraus, Daniel A. Fleisch, "Electromagnetics: With Applications", 5th Edition, Tata McGraw, 2007.

REFERENCES:

1. Theraja B.L., Theraja A.K. "A Textbook of Electrical Technology: Vol 2 AC and DC Machines, S.Chand Publication, 2012
2. Joseph Edminister, Mahmood Nahvi, "Schaum's Outline of Electromagnetics", 4th Edition, Tata McGraw-Hill, 2013.

BM17304	ELECTRONIC CIRCUITS	L	T	P	C
		4	0	0	4

OBJECTIVES

- To understand the working of half/full wave and bridge rectifier circuits
- To understand the methods of biasing transistors
- To understand the working of simple amplifier circuits, and design of signal generation circuits
- To understand and analysis of positive and negative feedback circuits
- To understand the working of regulated DC Power supplies.

UNIT I DIODE APPLICATIONS AND TRANSISTOR BIASING 12

Rectifiers – HWR, FWR, Bridge rectifier with and without capacitor and pie filter. Clipper- clampers – voltage multiplier circuits - Operating point of the bi-polar junction transistor – Fixed bias circuit –

Transistor on saturation – Emitter stabilized Bias Circuit – Voltage divider bias – Transistors switching network – Trouble shooting the Transistor (In circuit testing)- practical applications. Biasing the FET transistors.

UNIT II SMALL SIGNAL AMPLIFIERS 12

Two port network, h-parameter model – small signal analysis of BJT (CE and CC configurations only) — high frequency model of BJT – (CE configuration only) - small signal analysis of JFET (CS configuration only) - Frequency response of BJT and FET.

UNIT III FEEDBACK AMPLIFIER AND OSCILLATORS 12

Basic of feedback system (block diagram approach) – Types of feedback amplifier – Basic principle of oscillator and condition for Oscillation, Audio oscillators – RC phase shift and wein bridge oscillator. RF oscillators – Hartely and Collpit oscillator – Crystal oscillator, Multivibrators.

UNIT IV POWER AMPLIFIERS 12

Definition – Types of power amplifiers – Class A (series fed – transformer coupled)- Class B amplifier – Class-B push-pull amplifier – Complementary symmetry type – Class C amplifier – Heat sinking .

UNIT V VOLTAGE REGULATORS 12

Shunt voltage regulator – Series voltage regulator – current limiting – feedback technique – SMPS (Block diagram approach) – DC to DC converter - Three terminal IC regulators (78XX and 79XX).

TOTAL: 60 PERIODS

OUTCOMES:

On completion of the course students will be able to

- design the half/full wave and bridge rectifier circuits for the given specifications
- design the Fixed, Collector to base, and emitter bias circuits
- design the amplifier and signal generator circuits
- analyze the different positive and negative feedback amplifier circuits
- design Variable regulated DC Power supplies

TEXT BOOKS:

1. Robert L. Boylestad, Louis Nashelsky , “Electronic Devices and circuit Theory” , Prentice Hall of India , 2004.

REFERENCES:

1. David A. Bell , “Electronic Devices And Circuits” 4 th Edition Prentice Hall of India, 2003.
2. Millman Haykins, “Electronic Devices And Circuits”, 2nd Edition Tata MC Graw Hill,2007.

BM17305	BIOCHEMICAL SCIENCE	L	T	P	C
		3	0	0	3

OBJECTIVES

- To study structural and functional properties of carbohydrates, proteins, lipids and nucleic acids
- To emphasize the role of these biomolecules by providing basic information on their metabolism and disorders.

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 CARBOHYDRATES 9

Classification of carbohydrates - mono, di, oligo and polysaccharides. Structure, physical and chemical properties of carbohydrates Isomerism, racemisation and mutarotation. Metabolic pathways – Glycolysis, glycogenesis, glycogenolysis, and its hormonal regulation. TCA cycle – amphibolic pathway , Electron transport chain and Oxidative phosphorylation. Biochemical aspect of Diabetes mellitus and Glycogen storage Disease.

UNIT III LIPIDS 10

Classification of lipids- simple, compound and derived lipids. Nomenclature of fatty acid, physical and chemical properties of fat. Metabolic pathways: synthesis and degradation of fatty acid (beta oxidation), Hormonal regulation of fatty acid metabolism, ketogenesis. Cholesterol biosynthesis, regulation, and its transport (HDL & LDL role). Disorders of lipid metabolism

UNIT IV NUCLEIC ACID & PROTEIN 10

Structure of purines and pyrimidines, nucleoside, nucleotide, DNA act as a genetic material, chargaffs rule. Watson and crick model of DNA. Structure of RNA and its type. Classification of amino acids – characteristics of amino acids – Zwitterions, iso-electric point, amino acids as biosynthetic precursors(epinephrine, dopamine, histamine). Protein classification. Structure of proteins, primary, secondary, tertiary and quaternary structure. Metabolism of ammonia and Urea cycle.

UNIT V ENZYME AND ITS CLINICAL APPLICATION 9

Classification of enzymes, apoenzyme, coenzyme, holoenzyme and cofactors. Kinetics of enzymes - Michaelis-Menten equation, line weaver burk plot. Factors affecting enzymatic activity: temperature, pH, substrate concentration and enzyme concentration. Inhibitors of enzyme action: Competitive, un-competitive, non- competitive, irreversible. Enzyme: Mode of action, allosteric and covalent regulation. Clinical significance of enzymes. Measurement of enzyme activity and interpretation of units.

TOTAL: 45 PERIODS

OUTCOMES:

On completion of the course students will be able to

- Explain the fundamentals of biochemistry
- Wide view about the classification, structures and properties of carbohydrates and their metabolism.
- Deep understanding about the metabolism of lipids and their physiological roles.
- Basic knowledge in structures of purines and pyrimidines. Classification, structures, properties and purification of amino acids and proteins.
- Knowledge about the mechanism of actions of enzymes and co-enzymes, clinical importance of enzymes and interpretation of their activities.

TEXT BOOKS:

1. RAFI MD, “Text book of biochemistry for Medical Student”, Second Edition, University Press, 2014.
2. W. Rodwell, David Bender, Kathleen M. Botham, Peter J. Kennelly, P. Anthony Weil—Harper’s, “Review of biochemistry”, 30th Edition, LANGE Medical Publications, 2015.

3. Trevor palmer and Philip L Bonner, "Enzymes: Biochemistry, Biotechnology, Clinical Chemistry", 2nd Edition, Woodhead Publishing, 2009.

REFERENCES:

1. Keith Wilson & John Walker, "Practical Biochemistry - Principles & Techniques", Oxford University Press, 2009.
2. Pamela.C.Champe & Richard.A.Harvey, "Lippincott Biochemistry Lippincott's Illustrated Reviews", 6th Edition, LWW publishers,2013.

BM17311	BIOCHEMISTRY AND PHYSIOLOGY LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES

- Estimation and quantification of biomolecules.
- Separation of macromolecules.
- Estimation and interpretation of biochemical parameter.

LIST OF EXPERIMENTS:

1. General guidelines for working and functional component of biochemistry lab
2. Preparation of solutions: 1) percentage solutions, 2) molar solutions, 3) normal solutions
3. Spectroscopy: Determination of absorption maxima (λmax) of a given solution
4. General tests for carbohydrates, proteins and lipids.
5. Preparation of serum and plasma from blood.
6. Estimation of blood glucose.
7. Estimation of creatinine.
8. Estimation of urea.
9. Estimation of cholesterol
10. Assay of SGOT/SGPT.
11. Separation of proteins by SDS electrophoresis(Demo)
12. Separation of amino acids by thin layer chromatography
13. Identification of Blood groups
14. Estimation of Hemoglobin
15. Total WBC Count
16. Estimation of ESR
17. PCV, MCH, MCV, MCHC

TOTAL: 60 PERIODS

OUTCOMES:

On completion of the course students will be able to

- Identify the Biochemistry laboratory functional components
- Comprehend the basics principle of preparation of buffers.
- Have a sound knowledge of qualitative test of different biomolecules.
- Explore the basic knowledge about Biochemical & haematological parameters and their interpretation in Blood sample.
- Have a sound knowledge of separation technology of proteins and amino acids.

LAB REQUIREMENT FOR A BATCH OF 30 STUDENTS:

1. Colorimeter 2 Nos
2. Spectrophotometer 1 No.
3. pH meter 1 No
4. Weighing balance 1 No
5. Refrigerator 1 No

6. SDS gel electrophoresis 1 No
7. TLC, ready TLC plates 1 No
8. Wintrobe's tube 2 Nos.
9. Centrifuge Normal 1 No
10. Microslides 2 packets
11. Lancet 2 boxes
12. Microscope 3 No
13. Neubaur's Chamber 2 Nos.
14. Heparinized Syringe 1box
15. Haemoglobinometer 1 No
16. Blood Grouping Kit 2

BM17312	ELECTRONIC CIRCUITS LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES

- To design various rectifier circuits
- To design various types of biasing Circuits
- To design the RC coupled , FET& Power amplifier circuits
- To design of RC and LC oscillators circuits
- To design of astable & Monostable circuits

LIST OF EXPERIMENTS

1. Rectifiers – HWR and FWR (with & without capacitor filter)
2. Zener diode as regulator
3. Design of biasing circuits i) Fixed bias, ii) Self bias, iii) collector to base bias
4. Design of a FET amplifier
5. Design of Differential amp – CMRR and determination of Gain
6. Design of RC coupled amplifier
7. Design of Voltage series feedback amplifier
8. Design of Class A and Class B amplifier
9. Design of RC phase shift oscillator
10. Design of Hartely Oscillator
11. Design of Colpit oscillator
12. Design of pulse shaping circuits
    i). Astable Multivibrator
    ii). Monostable Multivibrator

TOTAL: 60 PERIODS

LAB REQUIREMENT FOR A BATCH OF 30 STUDENTS:

1. Variable DC Power Supply
2. Fixed Power Supply
3. CRO
4. Multimeter
5. Function Generator
6. Digital LCR Meter
7. BC107,BF195, 2N2222, BC147, BFW10,SL100
8. LEDs
9. Resistors
10. Capacitors
11. Inductors
12. Bread Boards

13. Transformer , Diodes, Zener Diodes

OUTCOMES:

On completion of the course students will be able to

- design rectifier, voltage regulator and Zener diode circuits for the given specifications
- design the different types of clipper and clamper circuits using Diode
- design the Fixed, Collector to base, emitter bias and voltage divider bias circuits using BJT
- design feedback amplifier, power amplifier and sine wave oscillator circuits using BJT
- design multivibrator circuits using BJT for generating time delay.

BM17313	PCB DESIGN LABORATORY	L	T	P	C
		0	0	2	1

OBJECTIVES

- To familiarize the electronic components and basic electronic instruments
- To make students familiar with PCB design and various processes involved
- To provide in-depth core knowledge in the fabrication of Printed
- To provide the knowledge in assembling and testing of the PCB based electronic circuits
- To provide knowledge on designing of real time PCB boards.

List of Experiments

1. Study of Electronic Components
    a. Resistors, capacitors, inductors.
    b. Transformers, Diodes, transistors
    c. Integrated Circuits, Display, Switches
2. Study of Instruments and Equipments (DMM, Power supply, CRO, FG)
3. Generation of CAM Files for single side PCB (Measuring voltage Drop)
4. Generation of CAM Files for single side PCB (Full wave Rectifier)
5. PCB Assembly and Testing (Measuring voltage Drop)
6. PCB Assembly and Testing (Full wave Rectifier)
7. Study of single side PCB Fabrication process by photo resist Method.

TOTAL: 30 PERIODS

LAB REQUIREMENT FOR A BATCH OF 30 STUDENTS

1. Computers with ORCAD software – 30 Nos.
2. Multimeter – 15 Nos.

OUTCOMES:

On completion of the course students will be able to

- Design lay out for a circuit with suitable dimensions of the devices
- Validate the design before implementing

SEMESTER IV

MA17353	PROBABILITY AND STATISTICS Common to Chemical, Biotech, BME & IT	L T P C 3 2 0 4

OBJECTIVE

- To provide the required skill to apply the statistical tools in Engineering problems.

UNIT I ONE – DIMENSIONAL RANDOM VARIABLE 15

Discrete and continuous random variables – Moments – Moment generating functions – Binomial, Poisson, Geometric, Uniform, Exponential, Gamma, Weibull and Normal distributions – Functions of Random Variable.

UNIT II TWO - DIMENSIONAL RANDOM VARIABLES 15

Joint distributions – Marginal and conditional distributions – Covariance – Correlation and Linear regression – Transformation of random variables – Applications of Central Limit Theorem.

UNIT III TESTING OF HYPOTHESIS 15

Statistical hypothesis - Large sample test based on Normal distribution for single mean and difference of means -Tests based on t, F and Chi-square test for single sample standard deviation. Chi-square tests for independence of attributes and goodness of fit.

UNIT IV DESIGN OF EXPERIMENTS 15

One way and Two way classifications - Completely randomized design – Randomized block design – Latin square design.

UNIT V STATISTICAL QUALITY CONTROL 15

Control charts for measurements (X and R charts) – Control charts for attributes (p, c and np charts) – Tolerance limits - Acceptance sampling.

TOTAL: 75 PERIODS

OUTCOMES:

On completion of the course students will be able to

- Characterize standard probability distribution by employing basic techniques and methods of probability mass function and probability density function for discrete and continuous random variables
- Develop skills to solve problems on correlation and regression
- Obtain statistical data from experiments and able to analyze the same using statistical test.
- Design experiments using suitable ANOVA techniques and draw conclusions.
- Use control charts to study, analyze and interpret problems in statistical quality control.

TEXT BOOKS:

1. T. Veerarajan, “Probability, Statistics and Random Processes with Queueing Theory and Queueing Networks” , Mc Graw Hill, 2016.
2. Johnson. R.A. and Gupta. C.B., “Miller and Freund’s Probability and Statistics forEngineers", Pearson Education, Asia, 7th Edition, 2007.

REFERENCES:

1. Devore. J.L., “Probability and Statistics for Engineering and the Sciences”, CengageLearning, New Delhi, 8th Edition, 2012.
2. Walpole. R.E., Myers. R.H., Myers. S.L. and Ye. K., "Probability and Statistics forEngineers and Scientists", Pearson Education, Asia , 8th Edition, 2007.

3. Ross, S.M., “Introduction to Probability and Statistics for Engineers and Scientists", 3rdEdition, Elsevier, 2004.
4. Spiegel. M.R., Schiller. J. and Srinivasan. R.A., "Schaum’s Outline of Theory andProblems of Probability and Statistics", Tata McGraw Hill Edition, 2004.

CY17251 ENVIRONMENTAL SCIENCE AND ENGINEERING L T P C
3 0 0 3

OBJECTIVES

- To find the scientific, technological, economic and political solutions to environmental problems.
- To study the interrelationship between living organism and environment.
- To study the importance of environment by assessing its impact on the human world.
- To study the dynamic processes and understand the features of the earth’s interior and surface.
- To study the integrated themes and biodiversity, natural resources, pollution control and waste management.

UNIT I ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY 12

Definition, scope and importance of Risk and hazards; Chemical hazards, Physical hazards, Biological hazards in the environment – concept of an ecosystem – ecological succession processes – Introduction, types, characteristic features, structure and function of the forest ecosystem - grassland ecosystem - desert ecosystem - aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) – Introduction to biodiversity definition: genetic, species and ecosystem diversity – Significance of medicinal plants - biogeographical classification of India – value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values – Biodiversity at global, national and local levels – India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ conservation of biodiversity.

UNIT II ENVIRONMENTAL POLLUTION 10

Definition - causes, effects and control measures of Air pollution (Atmospheric chemistry - Chemical composition of the atmosphere; Chemical and photochemical reactions in the atmosphere - formation of smog, PAN, acid rain, oxygen and ozone chemistry- Mitigation procedures - Control of particulate and gaseous emission, Control of SO_2, NO_X, CO and HC) - Water pollution : Physical and chemical properties of terrestrial and marine water and their environmental significance - Water quality parameters – physical, chemical and biological; absorption of heavy metals - Water treatment processes. Soil pollution - soil waste management: causes, effects and control measures of municipal solid wastes – Marine pollution - Noise pollution - Thermal pollution - Nuclear hazards– e-Waste – toxic substances in e-waste – risks related to toxic substances – role of an individual in prevention of pollution – pollution case studies.

UNIT III NATURAL RESOURCES 10

Forest resources: Use and over-exploitation, deforestation, case studies- timber extraction, mining, dams and their effects on forests and tribal people – Water resources: Use and overutilization of surface and ground water, dams-benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern

agriculture, fertilizer-pesticide problems, water logging, salinity, case studies – Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources - energy production from waste materials. Energy Conversion processes – Biogas – production and uses, anaerobic digestion; case studies – Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification – role of an individual in conservation of natural resources – Equitable use of resources for sustainable lifestyles. Introduction to Environmental Biochemistry: Proteins –Biochemical degradation of pollutants, Bioconversion of pollutants.

UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT 7

From unsustainable to sustainable development – urban problems related to energy – water conservation, rain water harvesting, watershed management – resettlement and rehabilitation of people; its problems and concerns, case studies – role of non-governmental organization environmental ethics: Issues and possible solutions – Principles of green chemistry - nuclear accidents and holocaust, case studies – wasteland reclamation – consumerism and waste products – environment protection act – Air act – Water act – Wildlife protection act – Forest conservation act – The Biomedical Waste (Management and Handling) Rules; 1998 and amendments- scheme of labelling of environmentally friendly products (Ecomark). Enforcement machinery involved in environmental legislation- central and state pollution control boards - disaster management: floods, earthquake, cyclone and landslides. Public awareness and case studies.

UNIT V HUMAN POPULATION AND THE ENVIRONMENT 6

Population growth, variation among nations – population explosion – family welfare programme – environment and human health – human rights – value education – HIV / AIDS – Dengue fever- Swine flu – women and child welfare – Environmental impact analysis (EIA)- GIS-remote sensing - role of information technology in environment and human health – Case studies. Effect of radiation from computing devices.

TOTAL: 45 PERIODS

OUTCOMES:

On completion of the course students will be able to

- Solve problems that cannot be solved by mere laws.
- Get familiarized with ecological balance.
- Get public awareness of environment at infant stage.
- Find ways to protect the environment and play proactive roles.
- Develop and improve the standard of better living.

TEXT BOOKS:

1. Gilbert M.Masters, “Introduction to Environmental Engineering and Science”, 2nd edition,Pearson Education (2004).
2. Benny Joseph, “Environmental Science and Engineering”, Tata Mc Graw-Hill, New Delhi, 2006.

REFERENCES:

1. Dharmendra S. Sengar, ‘Environmental law’, Prentice hall of India Pvt Ltd, New Delhi, 2007.
2. Erach Bharucha, “Textbook of Environmental Studies”, 3rd edition, Universities Press(I) Pvt, Ltd, Hydrabad, 2015.
3. G. Tyler Miller and Scott E. Spoolman, “Environmental Science”, 15th edition, Cengage Learning India PVT, LTD, Delhi, 2014.
4. Rajagopalan, R, ‘Environmental Studies-From Crisis to Cure’, 3rd edition,Oxford University Press,2015.

BM17401 BIOMEDICAL INSTRUMENTATION L T P C
3 0 0 3

OBJECTIVES

- Learn about the scope of biomedical instrumentation and its applications.
- Learn the various bio-potential electrodes and equivalent circuits.
- Gain knowledge about the recording of various bio potential measurements from the human body.
- Understand the principles & recording of non-electrical physiological measurements and bio-amplifiers.
- Study the various biochemical analytical techniques used in the laboratories.
- Familiarize with the electrical and patient safety.

UNIT I BIO POTENTIAL & ELECTRODES 9

Origin of bio potential and its propagation. Electrode Circuit Model and Motion Artifact, Electrode-electrolyte interface, electrode–skin interface, half-cell potential, impedance, Polarization effects of electrode – non-Polarizable electrodes. Types of electrodes - surface, needle and micro electrodes and their equivalent circuits. Recording problems measurement with two electrodes, Biochemical Transducers.

UNIT II ELECTRODE CONFIGURATIONS & BIO AMPLIFIERS 10

Biosignals characteristics – frequency and amplitude ranges. ECG – Einthoven's triangle, standard 12 lead system. EEG – 10-20 electrode system, unipolar, bipolar and average mode. EMG– unipolar and bipolar mode.

Need for bio-amplifier - single ended bio-amplifier, differential bio-amplifier – right leg driven ECG amplifier. Isolation amplifiers – transformer and optical isolation - isolated DC amplifier and AC carrier amplifier. Chopper amplifier. Power line interference, need for Band pass filtering.

UNIT III MEASUREMENT OF NON-ELECTRICAL PARAMETERS 9

Temperature, respiration rate and pulse rate measurements. Blood Pressure: indirect methods - auscultatory method, oscillometric method, direct methods: electronic manometer, Pressure amplifiers - systolic, diastolic, mean detector circuit. Blood flow and cardiac output measurement: Indicator dilution, thermal dilution and dye dilution method, Electromagnetic and ultrasound blood flow measurement.

UNIT IV BIO-CHEMICAL MEASUREMENT & ANALYTICAL TECHNIQUES 8

Biochemical sensors - pH, pO2 and pCO2, Ion selective Field effect Transistor (ISFET), Immunologically sensitive FET (IMFET), Blood glucose sensors - Blood gas analyzers, colorimeter, flame photometer, spectrophotometer, blood cell counter, auto analyzer (simplified schematic description).

UNIT V PATIENT SAFETY 9

Physiological effects of electricity – important susceptibility parameters – Macro shock –Micro shock hazards – Patient's electrical environment – Isolated Power system –Conductive surfaces – Electrical safety codes and standards – Basic Approaches to protect against shock, Protection equipment design, Electrical safety analyzer – Testing the Electric system

TOTAL: 45 PERIODS

OUTCOMES:

On completion of the course students will be able to

- Design a suitable electrode for a physiological and non- physiological signals that can be measured from the human body

- Record the various bio signals using electrode from the human body and design a suitable bio-amplifiers for bio signal acquisition system.
- Implement a various non-electrical parameters acquisition system from the human body.
- Practice with different types of analytical and diagnostic tools practiced in diagnostic and clinical laboratories.
- Develop a device for medical equipment safety and patient safety.

TEXT BOOKS:

1. Leslie Cromwell, "Biomedical Instrumentation and Measurement", Prentice Hall of India, New Delhi, 2007.
2. John G. Webster, "Medical Instrumentation Application and Design", John Willey and sons, 2002.
3. Joseph J. Carr and John M. Brown, "Introduction to Biomedical equipment technology", John Willey and sons, New York, 1997.

REFERENCES:

1. Richard Aston –"Principles of Biomedical Instrumentation and Measurement", Merril Publishing Company, 1990.
2. L.A Geddas and L.E.Baker– "Principles of Applied Biomedical Instrumentation", 2004.
3. John G. Webster, "Bioinstrumentation", John Willey and sons, New York, 2004.
4. Khandpur R.S, "Handbook of Biomedical Instrumentation", Tata McGraw- Hill, New Delhi, 2003.
5. Myer Kutz – "Standard Handbook of Biomedical Engineering & Design" –McGraw-Hill Publisher, 2003.

BM17402 ANALOG AND DIGITAL INTEGRATED CIRCUITS L T P C
4 0 0 4

OBJECTIVES:

- Understand the application of analog ICs in the designing circuit.
- To design the various combinational circuits and sequential circuits using IC 7408, IC 7432, IC 7404, IC 7486, IC 7400, IC 7402, IC 7476 and IC 7474
- To design the various analog circuits for linear and non linear applications using IC 741, IC 555, IC 556, IC 565.
- Knowledge on the design of the various functional circuits using these ICs.
- Understand the working and application of analog circuits in real time.

UNIT I NUMBER SYSTEMS AND LOGIC GATES 12

Decimal, Binary, Octal and Hexadecimal Numbers.-Conversion between these number systems. - Complements r"s and (r-1)"s complements.-subtraction using complements –Encoding numbers and characters using Binary digits. –Binary coded Decimal –Gray code\ - Binary to Gray code conversion –ASCII Code. Logic gates – Truth tables – NOT, AND, OR, NOR, NAND, XOR, XNOR - Boolean Laws and theorems Solving Boolean expressions, Truth Tables and Logic circuits – The Karnaugh Map – half adder, full adder, Multiplexers and Demultiplexers - Decoders and encoders. Coding of Combination Circuits in verilog.

UNIT II REGISTERS AND COUNTERS 12

Flip Flops – RS, D, T, JK Flip Flops – Characteristic equations, exciting tables – JK Master– Slave flip-flop – Universal shift register. Design of modulo –N counters– counter design using state diagram. Sequential circuit design with verilog.

UNIT III OPERATIONAL AMPLIFIERS 12

The characteristics of Ideal Operation – slew rate, offset voltage, bias current, CMRR, bandwidth-equivalent circuit of an op-Amp – virtual ground concept – Linear applications of op-amp –inverting And non-inverting amplifier, summing, subtracting, averaging amplifier - voltage to current converter – current to voltage converter – Differential amplifiers – differentiator And integrator. Nonlinear applications – comparator-Schmitt Triggers – Precision Diode Half wave and full wave rectifiers – Average detectors – peak detector

UNIT IV ACTIVE FILTERS AND SIGNAL GENERATOR 12

Active filters (first and second order) – Low pass, high pass, band pass filters, band reject filters (notch filters). Oscillators - RC Phase shift and Wein-bridge. Waveform generators - Square, triangular and saw tooth.

UNIT V TIMER, PLL, A/D AND D/A CONVERTERS 12

555 Timer (internal diagram) and its applications – mono stable multivibrator, astable multivibrator. Phase locked Loop (565 - block diagram approach)and its applications -Frequency multiplication, Frequency translation, voltage to frequency and frequency to voltage converters. DAC – Binary weighted DAC and R-2R DAC. ADC – single slope and dual slope ADCs, successive approximation ADC

TOTAL: 60 PERIODS

OUTCOMES:

On completion of the course students will be able to

- Knowledge on the application of analog ICs in the designing circuit.
- Thorough understanding on the applications of Digital ICs.
- Understand the basic of the Digital systems and the fundamentals behind their working.
- Design various functional circuits using these ICs.
- Knowledge on the functioning of analog & digital circuit and their applications.

TEXT BOOKS:

1. M. Morris Mano , “Digital Logic and Computer design “ Prentice Hall 1994.
2. Ramakant A. Gayakwad , “Op-AMP and Linear Ics”, Prince Hall, 1994

REFERENCES:

1. Robert B.Northrop, “Analysis and Application of Analog Electronic Circuits to Biomedical Instrumentation”, CRC Press, 2004.
2. Sergio Franco, “Design with Operational Amplifiers and analog Integrated circuits”, McGraw- Hills, 2003.
3. Millman J and Halkias .C., “Integrated Electronics”, TMH, 2007.
4. John. F. Wakerly, “Digital Design Principles and Practices”, Fourth Edition, Pearson Education, 2007 .
5. Charles H. Roth, Jr, “Fundamentals of Logic Design”, Fourth Edition, Jaico Books, 2002

CS17201	DATA STRUCTURES (Common to EEE, ECE and BME)	L	T	P	C
		3	0	0	3

OBJECTIVES

- To recognize and distinguish the applications of various linear and non linear data structures.
- To demonstrate the understanding of stacks, queues and their applications.

- To apply the concepts of List ADT.
- To analyze the concepts of tree and graph data structures.
- To be able to incorporate various searching and sorting techniques in real time scenarios.

UNIT I BASIC DATA STRUCTURES 9

Introduction to Data Structure - Classes and Objects in Python – Stack – ADT - Stack Applications - Balancing symbols -Evaluating the Postfix expressions – Queue - ADT – Queue Applications - Dequeue - Circular Queue

UNIT II LINKED LIST 9

Linked List Implementation - Singly Linked List- Circular Linked List - Doubly Linked List – All operation (Insertion, Deletion, Merge, Traversal) - Applications of lists – Polynomial Manipulation

UNIT III TREES 9

Basic Tree Terminologies- Binary Tree, Representation of Trees, Tree Traversal, Binary Search Tree – Operations, Implementation. Binary Heap- Properties, Heap Operations.

UNIT IV GRAPHS 9

Graph Terminologies, Graph ADT, Traversal- BFS, DFS, Directed Acyclic Graph- Topological Sorting, Shortest Path- Dijkstra's Algorithm.

UNIT V SEARCHING AND SORTING 9

Searching- Linear search, Binary search, Hashing- Hash function, Collision resolution techniques- Linear probing, Separate chaining. Sorting- Bubble sort, Selection sort, Insertion sort, Shell sort, Merge sort, Quick sort.

TOTAL: 45 PERIODS

OUTCOMES:

On completion of the course students will be able to

- Analyze the various data structure concepts.
- Apply data structures to solve various problems.
- Understand non-linear data structures.
- Correlate the uses of graphs in real life scenarios
- Apply different Sorting, Searching and Hashing algorithms.

TEXTBOOKS:

1. Bradley N. Miller,,Ranum .David L "Problem Solving with Algorithms and Data Structures Using Python", Franklin, Beedle & Associates ,2nd Edition, 2013. [Units 1,3,5]
2. Michael T. Goodrich ,,Roberto Tamassia Michael H. Goldwasser, "Data Structures and Algorithms in Python" Wiley, 2013 . [Units 2, 4]

REFERENCES:

1. Rance D. Necaise , "Data Structures and Algorithms using Python", John Wiley & Sons, 2011.
2. David M.Reed and John Zelle, "Data Structures and Algorithms using Python and C++", Franklin Beedle & Associates 2009.

BM17403 PATHOLOGY AND MICROBIOLOGY L T P C
3 0 0 3

OBJECTIVES:

- Gain knowledge on the structural and functional aspects of living organisms.
- Know the etiology and remedy in treating the pathological diseases.
- Empower the importance of public health.

UNIT I CELL DEGENERATION, REPAIR AND NEOPLASIA 9

Cell injury - Reversible cell injury and Irreversible cell injury and Necrosis, Apoptosis, Pathological calcification- Dystrophic and Metastatic. cellular adaptations of growth and differentiation, Inflammation and Repair including fracture healing, Neoplasia, Classification, Benign and Malignant tumours, carcinogenesis, spread of tumours. Autopsy and biopsy.

UNIT II FLUID AND HEMODYNAMIC DERANGEMENTS 9

Edema, Hyperemia/Ischemia, normal hemostasis, thrombosis, disseminated intravascular coagulation, embolism, infarction, shock. Hematological disorders-Bleeding disorders, Leukaemias, Lymphomas.

UNIT III 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 , culture media and its types , culture techniques and observation of culture. Disease caused by bacteria, fungi, virus.

.**UNIT IV IMMUNOPATHOLOGY 10**

Antigen, antibody – Immunoglobulins, Immunity - Innate and Acquired. Antigen –antibody reactions: precipitation, agglutination, complement fixation test, neutralization test, opsonization, immunofluorescence, immunoelectrophoresis, RIA and ELISA. Hypersensitivity reaction and its types. Monoclonal antibody production and its applications.

UNIT V MICROSCOPES 8

Light microscope – bright field, dark field, phase contrast, fluorescence, Electron microscope (TEM & SEM). Preparation of samples for electron microscope.

TOTAL: 45 PERIODS

OUTCOMES:

On completion of the course students will be able to

- Analyze the pathological aspects of various abnormalities.
- Outline the origin/cause of various fluid imbalance and hematological disease.
- Comprehend about the normal flora and how microbes harm us by causing disease.
- Illustrate the interaction of cellular and molecular components of immune system.
- Explain the various functional aspects of microscope.

TEXT BOOKS:

1. Ramzi S Cotran, Vinay Kumar & Stanley L Robbins, “Pathologic Basis of Diseases”, 7th edition,WB Saunders Co. 2005.
2. Ananthanarayanan & Panicker, “Textbook of Microbiology” , University press (India) Private Limited, 10th edition, 2017.

REFERENCES:

1. Churchill Livingstone “Underwood JCE: General and Systematic Pathology”, 3rd edition, 2000.

2. Dubey RC and Maheswari DK. “A Text Book of Microbiology” Chand & Company Ltd, 2007.
3. Prescott, Harley and Klein, “Microbiology”, 10th edition, McGraw Hill, 2017

CS17211	DATA STRUCTURES LABORATORY (Common to EEE, ECE and BME)	L	T	P	C
		0	0	4	2

OBJECTIVES:

- To learn and implement the various linear and non linear data structures.
- To understand the tree and graph traversal methods.
- To apply searching and sorting techniques for practical scenarios

LIST OF EXPERIMENTS

1. Basics of classes and objects
2. Stack implementation and its applications
3. Queue implementation
4. Linked List Operations
5. Binary Search Tree
6. Tree Traversals
7. Graph Traversals
8. Sorting Techniques
9. Searching Techniques
10. Mini Project on Application of Data Structures
    (Printing Tasks, Hot Potato Game, Palindrome Checker, Push Down Automata)

TOTAL: 30 PERIODS

PLATFORM NEEDED:

Hardware: PC with 4 GB RAM, i3 Processor
Software: Python 3 interpreter for Windows/Linux

OUTCOMES:

On completion of the course students will be able to

- Design and implement stacks, queues and linked lists.
- Work with various data structures and map its applications to appropriate scenarios.
- Apply good programming design methods for program development.
- Design and implement trees and graph concepts.
- Idealize new sorting and searching algorithms.

BM17411	ANALOG AND DIGITAL INTEGRATED CIRCUITS LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES:

- To design digital logic and circuits
- To learn the function of different ICs
- To understand the applications of operation amplifier.
- To learn the working of multivibrators
- To design circuits for generating waveforms using ICs.

LIST OF EXPERIMENTS:

1. Study of logic gates, Half adder and Full adder

2. Encoder and BCD to 7 segment decoder
3. Multiplexer and demultiplexer using digital ICs
4. Universal shift register using flip flops
5. Design of mod-N counter
6. Inverting, non-inverting amplifier and comparator
7. Integrator and Differentiator
8. Active filter – first order and second order LPF and HPF
9. Current to Voltage convertor and Voltage to Current Convertor
10. Comparator, Peak detector and Average detector
11. Instrumentation amplifier using IC741
12. Wein bridge oscillator
13. Multivibrator using IC555 Timer
14. Timer
15. Phase Lock Loop
16. A/D and D/A convertor

TOTAL: 60 PERIODS

OUTCOMES:

On completion of the course students will be able to

- Design Circuits using logic gates
- Build Circuits for different application using opamp
- Differentiate between oscillator and wave form generator
- Convert Signals from Analog to Digital Vice versa

LAB EQUIPMENTS FOR A BATCH OF 30 STUDENTS:

1. Digital Trainer Kit - 15 Nos. (with 5 V, Variable and fixed frequency Clock, Bread Board, Four Seven Segment displays, LEDs for output display, Logic 1 and 0 Input switches)
2. Logic ICs - 50Nos each
   (7400, 7402, 7404, 7408, 7410, 7420, 7432, 7447, 7448, 7474, 7476, 7483, , 7485, 7486, 7490, 7495, 74151, 741 Common Anode and cathode 7-segment displays, LEDs)
3. NE555 - 50 nos
4. PLL - 50 nos
5. A/D and D/A convertors - 50 nos
6. Resistors - 50 nos
7. Capacitors - 50 nos
8. IC Power supply (5 V fixed) - 15 Nos
9. Bread Boards - 15 Nos

BM17412	PATHOLOGY AND MICROBIOLOGY LABORATORY	L	T	P	C
		0	0	2	1

OBJECTIVES

- Use Compound microscope
- Practice on chemical examinations, Cryoprocessing, Histopathological examinations

LIST OF EXPERIMENTS:

1. Urine physical and chemical examination (protein, reducing substances, ketones, bilirubin and blood)
2. Study of parts of compound microscope

3. Histopathological slides of benign and malignant tumours
4. Manual paraffin tissue processing and section cutting (demonstration)
5. Cryo processing of tissue and cryosectioning (demonstration)
6. Basic staining – Hematoxylin and eosin staining
7. Simple stain.
8. Gram stain.
9. AFB stain.
10. Slides of malarial parasites, micro filaria and leishmania donovani.
11. Haematology slides of anemia and leukemia.
12. Differential count of Blood cells
13. Bleeding and Clotting time
14. Study of bone marrow charts.

TOTAL: 30 PERIODS

OUTCOMES:

On completion of the course students will be able to

- Student can perform practical experiments on tissue processing, cryoprocessing, staining Processes
- Demonstration of different staining technique for microscopic view of bacteria.

TEXT BOOKS:

1. 1.Textbook of Medical Laboratory Technology, Ramnik Sood, 6thEdition, Jaypee Brothers Medical Publishers, 2009

LAB EQUIPMENTS FOR 30 STUDENTS:

1. Wax dispenser 1 No.
2. Slide warming 1 No.
3. Microtome 1 No.
4. Microscope 4 No.
5. Microphotographic unit 1 No.
6. Slides 1 box
7. Coverslip 1 box
8. Capillary tubes 1 box
9. Lancet 2 boxes
10. Distillation Unit 1 No.
11. Water bath normal 1 No.
12. Incubator 1 No.
13. Autoclave 1 No.
14. Oven 1 No.
15. Refrigerator 1 No.

SEMESTER V

BM17501 **PRINCIPLES OF COMMUNICATION SYSTEMS** **L T P C**
3 0 0 3

OBJECTIVES

- To understand, analyze and explain various analog modulation schemes.
- To understand various digital modulation and pulse modulation techniques.
- To gain knowledge on multi-user radio communication
- To develop the ability to compare and contrast the strengths and weaknesses of various communication systems
- To be familiarized with source and Error control coding

UNIT I AMPLITUDE MODULATION 9

Introduction to communication system, Need for modulation, power relations in AM waves, Generation of AM waves, detection of AM waves, Generation of DSB, SSB, VSB Modulated Wave, Demodulation of DSB, SSB and VSB Waves ,Comparison of AM techniques.

UNIT ANGLE MODULATION 9

Basic concepts, Frequency Modulation: Single tone frequency modulation, Narrow band FM, Wide band FM, Constant Average Power, Transmission bandwidth of FM Wave - Generation of FM ,PM Waves, detection of FM , PM waves, Comparison of FM and AM.

UNIT III DIGITAL COMMUNICATION 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).

Unit IV 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 V SOURCE AND ERROR CONTROL CODING 9

Entropy, Source encoding theorem, Shannon fano coding, Huffman coding, mutual information, channel capacity, Error Control Coding, linear block codes, cyclic codes, convolution codes, viterbi decoding algorithm.

TOTAL: 45 PERIODS

OUTCOMES:

On completion of the course students will be able to

- Analyze 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
- Describe the source and Error control coding of information
- Analyze the concept of mobile communication.

TEXTBOOKS:

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.

REFERENCES:

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.

BM17502	BIOCONTROL SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To introduce the relevance of this course to the existing technology through case studies and simulations
- To study the mathematical techniques for analysis of given system
- To study the given system in time domain and frequency domain analysis.
- To study the stability analysis of the given system
- To study the concept of physiological control system

UNIT I CONTROL SYSTEM MODELING 9

Terminology and basic structure of control system, example of a closed loop system, transfer function, modeling of electrical systems, translational and rotational mechanical systems, and electromechanical systems, block diagram and signal flow graph representation of systems, reduction of block diagram and signal flow graph, conversion of block diagram to signal flow graph. Need for modeling physiological system.

UNIT II TIME RESPONSE ANALYSIS 9

Step and impulse responses of first order and second order systems, determination of time domain specifications of first and second order systems from its output responses, definition of steady state error constants and its computations.

UNIT III STABILITY ANALYSIS 9

Definition of stability, Routh- Hurwitz criteria of stability, root locus technique, construction of root locus and study of stability, definition of dominant poles and relative stability.

UNIT IV FREQUENCY RESPONSE ANALYSIS 9

Frequency response, Nyquist stability criterion, Nyquist plot and determination of closed loop stability, definition of gain margin and phase margin, Bode plot, determination of gain margin and phase margin using Bode plot, use of Nichol‘s chart to compute frequency and bandwidth.

UNIT V PHYSIOLOGICAL CONTROL SYSTEM 9

Difference between engineering and physiological control systems, generalized system properties, models with combination of system elements, linear models of physiological systems-Examples, Introduction to simulation. Examples of Biological control Systems: Cardiovascular Control System, Skeletal Muscle Servomechanism, Oculo - motor system, sugar level Control Mechanism.

TOTAL: 45 PERIODS

OUTCOMES:

On completion of the course students will be able to

- Comprehend and appreciate the significance and role of this course in the present contemporary world
- Develop mathematical model and perform stability analysis.
- Analyze the different systems in time and frequency domain.
- Explain the concept of physiological control systems

TEXT BOOKS:

1. J.Nagrath and M.Gopal, “Control System Engineering”, New Age International Publishers,5th Edition, 2007.
2. Michael C K Khoo, — “Physiological control systems”, IEEE Press, Prentice Hall of India, 2005.

3. Milsum John H, "Biological Control System Analysis", 2nd Edition, McGraw Hill Publications, 1996

REFERENCES:

1. Farid Golnaraghi, Benjamin C. Kuo, — “Automatic Control Systems”, Wiley, 9th edition 2009.
2. M.Gopal, —Control System – “Principles and Design”, Mc Graw-Hill, 2nd edition 2006.
3. Constantine H. Houpis, Stuart N. Sheldon, — “Linear Control System Analysis and Design with MATLAB”, CRC Press, 6th edition 2013.
4. Richard C. Dorf & Robert H. Bishop, — “Modern Control Systems”, Prentice Hall, 12th edition 2010.
5. Joseph J. DiStefano, Allen R. Stubberud, Schaum's Outline of — “Feedback and Control Systems”, McGraw-Hill Education; 2nd edition 2013.

BM17503	SIGNALS AND SYSTEMS ANALYSIS	L	T	P	C
		3	0	2	4

OBJECTIVES

- To understand the basic properties of signal & systems and the various methods of classification
- To learn Laplace Transform &Fourier transform and their properties
- To know Z transform & DTFT and their properties
- To characterize LTI systems in the Time domain and various Transform domains

UNIT I CLASSIFICATION OF SIGNALS AND SYSTEMS 9

Continuous time signals (CT signals) - Discrete time signals (DT signals) - Step, Ramp, Pulse, Impulse, Sinusoidal, Exponential, Classification of CT and DT signals - Periodic & Aperiodic signals, Deterministic & Random signals, Energy & Power signals - CT systems and DT systems- Classification of systems – Static & Dynamic, Linear & Nonlinear, Time-variant & Time-invariant, Causal & Noncausal, Stable & Unstable.

UNIT II ANALYSIS OF CONTINUOUS TIME SIGNALS 9

Fourier series analysis-spectrum of Continuous Time (CT) signals- Fourier and Laplace Transforms in CT Signal Analysis - Properties.

UNIT III LINEAR TIME INVARIANT- CONTINUOUS TIME SYSTEMS 9

Differential Equation-Block diagram representation-impulse response, convolution Integrals-Fourier and Laplace transforms in Analysis of CT systems.

UNIT IV ANALYSIS OF DISCRETE TIME SIGNALS 9

Sampling – Nyquist Criteria- DTFT – Properties of DTFT - Z Transform – Properties of Z Transform

UNIT V LINEAR TIME INVARIANT-DISCRETE TIME SYSTEMS 9

Difference Equations-Block Diagram Representation-Impulse response - Convolution sum-Discrete Fourier and Z Transform Analysis of Recursive & Non-Recursive systems

Practical:

1. Time Shifting, Time Reversing, Time Scaling
2. Construction of signals with different Frequencies.
3. Analyse the stability of an CT System with various inputs.
4. Analyse the stability of an DT System with various inputs.

5. Reconstruct a signals from samples and study the effect of Aliasing.

TOTAL (L: 45+P: 30): 75 PERIODS

Equipment required for 30 students
Computers with MATLAB software- 15 Numbers

OUTCOMES:
On completion of the course students will be able to
- classify real time signals and systems.
- compute Fourier series for CT signals.
- implement a system to perform Fourier operation on CT signals
- compute Fourier transform for DT signals
- implement a system to perform Fourier and Z transform on DT signals.

TEXT BOOK:
1. Allan V.Oppenheim, S.Wilsky and S.H.Nawab, "Signals and Systems", Pearson, 2007.

REFERENCES:
1. B. P. Lathi, "Principles of Linear Systems and Signals", Second Edition, Oxford, 2009.
2. R.E.Zeimer, W.H.Tranter and R.D.Fannin, "Signals & Systems - Continuous and Discrete", Pearson, 2007.
3. John Alan Stuller, "An Introduction to Signals and Systems", Thomson, 2007.
4. M.J.Roberts, "Signals & Systems Analysis using Transform Methods & MATLAB", Tata McGrawHill, 2007.

BM17504 MICROPROCESSOR, MICROCONTROLLER AND SYSTEM DESIGN **L T P C 3 0 0 3**

OBJECTIVES:
- To Study the Architecture of 8086 microprocessor
- To learn the design aspects of I/O and Memory Interfacing circuits.
- To Study about communication and bus interfacing
- To Study the Architecture of 8051 microcontroller

UNIT I THE 8086 MICROPROCESSOR **9**
Introduction to 8086 – Microprocessor architecture – Addressing modes - Instruction set and assembler directives – Assembly language programming –Stacks– Interrupts and interrupt service routines – Byte and String Manipulation.

UNIT II 8086 SYSTEM BUS STRUCTURE **9**
8086 signals – Basic configurations – System bus timing –System design using 8086 – IO programming –- Multiprocessor configurations – Coprocessor, Closely coupled and loosely Coupled configurations.

UNIT III I/O INTERFACING **9**
Memory Interfacing and I/O interfacing - Parallel communication interface – Serial communication interface – D/A and A/D Interface - Timer – Keyboard /display controller Interrupt controller – DMA controller – Programming and applications Case studies: Traffic Light control, LED display , LCD display, Keyboard display interface and Alarm Controller.

UNIT IV MICROCONTROLLER 9

Architecture of 8051 – Special Function Registers(SFRs) - I/O Pins Ports and Circuits - Instruction set- Addressing modes - Assembly language programming.

UNIT V INTERFACING MICROCONTROLLER 9

Programming 8051 Timers - Serial Port Programming - Interrupts Programming – LCD &Keyboard Interfacing - ADC, DAC & Sensor Interfacing - External Memory Interface- Stepper Motor and Waveform generation.

TOTAL: 45 PERIODS

OUTCOMES:

On completion of the course students will be able to

- able to write assembly language programs for 8086 microprocessor and execute using trainer kits
- able to interface the 8086 processor with 8282, 8284 and 8286 IC'S
- able to interface the 8086 processor with RAM and ROM IC's
- able to write assembly language programs for 8051 microcontroller and execute using trainer kits
- able to interface the 8051 Microcontroller with RAM, ROM, DAC, ADC IC's, LED and LCD display

TEXTBOOKS:

1. Douglas V.Hall, "Microprocessor and Interfacing, Programming and Hardware Revised" second Edition, Indian edition, Tata McGraw Hill, 2007.
2. Muhammad Ali Mazidi, Janice Gillispie Mazidi, Rolin D.MCKinlay The 8051Microcontroller and Embedded Systems, Second Edition, Pearson Education 2008.

REFERENCES:

1. Kenneth J. Ayala., "The 8051 Microcontroller, 3rd Edition, Thompson Delmar Learning, New Delhi, 2007.
2. A.K. Ray, K.M .Bhurchandi "Advanced Microprocessor and Peripherals" ,Second edition, Tata McGraw-Hill, 2007.
2. Barry B. Brey, "The Intel Microprocessors Architecture, Programming and Interfacing" Pearson Education, New Delhi, 2007,
3. Zdravko Karakehayov, "Embedded System Design with 8051 Microcontroller hardware and software", Mercel Dekkar, 1999.
4. Krishna Kant, " Microprocessor and Microcontroller Architecture, programming and system design using 8085, 8086, 8051 and 8096, PHI, 2007

BM17505	HOSPITAL ENGINEERING AND MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the fundamentals of hospital administration
- To know the management and market related research process
- To explore various roles and responsibilities of Engineers in hospital.
- To understand various waste management techniques
- To learn the standards and safety aspects in hospital.

UNIT I INTRODUCTION TO HOSPITAL ENGINEERING 9

Distinction between Hospital and Industry, History of engineering and technology in health care – Health care environment – Educational responsibilities – Staff structure in hospitals – Careers, roles and responsibilities. Hospital Planning- Equipment Planning – Functional Planning - Management Decisions and Related Information Requirement - Clinical Information Systems - Administrative Information systems.

UNIT II MANAGEMENT AND MARKETING RESEARCH PROCESS 9

Manpower Planning - Different Departments of Hospital, Recruitment, Selection, Training Guidelines –Methods of Training – Evaluation of Training – Leadership grooming and Training, Promotion – Transfer, Communication, Current Issues in Hospital Management. Marketing information systems – Consumer Markets & Consumer Buyer Behavior - Model of consumer behavior - The buyer decision process - Model of business buyer behavior - WTO and its implications.

UNIT III ROLES AND RESPONSIBILITIES OF ENGINEERS IN HOSPITAL 9

Biomedical equipment procurement procedure - purchase & contract procedures, selection testing calibration and installation, Training to medical staffs - operating instructions. Management of medical equipment's, planned preventive maintenance system, preventive maintenance & repair. Requirements of inter departmental computerization. DBMS in hospital, computerized medical record evaluation, Database approach to laboratory computerization

UNIT IV BIOMEDICAL WASTE MANAGEMENT& SUPPORTIVE SERVICES 9

General and Hazardous health care waste – categories– Color coding, collection, segregation and disposal. Modern Technology for handling Biomedical Wastes – Monitoring & Controlling of Cross Infections, Protective Devices – Bioethics and Handling of Waste Management. Support Service, Technical information systems – Medical Transcription, Medical Records Department – Central Sterilization and Supply Department.

UNIT V STANDARDS AND SAFETY ASPECTS IN HOSPITALS 9

Necessity for standardization, Quality Auditing - Need for Accreditation of hospitals - FDA Regulations- Joint Commission International - Regulatory Bodies of India- NABH – procedures and documentation, Medical Council of India - Pharmacy Council Of India, International Standards ISO 9000 – 9004 – Features of ISO 9001 – ISO 14000 – Environment Management Systems. Labor laws applicable to hospitals, Medical Ethics. Security – Loss Prevention – Fire Safety – Alarm System – Safety Rules. Health Insurance & Managing Health Care – Medical Audit – Hazard and Safety in a hospital Setup.

TOTAL: 45 PERIODS

OUTCOMES:

On completion of the course students will be able to

- Explain the principles of Hospital administration.
- Identify the importance of management of staff and equipment.
- Identify the importance of Engineers in hospitals.
- Identify various techniques used for waste management.
- Understand safety procedures followed in hospitals.

TEXT BOOKS:

1. R.C. Goyal, "Hospital Administration and Human Resource Management", PHI – Fifth Edition, 2010.
2. G.D. Kunders, "Hospitals – Facilities Planning and Management – TMH", New Delhi" – Fifth Reprint 2007.
3. V. J. Landrum, "Medical Waste Management and disposal, Elsevier", 1991

REFERENCES:

1. Cesar A. Caceres and Albert Zara, “The Practice of Clinical Engineering, Academic Press, New York, 1977.
2. Norman Metzger, “Handbook of Health Care Human Resources Management”, 2nd edition Aspen Publication Inc. Rockville, Maryland, USA, 1990.
3. Arnold D. Kalcizony& Stephen M. Shortell, “Health Care Management”, 6th Edition Cengage Learning, 2011.
4. Thomas A. Mappes and David DeGrazia (editors),"Biomedical Ethics", McGraw Hill, 4th Edition, 1996

BM17511	MICROPROCESSOR, MICROCONTROLLER AND SYSTEM DESIGN LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES:

- Introduce ALP concepts and features
- Write ALP for arithmetic and logical operations in 8086 and 8051
- Differentiate Serial and Parallel Interface
- Interface different I/Os with Microprocessors
- Be familiar with MASM

LIST OF EXPERIMENTS:

8086 Programs using kits and MASM

1. Basic arithmetic and Logical operations
2. Move a data block without overlap
3. Code conversion, decimal arithmetic
4. Sorting and searching
5. Counters and Time Delay

Peripherals and Interfacing Experiments

6. Traffic light control
7. Stepper motor control
8. Key board and Display
9. Serial interface and Parallel interface
10. A/D and D/A interface and Waveform Generation

8051 Experiments using kits and MASM

11. Basic arithmetic and Logical operations
12. Square and Cube program, Find 2’s complement of a number
13. Unpacked BCD to ASCII

LAB EQUIPMENT FOR A BATCH OF 30 STUDENTS:

HARDWARE:

1. 8086 development kits - 30 nos
2. Interfacing Units - Each 10 nos
3. Microcontroller - 30 nos

SOFTWARE:

1. Intel Desktop Systems with MASM - 30 nos
2. 8086 Assembler
3. 8051 Cross Assembler

TOTAL: 60 PERIODS

OUTCOMES:

On completion of the course students will be able to

- Write ALP Programme for fixed and Floating Point and Arithmetic
- Interface different I/Os with processor
- Generate waveforms using Microprocessors
- Execute Programs in 8051
- Explain the difference between simulator and Emulator

BM17512	BIOMEDICAL INSTRUMENTATION LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES:

- Measurement of physiological parameters
- Biochemical parameters measurement
- Biosignal analysis
- Biotelemetry unit

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 of EMG and Measurement of NCV
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 analog circuit
7. Study of Galvanic Skin Resistance using GSR System
8. Measurement of pH and conductivity.
9. Study of biotelemetry Unit
10. To measure the blood pressure levels using Sphygmomanometer.
11. Simulation of ECG – detection of QRS complex and heart rate
12. Design a suitable filter for biosignal Acquisition

TOTAL: 60 PERIODS

LAB REQUIREMENTS FOR A BATCH OF 30 STUDENTS:

1. Multiparameter patient monitoring system: 1 No.
2. EEG recorder with accessories for evoked studies: 1 No.
3. ECG recorder: 1 No.
4. EMG recorder: 1 No.
5. PH meter, conductivity meter: 1 No.
6. Blood flow measurement system using ultrasound transducer: 1 No.
7. GSR measurement setup. : 1 No.
8. Function Generators
9. DSOs
10. Regulated Power supplies
11. Bread boards
12. IC 741

OUTCOMES:

On completion of the course students will be able to

- Design amplifier circuits for Bio signal measurements.

- Record and analysis of bio signals.
- Implement biochemical recorders.
- Design simulation circuits for biosignal measurements
- Design a filter for biosignal Acquisition

HS17361	INTERPERSONAL SKILLS/ LISTENING AND SPEAKING	L	T	P	C
	Common to CSE, ECE, IT, MECH, BT, AUTO, CIVIL, MCT& BME	0	0	2	1

OBJECTIVES

- To upgrade the learners' listening and speaking skills for educational purposes.
- To enhance the employability skills of the learners with a special focus on listening and speaking skills.

UNIT I INTRODUCTION 6

Importance of listening and Types of Listening – listening to TED Talks, lectures, etc. **Speaking**: group discussions on general topics like how to grow organic potted plants, to furnish an apartment inexpensively, etc. – **Phonetics**

UNIT II APPRECIATIVE LISTENING AND IMPROMPTU 6

Listening - Listening to motivational speeches, music and poetry. **Speaking** – pick and talk, short talks on any event on topics- a trip to remember, a job I'd love to have, etc. – **Vocabulary**: Collocation.

UNIT III INFORMATIVE LISTENING AND PERSUASIVE SPEAKING 6

Listening – Listening- to gather information such as facts, directions, news or instructions. **Speaking –** Persuasive speaking- convincing the audience with the speaker's view on the topics- food additives and unhealthiness, financial education is important in today's world, etc. – **Vocabulary**: Idioms and Phrases

UNIT IV CRITICAL LISTENING AND SPEAKING ON SPECIAL OCCASION 6

Listening – Critical Listening- listening to examine and evaluate the message for logic and truth - televised debate, election campaign. **Speaking** – speech to commemorate a person or an event- speech of Introduction, etc. – **Vocabulary**: Foreign Words and Phrases.

UNIT V EMPATHETIC LISTENING AND DEMONSTRATIVE SPEAKING 6

Listening– Empathetic Listening – paying attention to another person with empathy – listening to problems and issues (videos). **Speaking –** Demonstrative speaking – Demonstrate a process using visual aids (charts, graphs, maps, pictures, etc.) – **Grammar**: Different types of Questions.

TOTAL: 30 PERIODS

OUTCOMES:

On completion of the course students will be able to

- Identify the different types of listening and speaking for effective interpersonal communication.
- Discuss and respond to content of a listening passage.
- Comprehend and answer questions based on the texts/passages given.
- Understand different genres of texts and comprehend the materials to improve their vocabulary and are familiar with new words, phrases, sentence structures and ideas.
- Make inferences and predictions about spoken discourse.

REFERENCES

1. "Technical Communication – Principles and Practice," Second Edition – Meenakshi Raman and Sangeetha Sharma, Oxford University Press, December, 2011.
2. "Interpersonal Skills: How to develop Interpersonal Skills for work and home," Henry Lee (Kindle Edition)
3. "Teaching the Core Skills of Listening and Speaking," Erik Palmer (Kindle Edition)

SEMESTER VI

BM17601	DIGITAL SIGNAL PROCESSING TECHNIQUES	L	T	P	C
		3	2	0	4

OBJECTIVES:

- To learn discrete Fourier transform and its properties
- To know the characteristics of IIR and FIR filters learn the design of infinite and finite impulse response filters for filtering undesired signals
- To understand Finite word length effects
- To study the concept of Multirate and adaptive filters

UNIT I DISCRETE FOURIER TRANSFORM 15

Discrete Signals and Systems- A Review – Introduction to DFT – Properties of DFT – Circular Convolution - Filtering methods based on DFT – FFT Algorithms –Decimation in time Algorithms, Decimation in frequency Algorithms – Use of FFT in Linear Filtering.

UNIT II FINITE IMPULSE RESPONSE (FIR) FILTER 15

Introduction to FIR filter - phase delay and group delay – linear phase transfer function. Design of FIR filter using Fourier method, Rectangular window, Hanning window, Hamming window, Kaiser window. Design using frequency sampling technique. Structure realization of FIR system – direct form, cascade form, linear phase FIR system.

UNIT III INFINITE IMPULSE RESPONSE (IIR) FILTER 15

Introduction to IIR filter - Impulse-invariant transformation technique – Bilinear transformation technique – frequency transformation in digital domain - design of Butterworth filter and Chebyshev filter (type-1) (restricted to 3rd order). Structure realization of IIR system – lattice structure and lattice-ladder structure.

UNIT IV ANALOG TO DIGITAL CONVERSION & QUANTIZATION ERROR 15

Sampling of analog signals- Sampling theorem- ADC - Quantization of continuous amplitude signals, Sinusoidal signal- Fixed point and floating point number representations –Quantization- Truncation and Rounding errors - Quantization noise – coefficient quantization error – Product quantization error - Overflow error – Round off noise power - limit cycle oscillations due to product round off and overflow errors – Principle of scaling

UNIT V BASICS OF RANDOM SIGNAL PROCESSING 15
(ONLY QUALITATIVE ANALYSIS)

Introduction to probability function, joint probability, conditional probability – estimation parameters – joint distribution function, probability density function, ensemble average – mean squared value, variance, standard deviation, moments, correlation, covariance, Orthogonality, auto-covariance, auto-correlation, cross-covariance and cross-correlation – stationarity – ergodic – white noise –

Decimator (down sampling) – frequency-domain analysis of decimator – interpolation (up sampling) – frequency-domain analysis of interpolator

TOTAL: 75 PERIODS

OUTCOMES:

On completion of the course students will be able to

- Apply DFT for the analysis of digital signals & systems
- Design and implement IIR filters.
- Design and implement FIR Filters.
- Characterize finite Word length effect on filters
- Analyse random signals and apply it for real time processing

TEXT BOOKS:

1. John G. Proakis and Dimitris G. Manolakis, "Digital Signal Processing, Algorithms and Applications", Pearson education, New Delhi, 4th Edition, 2007.
2. E. C. Ifeachor and B.W. Jervis, "Digital Signal processing – A Practical Approach",Pearson education, New Delhi, 4th Edition, 2004.

REFERENCES:

1. Sanjit K. Mitra, "Digital Signal Processing – A computer Based Approach", TMH, New Delhi, 1998
2. Andreas Antoniou, Digital filter Analysis and Design", Prentice Hall India
3. R. Rabiner and B. Gold, "Theory and Application of Digital Signal processing", PHI

BM17602	DIAGNOSTIC EQUIPMENT	L	T	P	C
		3	0	0	3

OBJECTIVES

- To study the properties and techniques in ultrasound imaging
- To understand the Electrophysiology of various physiological systems and recording of the bioelectric signals.
- To outline the different components and working principle of pulmonary function measuring devices.
- To familiarize with the different parts of sensory medical equipment and its working principle.
- To learn the concepts of basic patient monitoring system and telemetry unit.

UNIT I BIOMEDICAL RECORDER 9

Basic Measurement system, ECG, VCG, BCG, PCG, Holter Monitor, EEG, MEG, Evoked and Event related potentials, EMG ,ENG, EGG, Effects of Artifacts, Abnormal waveform.

UNIT II IMAGING EQUIPMENTS 9

Ultrasound-Diagnosis: Tissue Reaction, Basic principles of Echo technique, display techniques A, B and M mode, Application of ultrasound as diagnostic tool – Echocardiogram, Echoencephalogram, abdomen, obstetrics and gynecology, ophthalmology, Endoscope and its types, Thermo graphic Equipment – Recording and clinical application.

UNIT III RESPIRATORY MEASUREMENT SYSTEM 9

Instrumentation for measuring the mechanics of breathing – Spirometer -Lung Volume and vital capacity, measurements of residual volume, Pneumotachometer – Airway resistance

measurement, Whole body Plethysmograph, Intra-Alveolar and Thoracic pressure measurements, Apnoea Monitor.

UNIT IV SENSORY MEASUREMENT SYSTEM 9

Psycho Physiological Measurements-for testing and sensory Responses, Audiometer-Pure tone, Speech, galvanic skin resistance (GSR), Eye - Test Standard, Trial case lenses, Tonometer - Applanation Tonometer, slit lamp, auto refractometer, Dioptron, Retinoscope,ERG,EOG.

UNIT V PATIENT MONITORING AND BIOTELEMETRY 9

Patient monitoring systems- BP measurement– Direct and indirect method, Heart rate, Pulse rate, temperature measurement, Respiration Rate, Oximetry, Foetal Monitor, Central consoling controls, Radio Telemetry (single, multi), Portable and Landline Telemetry unit, Ambulatory Telemonitoring, Applications in ECG and EEG Transmission.

TOTAL: 45 PERIODS

OUTCOMES:

On completion of the course students will be able to

- Service and improvise the modern imaging systems.
- Model different types pulmonary function measuring devices.
- Design different biomedical recorders.
- Apply the engineering principles in various sensory medical equipment design .
- Implement modern patient monitoring system and telemetry unit.

TEXT BOOKS:

1. Khandpur R.S., “Handbook of Biomedical Instrumentation ” Tata McGraw Hill Publication Company Ltd, New Delhi, 1997
3. L.A Geddes and L.E.Baker, “Principles of Applied Biomedical Instrumentation”, 3rd Edition, 2008

REFERENCES:

1. John G. Webster, “Medical Instrumentation”, 3rd Edition, John Wiley & Sons, 2004.
2. Cromwell, “Biomedical Instrumentation & Measurements” 2 nd Edition, Prentice-hall of India private limited, 2009.
3. Carr & Brown, “Introduction to Biomedical Equipment Technology”, 7 th Edition, Pearson Education, 2004.
4. B H Brown, R H Smallwood, D C Barber, P V Lawford and D R Hose, “Medical Physics and Biomedical Engineering”, 2nd Edition, IOP Publishers. 2001.
5. Myer Kutz, “Standard Handbook of Biomedical Engineering & Design”, Mc Graw Hill, 2003.

BM17603 BIOMECHANICS L T P C
3 0 0 3

OBJECTIVES:

- Be exposed to principles of mechanics.
- Understand the fluid mechanics.
- Learn the mechanics of physiological systems.
- Be familiar with the mathematical models used in the analysis of biomechanical systems.
- Be exposed to the advancements in biomechanics.

UNIT I INTRODUCTION TO MECHANICS 9

Introduction- Scalars and vectors, Statics: Force types, Resolution and composition of forces, Resultant of forces, moments of force and couple, vector method for resultant force determination, parallel forces in space, equilibrium of coplanar forces Dynamics: Basic principles- Linear motion, Newton's laws of motion, Impulse and Momentum, Work and Energy Kinetics: Calculation of velocity and acceleration, Kinematics: Link segment models, Force transducers and force plates. Introduction to Constitutive equations

UNIT II MECHANICS OF BIOFLUIDS 9

Intrinsic fluid properties: Density, Viscosity, Compressibility and Surface Tension Viscometers: Capillary, Coaxial cylinder and cone and plate; Rheological properties of blood, Pressure-flow relationship for Non-Newtonian Fluids: Power law fluid, Bingham Plastic, Casson's fluid; Fluid mechanics in straight tube: Flow development, Viscous and Turbulent Sheer Stress, Effect of pulsatility, Boundary Layer Separation. Structure of blood vessels, material properties and modelling of Blood vessels Heart: Material characterization of cardiac muscle, Native heart valves: Mechanical properties and valve dynamics, Prosthetic heart valve fluid dynamics.

UNIT III MECHANICS OF BIOSOLIDS 9

Constitutive equation of visco elasticity: Maxwell & Voight models – anisotropy. Hard Tissues: Structure, blood circulation, elasticity and strength, visco elastic properties, functional adaptation Soft Tissues: Structure, functions, material properties and modelling of Soft Tissues: Cartilage, Tendons and Ligaments Skeletal Muscle: Muscle action, Hill's models, mathematical modelling Bone fracture mechanics.

UNIT IV BIOMECHANICS OF JOINTS 9

Skeletal joints, forces and stresses in human joints, Analysis of rigid bodies in equilibrium, Free body diagrams, Structure of joints, Types of joints, Biomechanical analysis of elbow, shoulder, spinal column, hip, knee and ankle. Biotribology: Lubrication of synovial and prosthetic joints Total knee and hip joint replacement.

UNIT V ERGONOMICS AND KINESIOLOGY 9

Introduction to Finite Element Analysis, finite element analysis of lumbar spine; Ergonomics: Musculoskeletal disorders, Ergonomic principles contributing to good workplace design, Design of a Computer work station; Whole body vibrations, Hand transmitted vibrations. Gait analysis, Kinesiological EMG; Sports biomechanics: Motion analysis using video, Isokinetic dynamometry, Computer simulation modelling in sports.

TOTAL: 45 PERIODS

OUTCOMES:

On completion of the course students will be able to

- Solve the dynamics and fluid mechanics problems.
- Explain the mechanics of physiological systems.
- Analyze the biomechanical systems.
- Work with the knowledge of Ergonomics.
- Design orthopaedic applications.

TEXT BOOKS:

1. Y.C. Fung, "Bio-Mechanics- Mechanical Properties of Tissues", Springer-Verlag, 1998.
2. Marcelo Epstein, "The Elements of Continuum Biomechanics", ISBN: 978-1-119-99923-2, 2012.
3. Neil J. Mansfeild, "Human Response to Vibration", CRC Press, 2005.

REFERENCES:

1. Jay D. Humphrey, Sherry De Lange, “An Introduction to Biomechanics: Solids and Fluids, Analysis and Design”, Springer Science Business Media, 2004.
2. Shrawan Kumar, “Biomechanics in Ergonomics”, Second Edition, CRC Press 2007.
3. Sheraz S. Malik et. al. “Orthopaedic Biomechanics Made Easy”, Cambridge University Press, 2015.
4. Carl J. Payton, “Biomechanical Evaluation of movement in sports and Exercise”, 2008.

BM17604	MEDICAL PHYSICS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To study the complete non-ionizing radiations including light and its effect in human body.
- To understand the principles of ultrasound radiation and its applications in medicine.
- To learn about radioactive nuclides and also the interactions of radiation with matters and how isotopes are produced.
- To know various detectors for detecting the presence of ionizing radiation.

UNIT I NON-IONIZING RADIATION AND ITS MEDICAL APPLICATIONS 9

Introduction to EM waves - Tissue as a leaky dielectric - Relaxation processes: Debye model, Cole–Cole model- Overview of non-ionizing radiation effects-Low Frequency Effects- Higher frequency effects. Physics of light-Measurement of light and its unit- limits of vision and color vision an overview - Applications of ultraviolet and IR in medicine.

UNIT II SOUND IN MEDICINE 9

Physics of sound, Normal sound levels –ultrasound fundamentals – Generation of ultrasound (Ultrasound Transducer) - Interaction of Ultrasound with matter: Cavitation, Reflection, Transmission- Scanning systems – Artifacts- Ultrasound- Doppler-Double Doppler shift-Clinical Applications.

UNIT III PRINCIPLES OF RADIOACTIVE NUCLIDES AND DECAY 9

Introduction to Radioisotopes - Radioactive decay : Spontaneous Fission, Isomeric Transition, Alpha Decay, Beta Decay, Positron Decay, Electron Capture- Radioactive decay equations – Half life- Mean Life- Effective half-life - Natural and Artificial radioactivity, - Production of radionuclide – Cyclotron produced Radionuclide - Reactor produced Radionuclide:fission and electron Capture reaction, Target and Its Processing Equation for Production of Radionuclide - Radionuclide Generator-Technetium generator.

UNIT IV INTERACTION OF RADIATION WITH MATTER 9

Interaction of charged particles with matter –Specific ionization, Linear energy transfer, range, Bremsstrahlung, Annihilation - Interaction of X and Gamma radiation with matter: Photoelectric effect, Compton Scattering, Pair production- Attenuation of Gamma Radiation - Interaction of neutron with matter and their clinical significance- Radionuclide used in Medicine and Technology.

UNIT V SCINTILLATION, SEMICONDUCTOR and GAS FILLED DETECTORS 9

Scintillation Detectors - Solid Scintillation Counters - Gamma-Ray Spectrometry- Liquid Scintillation Counters-Characteristics of Counting Systems-Gamma Well Counters-Principles of Gas-Filled Detectors - Ionization Chambers-Geiger–Müller Counters.

TOTAL: 45 PERIODS

OUTCOMES:

On completion of the course students will be able to

- Analyze the low frequency and high frequency effects of non-ionizing radiation and physics of light.
- Define various clinical applications based on ultrasound wave.
- Explain the process of radioactive nuclide production using different techniques
- Analyze radiation mechanics involved with various physiological systems
- Outline different methods of detecting and recording the ionizing radiation and its interaction with matter

TEXT BOOKS:

1. B H Brown, R H Smallwood, D C Barber, P V Lawford and D R Hose, "Medical Physics and Biomedical Engineering", 2nd Edition, IOP Publishers.2001. (Unit I & II)
2. Gopal B. Saha, "Physics and Radiobiology of Nuclear Medicine", 4th Edition, Springer, 2013. (Unit III & IV)
3. R.Hendee and Russell Ritenour "Medical Imaging Physics", Fourth Edition William, Wiley-Liss, 2002. (Unit V)

REFERENCES:

1. S.Webb,"The Physics of Medical Imaging", Taylor and Francis, 1988
2. Hylton B.Meire and Pat Farrant "Basic Ultrasound" John Wiley & Sons, 1995
3. John R Cameran , James G Skofronick "Medical Physics" John-Wiley & Sons. 1978
4. W.J.Meredith and J.B. Massey "Fundamental Physics of Radiology" Third edition, Varghese Publishing house. 1992

BM17605	THERAPEUTIC EQUIPMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

- study the working principle of cardiac care therapy equipment.
- learn the functioning of different types of diathermy, physiotherapy and electrotherapy equipment.
- gain adequate knowledge about the working principle of extracorporeal devices and lithotripter equipment.
- understand the block & working of Anaesthesia and Oncology therapeutic equipment and its working principle.
- earn the function and uses of respiratory care equipment and Ventilators.

UNIT I PACEMAKER AND DEFIBRILLATOR 9

Cardiac Pacemakers - Need for Cardiac Pacemaker - External Pacemakers - Implantable Pacemakers – Recent Developments in Pacemaker system analyzer. Cardiac Defibrillators -Need for a Defibrillator - DC Defibrillator -Implantable Defibrillators – Pacer-cardioverter - Defibrillator analysis.

UNIT II SURGICAL DEVICES AND EQUIPMENT 9

Instruments for surgery - principle of surgical diathermy - surgical diathermy machine - safety aspects in Electro-Surgical diathermy Units. Physiotherapy and electrotherapy equipment - High frequency heat therapy – short wave Diathermy - Microwave diathermy - Ultrasonic therapy unit – Pain relief through Electrical Stimulation – Bladder Stimulators – Cerebellar Stimulators, TENS, Muscle stimulators, Biofeedback, CATH Lab-Angioplasty, Atherectomy.

UNIT III EXTRACORPOREAL DEVICES AND LITHOTRIPTERS 9

Heart lung Machine, Dialyzer unit, Lithotripters - electronic monitoring of functional parameter. Principles of Cryogenic technique and application.

UNIT IV ANESTHESIA MACHINE AND ONCOLOGY THERAPY EQUIPMENTS 9

Need for Anesthesia – Anesthesia machine - Electronics in Anesthesia machine, Automated Drug delivery systems. Instruments for Oncology-brachy therapy, Chemotherapy, Cobalt-60 Machine, Applications.

UNIT V VENTILATORS 9

Mechanics of Respiration - Artificial Respiration – Ventilators - Types of ventilators - – Pressure, Volume, and Time controlled, flow Diagrams, Modern ventilators - High frequency ventilators, Patient Cycle Ventilators, Humidifiers, Nebulizers and Aspirators.

TOTAL: 45 PERIODS

OUTCOMES:

On completion of the course students will be able to

- model and improvise different types of Pacemaker & Defibrillators
- limplement working principles of diathermy & electrotherapy equipment.
- apply the working principle of extracorporeal devices and lithotripsy to model and service the Equipment.
- design and service Anaesthesia and Oncology therapeutic equipment.
- extemporise respiratory care equipment

TEXT BOOK:

1. R. S. Khandpur, “Handbook of Biomedical Instrumentation”, Tata McGraw Hill Publication company Ltd, New Delhi, 1997

REFERENCES:

1. John G Webster, “Medical Instrumentation: Application and Design” John Wiley & Sons, 1998
2. John G Webster, "Bioinstrumentation", John Wiley & Sons, 2004.
3. L.A Geddes and L.E.Baker, “Principles of Applied Biomedical Instrumentation”, 3rd Edition, 2008.
4. R.Hendee and Russell Ritenour “Medical Imaging Physics”, Fourth Edition William, Wiley-Liss,2002.

BM17611 DIGITAL SIGNALS AND PROCESSING LABORATORY L T P C
0 0 4 2

OBJECTIVES:

- To implement Linear and Circular Convolution
- To implement FIR and IIR filters
- To study the architecture of DSP processor
- To demonstrate Finite word length effect

LIST OF EXPERIMENTS:

MATLAB / EQUIVALENT SOFTWARE PACKAGE

1. Digitization of Analog Signals and reconstruction
2. Generation of sequences (functional & random) & correlation
3. Linear and Circular Convolutions

4. Spectrum Analysis using DFT
5. FIR filter design
6. IIR filter design
7. Finite word length effect
8. Multirate Filters
9. Equalization
10. Adaptive filters

DSP PROCESSOR BASED IMPLEMENTATION

11. Study of architecture of Digital Signal Processor
12. Linear Convolution
13. Circular Convolution
14. FFT Implementation
15. Waveform generation

TOTAL: 60 PERIODS

OUTCOMES:

On completion of the course students will be able to

- Carry out simulation of DSP systems
- Demonstrate their abilities towards DSP processor based implementation of DSP systems
- Analyze Finite word length effect on DSP systems
- Demonstrate the applications of FFT to DSP
- Implement adaptive filters for various applications of DSP

LAB EQUIPMENT FOR A BATCH OF 30 STUDENTS (**2 students per system**)

1. PCs with Fixed / Floating point DSP Processors (Kit / Add-on Cards) 15 Units

LIST OF SOFTWARE REQUIRED:

1. MATLAB with Simulink and Signal Processing Tool Box or Equivalent Software in desktop systems-15 Nos
2. Signal Generators (1MHz) – 15 Nos
3. CRO (20MHz) -15 Nos

BM17612	DIAGNOSTIC & THERAPEUTIC EQUIPMENT LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES:

- During the course students will be able to practice on recording and analysis of different Bio potentials
- Students will be able to design and develop various diagnostic equipments.
- Students will be able to learn to work with various signal processing software.
- Students will be able to study various therapeutic equipments.
- Students will be able to learn to work with simulation software.

LIST OF EXPERIMENTS

1. Analyze EMG and EEG signals using LabVIEW / Matlab
2. Heart rate variability Analysis (HRV) using Kubios HRV software
3. Recording of lung flow, volume and capacities graph using PC based Spirometer.
4. To plot the human auditory response using Audiometer
5. Recording of PCG (Phonocardiograph) for Measurement of Heart Sound

6. Measurement of physiological parameters using patient monitoring system
7. Study of surgical diathermy.
8. Study and simulation of pacemaker & defibrillator using VI LABS
9. To study and demonstrate the working of Haemodialysis Machine
10. To study and demonstrate the working of Respiratory Ventilator.
11. Study of shortwave and ultrasonic diathermy
12. Design and demonstrate the working of TENS
13. Mini project (Should include hardware and software). – 15 Periods

TOTAL: 60 PERIODS

LAB REQUIREMENTS FOR 30 STUDENTS

1. Multi output power supply (+15v, -15v, +30V variable, +5V, 2A) 2 Nos.
2. Single parameter biotelemetry system 1 No.
3. Spirometry with associated analysis system 1 No.
4. ECG Simulator 1 No.
5. Medical stimulator 1 No
6. Audiometer 1No.
7. PC installed with LabVIEW & Kubios HRV software
8. PC installed with BIOPAC software and Hardware kit. 1 No.
9. Multioutput power supply (+15v, -15v, +30V variable, +5V, 2A) 2 Nos.
10. ECG Simulator 1 No.
11. Medical stimulator 1 No
12. PC installed with LabVIEW software
13. NI DAQ device 1 No.
14. PC installed with BIOPAC software and Hardware kit. 1 No.
15. Short wave Diathermy 1 No.
16. Ultrasound diathermy 1 No.
17. Haemodialysis machine 1 No.
18. Surgical diathermy with analyzer 1 No

OUTCOMES:

On completion of the course students will be able to

- Analyse and interpret between normal and abnormal conditions in biosignals.
- Have the knowledge about different types of cutting and coagulation.
- Calculates the respiratory capacity to diagnose acute and chronic conditions
- Apply various types of diathermy for Rehabilitation purpose.
- Ensure the safety of patients against electrical hazard

BM17613	MEDICAL INDUSTRIAL TRAINING	L	T	P	C
		0	0	2	1

OBJECTIVES

- To know the various biomedical industries and training centres.
- To develop the report writing and presentation skills of the students.

Industrial Training – Students will undergo two weeks of Industrial Training during fifth semester in biomedical industries or R&D centres and should produce the certificate from the industries or research centres. In addition to that each student will be required to submit a report. Reports are to represent the observations of the students after the training with their personal comments /

suggestions. Finally Viva-Voce to be conducted along with an External Examiner, constituted by Controller of Examinations.

Internal Continuous Assessment
20% - Certificate from industries
30% - Presentation
30% - Report
20% - Regularity in the class

TOTAL: 30 PERIODS

Outcomes:
On completion of the course students will be able to
- Approach an industry or training centre for collaboration.
- Draft technical reports flawlessly.
- Know the recent developments in industries.

SEMESTER VII

BM17701	PHYSIOLOGICAL MODELING	L	T	P	C
		2	0	2	3

OBJECTIVES
- Study the properties of physiological systems.
- Understand and appreciate the value and application of Physiological models and Vital organs.
- Model dynamically varying physiological system.
- Understand methods and techniques for analysis and synthesis of dynamic models.
- Develop differential equations to describe the dynamic models, simulate and visualize, dynamic responses of physiological models using software.

UNIT I SYSTEM CONCEPTS 6
Review of physiological system modeling- system properties- different configurations of tracheal network, static and dynamic resistance, System with volume storage capacity and its electrical analog , Simplified model of respiratory system , Simulation of aortic segments, Step response of resistant / compliant systems –Dye dilution study of circulation.

UNIT II TRANSFER FUNCTION 6
System as an operator and use of Transfer function, Bio Engineering of coupled systems, Examples of transformed signals and circuits for transfer function with impedance concept- Development of lung model, Impedance of a two stage ladder network.

UNIT III PERIODIC SIGNALS 6
Sinusoidal Functions, Analysis of Instrumentation to measure air flow system, second order system – representation of a respiratory system, Evaluation of Transfer function from frequency response for muscle response modes, Transient Response of an Undamped Second order system, General description of Natural Frequency Damping, Physical Significance of under damped responses of post systolic operations in aortic arch.

UNIT IV FEEDBACK 6
Characterization of Physiological Feedback systems- Hypophysis adrenal systems, papillary hippus, Simulation-Hodgkin-Huxley model, Model of cardiovascular variability.

UNIT V SIMULATION OF BIOLOGICAL SYSTEMS 6

Simulation of thermal regulation, pressure and flow control in circulation, occulo motor system, Endocrinal system.

THEORY: 30 PERIODS

PRACTICAL EXPERIMENTS

1. Introduction to simulation.
2. Simulation of Simple Lung Mechanics Model.
3. Simulation of Neuromuscular Reflex Model.
4. Simulation of Blood Circulatory Model.

TOTAL: 30+30= 60 PERIODS

LAB EQUIPMENT FOR A BATCH OF 30 STUDENTS

List of software required:

1. MATLAB with Simulink Tool Box or Equivalent Software in desktop systems -15 Nos

OUTCOMES:

On completion of the course students will be able to

- Explain application of Physiological models.
- Model dynamically varying physiological system
- Discuss methods and techniques to analyze and synthesis dynamic models
- Develop differential equations to describe the dynamic models, simulate and visualize
- Implement physiological models using software to get dynamic responses

TEXT BOOKS:

1. Willian B. Blesser, “A System Approach to Biomedicine”, Mc Graw Hill Book Co., New York, 1969
2. ManfreoClynes and John H.Milsum, “Biomedical Engineering System”, McGraw Hill and Co., NewYork , 1970 (Unit V).
3. MichealC.K.Khoo, ”Physiological Control System” Analysis, Simulation and Estimation“.-PrenticeHall of India , New Delhi , 2001(Unit V).

REFERENCES:

1. Richard Skalak and Shu Chien, “Hand Book of Biomedical Engineering”, Mc Graw Hill and Co.New York, 1987.
2. Douglas S.Rigg., “Control Theory and Physiological Feedback Mechanism”, The Wilkliam and Wilkins Co. Baltimore, 1970.

BM17702 DIGITAL IMAGE PROCESSING TECHNIQUES L T P C
3 0 0 3

OBJECTIVES

- To learn the fundamental concepts of Digital Image Processing.
- To understand the concepts of various transforms and enhancement techniques for Image processing operations.
- To be familiar in the techniques of segmentation, compression and Image restoration for various applications

UNIT I FUNDAMENTALS OF IMAGE PROCESSING 9

Image Analysis and Computer Vision- Overview. Image acquisition system- Film and digital camera. Imaging systems: Image formation and sensing, Image representation, Characteristics of grey-level digital images: Discrete sampling model, Quantization, Relationship between the pixels, Colour fundamentals and models.

UNIT II IMAGE PREPROCESSING AND IMAGE TRANSFORMS 10

Basic gray level transformation- Log transformation, Power - law transformation, Piece wise linear transformation. Histogram processing.

Image Transforms- DFT – DCT– Walsh - Hadamard – Haar – Slant – KL –and their properties.

UNIT III IMAGE ENHANCEMENT 8

Spatial Domain: Basics of Spatial Filtering–Smoothing and Sharpening Spatial Filtering **Frequency Domain:** Introduction to Fourier Transform – Smoothing and Sharpening frequency domain filters – Ideal, Butterworth and Gaussian filters, Homomorphic Filtering.

UNIT IV IMAGE SEGMENTATION AND RESTORATION 9

Segmentation: Detection of discontinuities–Edge linking and boundary detection – Region based segmentation- Morphological processing - erosion and dilation.

Image Restoration-Noise models– Restoration in the presence of Noise – spatial filtering, Periodic noise reduction by frequency domain filtering, Estimation of degradation function, Inverse filter-Weiner filtering.

UNIT V IMAGE COMPRESSION, IMAGE REPRESENTATION AND DESCRIPTION 9

Image compression: Introduction- Image compression models, Lossless and lossy compression methods, Image compression standards. **Boundary representation** – Chain Code – Polygonal approximation, signature, boundary segments – Boundary description – Shape number – Fourier descriptor, moments- Regional Descriptors –Topological feature, Texture - Patterns and pattern classes - Recognition based on matching

TOTAL: 45 PERIODS

OUTCOMES:

On completion of the course students will be able to

- Demonstrate the concepts of Image formation, acquisition systems and color representations
- Develop algorithms to pre-process the images.
- Apply image enhancement techniques in spatial and frequency domain.
- Perform segment and restore the images by applying suitable method
- Represent the images by different descriptors for feature selection and recognition.

TEXT BOOKS:

1. SE Umbaugh, “Digital Image Processing and Analysis: Human and Computer Vision Application with CVIP tools”, 2nd Edition, CRC Press, 2011
2. Rafael C Gonzalez, Richard E Woods, “Digital Image Processing”, 3rd edition, Pearson Education India, ISBN-10: 9332570329

REFERENCES:

1. N.Efford, “Digital Image Processing”, Addison Wesley 2000, ISBN 0-201-59623-7
2. M Sonka, V Hlavac and R Boyle, “Image Processing, Analysis and Machine Vision”, PWS 1999, ISBN 0-534-95393-X
3. W K Pratt, “Digital Image Processing”, John Wiley and Sons, 1991,
4. Anil Jain K. “Fundamentals of Digital Image Processing”, PHI Learning Pvt. Ltd., 2011.

5. Rafael C. Gonzalez, Richard E. Woods, Steven L. Eddins, "Digital Image Processing Using MATLAB", Third Edition Tata McGraw Hill Pvt. Ltd., 2011.

BM17703	RADIOLOGICAL EQUIPMENT	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the generation of X-ray and its uses in imaging
- To learn the principles of different radio diagnostic equipment in Imaging
- To know the techniques used for visualizing various sections of the body.
- To learn radiation therapy techniques and radiation safety.

UNIT I MEDICAL X-RAY EQUIPMENT 9

Nature of X-rays - X-Ray absorption – Tissue contrast. X- Ray Equipment (Block Diagram) – X-Ray Tube, the collimator, Bucky Grid, power supply, Cathode and filament currents, Focusing cup, Thermionic emission, Electromagnetic induction, Line focus principle and the heel effect, Causes of x-ray tube failure: Electron arcing/filament burn out, Failure to warm up tube, High temp due to over exposure, x-ray tube rating charts. X-ray Image Intensifier tubes – Fluoroscopy – Digital Fluoroscopy. Angiography- contrast materials used - Cine Angiography, Digital subtraction Angiography. Mammography and Dental x-ray unit.

UNIT II COMPUTED TOMOGRAPHY 9

Principles of tomography, CT Generations, X- Ray sources- collimation- X- Ray detectors-Viewing systems- spiral CT scanning – Ultra fast CT scanners. Advantages of computed radiography over film screen radiography: Time, Image quality, Lower patient dose, Differences between conventional imaging equipment and digital imaging equipment: Image plate, Plate readers, Image characteristics, Image reconstruction techniques- back projection and iterative method. Spiral CT, 3D Imaging and its application.

Case study: Interpretation of CT image (abdomen and brain) using cross-sectional anatomy

UNIT III MAGNETIC RESONANCE IMAGING 9

Fundamentals of magnetic resonance- Interaction of Nuclei with static magnetic field and Radio frequency wave- rotation and precession – Induction of magnetic resonance signals – bulk magnetization – Relaxation processes T1 and T2. Block Diagram approach of MRI system- system magnet (Permanent, Electromagnet and Super conductors), generations of gradient magnetic fields, Radio Frequency coils (sending and receiving), and shim coils, Electronic components, contrast agents used, fMRI.

UNIT IV NUCLEAR MEDICINE TECHNIQUES 9

Nuclear imaging – Augar scintillation camera – Nuclear tomography – single photon emission computer tomography, positron emission tomography – Recent advances Radionuclide imaging-Bone imaging, dynamic renal function, myocardial perfusion. Non imaging techniques-hematological measurements, Glomerular filtration rate, volume measurements, clearance measurement, whole -body counting, surface counting.

UNIT V RADIATION THERAPY AND RADIATION SAFETY 9

Radiation therapy – linear accelerator, Tele gamma Machine. SRS –SRT,-Recent Techniques in radiation therapy - 3DCRT – IMRT – IGRT and Cyber knife- radiation measuring instruments-Dosimeter, film badges, Thermo Luminescent dosimeters- electronic dosimeter- Radiation protection in medicine- radiation protection principles.

TOTAL: 45 PERIODS

OUTCOMES:

On completion of the course students will be able to

- Describe the working principle of various medical imaging equipment.
- Explain the principle of radio therapy techniques.
- Outline the methods of radiation safety.
- Elaborate the concept of tomographic techniques
- Analyse the radiation measurement techniques.

TEXT BOOKS:

1. Steve Webb, “The Physics of Medical Imaging”, Adam Hilger, Philadelpia, 1988
2. R.Hendee and Russell Ritenour “Medical Imaging Physics”, Fourth Edition William, Wiley-Liss,2002.

REFERENCES:

1. Gopal B. Saha “Physics and Radiobiology of Nuclear Medicine”- Third edition Springer, 2006.
2. B.H.Brown, PV Lawford, R H Small wood , D R Hose, D C Barber, “Medical physics andbiomedical Engineering”, - CRC Press, 1999.
3. Myer Kutz, “Standard handbook of Biomedical Engineering and design”, McGraw Hill, 2003.

BM17704	BIOMATERIALS AND APPLICATIONS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To study the characteristics of Biomaterials and its reaction in the host and understand its degradation mechanism
- To understand different metals and ceramics used as biomaterials
- To study the different polymeric materials and their application in Ophthalmology and membrane synthesis.
- To study the different types of soft and hard tissue implants.
- To understand the concept of biocompatibility and the methods of biomaterial testing

UNIT I INTRODUCTION TO BIO-MATERIALS 9

Definition and classification of bio-materials, Characterization of biomaterials: mechanical properties, surface properties, viscoelasticity. Host reactions to biomaterials: Inflammation, Wound Healing and Foreign Body Response, Failure mechanisms: corrosion, fracture, degradation of Implanted materials in the biological environment.

UNIT II METALLIC AND CERAMIC MATERIALS 9

Metallic implants: Stainless steels, co-based alloys, Ti-based alloys, shape memory alloy, applications. Ceramic implant: bioinert, biodegradable or bio resorbable, bioactive ceramics, applications.

UNIT III POLYMERIC IMPLANT MATERIALS 9

Polymerization, factors influencing the properties of polymers, polymers as biomaterials: Nylon, acrylates, rubber, biodegradable polymer, Bio polymers: Collagen, Elastin and chitin.

Applications: Medical Textiles, Materials for ophthalmology: contact lens, intraocular lens, Membranes for plasma separation and Blood oxygenation.

UNIT IV TISSUE REPLACEMENT IMPLANTS 9

Soft tissue replacements, sutures, surgical tapes, adhesive, Percutaneous and skin implants, maxillofacial augmentation, Vascular grafts, Prosthetic Cardiac Valves, hard tissue replacement Implants, Internal fixation device, joint replacements, dental implants.

UNIT V TESTING BIOMATERIALS: 9

Testing of blood-material interactions: blood compatibility and thrombogenicity, In vitro assessment of tissue compatibility: assay methods - direct contact test, agar diffusion test, elution test, clinical use. In vivo assessment of tissue compatibility: mechanical testing, criteria for assessing acceptability of the tissue response. Sterilization of implants: steam sterilization, EtO sterilization, radiation sterilization.

TOTAL: 45 PERIODS

OUTCOMES:

On completion of the course students will be able to

- Explain the properties of biomaterials and biomaterial- tissue reaction.
- Identify metals and ceramic implants used for medical applications
- Compare different polymeric materials and define its use in ophthalmology and membrane design.
- Outline the concept behind the different tissue replacements.
- Demonstrate various testing and evaluation techniques for biomaterials.

TEXT BOOKS:

1. Sujata V. Bhatt, “Biomaterials”, Second Edition, Narosa Publishing House, 2005.
2. BD Ratner, AS Hoffmann,FJ Schoen, JE Lemmons, “An Introduction to Materials in Medicine” Academic Press, Third Edition, 2013.

REFERENCES:

1. Park J.B, R.SLakes “Biomaterials An Introduction”, Springer, 2007.
2. Joseph D Bronzino, “Biomedical engineering Fundamentals”, CRC press, Third Edition,2006.
3. A.C Anand, J F Kennedy, M.Miraftab, S.Rajendran,“Woodhead Medical Textiles and Biomaterialsfor Healthcare”, Publishing Limited 2006.
4. Andrew F.VonRacum, Handbook of Biomaterials Evaluation: Scientific, Technical and Clinical Testing of Implant Materials, Second Edition, CRC Press, 1998.

BM17711 DIGITAL IMAGE PROCESSING LABORATORY L T P C
0 0 4 2

OBJECTIVES:

- To practice the basic image processing techniques.
- To understand the functions of transforms.
- To understand the concepts of image restoration and segmentation.
- To explore the applications of image processing.

LIST OF EXPERIMENTS

Simulation using MATLAB

1. Image sampling and quantization
2. Analysis of spatial and intensity resolution of images.
3. Intensity transformation of images.
4. DFT analysis of images
5. Transforms (Walsh, Hadamard, DCT, Haar)

6. Histogram Processing and Basic Thresholding functions
7. Image Enhancement-Spatial filtering
8. Image Enhancement- Filtering in frequency domain
9. Image restoration – Inverse and wiener filtering
10. Image segmentation – Edge detection, line detection and point detection.
11. Basic Morphological operations.
12. Region based Segmentation
13. Segmentation using watershed transformation
14. Analysis of images with different color models.
15. Study of DICOM standards
    - Compression and transmission of DICOM images.

MINI PROJECTS:

- Applications to Biometric and security
- Applications to Medical Images
- Texture analysis with statistical properties
- Boundary detection
- ROC analysis for Medical Image Application

TOTAL: 60 PERIODS

OUTCOMES:

On completion of the course students will be able to

- Perform enhancing operations on the image using spatial filters and frequency domain filters.
- Use transforms and analyse the characteristics of the image.
- Perform segmentation operations in the images.
- Implement project on simple image processing applications.
- Apply image processing technique to solve real health care problems

REFERENCES:

1. Rafael C. Gonzalez, Richard E. Woods, Steven Eddins, “Digital Image Processing using MATLAB”, Pearson Education, Inc., 2004.

BM17712	**HOSPITAL TRAINING**	**L T P C** **0 0 2 1**

OBJECTIVES

- Give you the opportunity to observe medical professionals at work in the wards and the roles of Allied Health Professionals;
- Provide access to healthcare Professionals to get a better understanding of their work; and
- Demonstrate patient-care in a hospital setting.

S.No.	Departments for visit
1	Cardiology
2	ENT
3	Ophthalmology
4	Orthopaedic and Physiotherapy
5	ICU/CCU
6	Operation Theatre

7	Neurology
8	Nephrology
9	Radiology
10	Nuclear Medicine
11	Pulmonology
12	Urology
13	Obstetrics and Gynecology
14	Emergency Medicine
15	Biomedical Engineering Department
16	Histo Pathology
17	Biochemistry
18	Pediatric/Neonatal
19	Dental
20	Oncology
21	PAC's
22	Medical Records / Telemetry

TOTAL: 30 PERIODS

ASSESSMENT:

- Students need to complete training in any leading Multi-speciality hospital for a period of 15 days. They need to prepare an extensive report and submit to their respective course in-charges during the session.
- Out of the following departments, it is mandatory to complete training in any 10. The students can give a presentation of the remaining departments during laboratory hours.

OUTCOMES:

On completion of the course students will be able to

- Advocate a patient-centred approach in healthcare
- Communicate with other health professionals in a respectful and responsible manner
- Recognize the importance of inter-professional collaboration in healthcare.
- Propose a patient-centred inter-professional health improvement plan based upon the patient's perceived needs
- Use the knowledge of one's own role and those of other professions to address the healthcare needs of populations and patients served

BM17713 **COMPREHENSION** **L T P C**
0 0 2 1

OBJECTIVES

1. To emphasize the importance of basic core subjects taught in the first semester to seventh semester of B.E degree course through periodic exercise.
2. To improve the technical knowledge, problem based learning, and principles of techniques.
3. To counsel students to improve their basic knowledge so that they will be better prepared for the campus interview and competitive exams.

The student will be tested for their understanding of the basic principles of the core engineering subjects. The internal assessment for a total of 50 marks will be made by a committee comprising of the faculty members of the department. The committee will conduct three written examinations of objective type questions type from the subjects.

Test 1-Electron Devices, Circuit Theory, Electronic Circuits, Electrical Machines, Sensors and Measurements
Test 2- Analog and Digital ICs, Microprocessors and Microcontrollers, Signal Processing, Analog and Digital Communication, Biocontrol Systems
Test 3- Anatomy and Human Physiology, Biochemistry, Microbiology, Biomedical Instrumentation, Diagnostic & Therapeutic Equipment, Radiological Equipment.

The external university examination, which carries a total of 50 marks, will be an objective type written examination conducted by the Controller of Examinations.

TOTAL: 30 PERIODS

OUTCOMES:

On Completion of the comprehension, the student can able to write competitive exams like GATE, DBT-JRF, ICMR-JRF, IES, etc.

SEMESTER VIII

		L	T	P	C
BM17811	**PROJECT WORK**	**0**	**0**	**16**	**8**

OBJECTIVES

- Identification of a real life problem in thrust areas
- Developing a mathematical model for solving the real life problem
- Finalization of system requirements and specification
- Proposing different solutions for the problem based on literature survey
- Proposing future trends in providing alternate solutions

"Solving a real life problem" should be the focus of U.G. project. The project could be classified as hardware, software, modeling, and simulation. It should involve one or many elements of techniques such as analysis, design and synthesis.
The Head of the Department will appoint a project coordinator who will coordinate the following:

- Grouping of students (Maximum 4 in a group)
- Allotment of projects and projects guides (Supervisors)
- Project monitoring at regular intervals

All projects allotment is to be completed by the 2nd week of 7th semester, so that students get sufficient time for completion of the project. All projects will be monitored at least twice in a semester through students' presentation. Sessional marks will be awarded by a monitoring committee comprising of faculty members as well as by the supervisor. Each student will be required to

1. Submit a one page synopsis before the seminar for display on notice board.
2. Give a 20 minutes presentation followed by 10 minutes discussion.
3. Submit a technical write-up on the talk delivered.
4. Actively participate in the oral presentations.

Each project group should maintain a log book of activities of the project. It should have entries related to the work done, problems faced, solution evolved etc. There shall be at least an Interim Evaluation and a final evaluation of the project in the 8th semester. Each project group has to submit an interim report in the prescribed format for the interim evaluation.

Students should execute the project work using the facilities of the institute. However, external projects can be taken up in reputed industries, if that work solves a technical problem of the external firm. Prior sanction should be obtained from the head of department before taking up external project work and there must be an internal guide for such projects.

Each project group should complete the project work in the 8th semester. Each student is expected to prepare a report and a technical paper in the prescribed format, based on the project work. The paper may be prepared as per IEEE standard and can have a maximum of six pages.

The project work is evaluated based on oral presentation, technical paper and the project report jointly by external and internal examiners constituted by the Controller of Examinations

Internal Continuous Assessment

40% - Literature Survey, Design and development/Simulation and analysis
30% - Presentation & demonstration of results
20% - Report
10% - Regularity in the class

OUTCOMES:

On completion of the course students will be able to

in a position to take up any challenging practical problems and find solution by formulating proper methodology.

TOTAL: 240 PERIODS

PROFESSIONAL ELECTIVES – I and II

		L	T	P	C
BM17E10	**MEDICAL OPTICS**	**3**	**0**	**0**	**3**

OBJECTIVES:

- To study about the optical properties of the tissues
- To study about optical instrumentation used in medical field.
- To study about the various diagnostic, therapeutic and surgical applications of light.

UNIT I OPTICAL PROPERTIES OF THE TISSUES 9

Light and matter – Characteristics of Light - Light transport inside the tissue - Tissue properties - Laser Characteristics - Laser tissue Interaction-Chemical-Thermal-Electromechanical –Photo ablative processes.

UNIT II INSTRUMENTATION IN PHOTONICS 9

Instrumentation for absorption - Scattering and emission measurements, excitation light sources – high pressure arc lamp - LEDs - Lasers , Optical filters - Polarizer, optical detectors–Time resolved and phase resolved detectors.

UNIT III SURGICAL APPLICATIONS OF LASERS 9

Lasers in ophthalmology - Dermatology – Dentistry – Urology – Otolaryngology - Tissue welding.

UNIT IV DIAGNOSTIC & THERAPEUTIC APPLICATIONS 9

Optical coherence tomography – Optical Elastography - Laser Induced Fluorescence (LIF)-Imaging - Raman Spectroscopy and Imaging - Holography and speckles - their applications in biology and medicine

UNIT V SPECIAL TECHNIQUES 9

Photodynamic therapy (PDT) – Applications of PDT- In vitro clinical diagnostics - Near field imaging of biological structures - fluorescent spectroscopy – Bio-stimulation effect - Laser Safety Procedures.

TOTAL: 45 PERIODS

OUTCOMES:

On completion of the course students will be able to

- know about optical equipment, their principles, appreciate their usage in therapeutic and surgical units of the hospitals
- Gain adequate knowledge on fundamentals of tissue optical properties.
- Know about various surgical applications of laser.
- Have in-depth knowledge about diagnostic and therapeutic applications of laser.
- Have sound knowledge about various special optical techniques and imaging modalities.

TEXT BOOKS:

1. Markolf H.Niemz, “Laser-Tissue Interaction Fundamentals and Applications”, Springer, 2007
2. Paras N. Prasad, “Introduction to Biophotonics”, A. John Wiley and Sons, Inc. Publications, 2003

REFERENCES:

1. Leon Goldman, M.D., & R.James Rockwell, Jr., “Lasers in Medicine”, Gordon and Breach, Science Publishers Inc., 1975.

BM17E11 SOFT COMPUTING METHODS L T P C
3 0 0 3

OBJECTIVES

- To learn the basics of artificial intelligence.
- To learn the theory and implementation of neural networks
- To introduce neural computing as an alternative knowledge acquisition/representation Paradigm.
- To introduce different optimization techniques.
- To understand fuzzy set theory.

UNIT I INTRODUCTION TO NEURAL NETWORKS 9

Biological Neurons and their Artificial models, Learning and Adaptation, Adaline, Madaline, Single layer and Multilayer Perceptron, Back Propagation Network, BAM, Hopfield Memory.

UNIT II ADVANCED NEURAL NETWORKS 9

Counter Propagation Network, Feature Mapping, Self Organizing Feature Maps, Learning Vector Quantization, Support Vector Machines.

UNIT III OPTIMIZATION 9

Derivative-based Optimization – Descent Methods – The Method of Steepest Descent – Classical Newton‘s Method – Step Size Determination – Derivative-free Optimization.

UNIT IV FUZZY SET THEORY 9

Introduction to Neuro – Fuzzy and Soft Computing – Fuzzy Sets – Basic Definition and Terminology– Set-theoretic Operations – Member Function Formulation and Parameterization – Fuzzy Rules and Fuzzy Reasoning – Extension Principle and Fuzzy Relations – Fuzzy If-Then Rules –Mamdani Fuzzy Models – Tsukamoto Fuzzy Models.

UNIT V ARTIFICIAL INTELLIGENCE AND EXPERT SYSTEMS 9

Definition, Motivation for computer assisted decision making, Knowledge representation- Production rules, Frames, Predicate calculus and Semantic nets, Knowledge acquisition, Reasoning methodologies- Problem representation, Search, Dempster - shafer theory, Evaluation. **Expert systems -** Basic concepts of Expert system, Structure of Expert system.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of the course, the student should be able to:

- Understand the basics of artificial intelligence.
- Understand and apply optimization techniques.
- Use fuzzy logic.
- Develop simple neural network based algorithms.
- Use a neural network to solve real-world problems.

TEXT BOOKS:

1. J.S.R.Jang, C.T.Sun and E.Mizutani, —"Neuro-Fuzzy and Soft Computing", PHI, 2004, Pearson Education 2004.
2. N.P.Padhy, —"Artificial Intelligence and Intelligent Systems", Oxford University Press, 2006.
3. S.N.Sivanandam and S.N.Deepa, "Principles of Soft Computing", Wiley India Pvt Ltd, 2011.

REFERENCES:

1. Timothy J. Ross, —"Fuzzy Logic with Engineering Applications", Wiley, Fourth Edition, 2016.
2. Davis E. Goldberg, —"Genetic Algorithms: Search, Optimization and Machine Learning", Pearson Education India, 2013.
3. S. Rajasekaran and G.A.V. Pai, —"Neural Networks, Fuzzy Logic and Genetic Algorithms", PHI, 2006.
4. R. Eberhart, P. Simpson and R. Dobbins, —"Computational Intelligence - PC Tools", AP Professional, Boston, 1996.
5. Elaine Rich & Kevin Knight, —"Artificial Intelligence", Second Edition, Tata McGraw Hill Publishing Comp., New Delhi, 2006.
6. Simon Haykin, —"Neural Networks Comprehensive Foundation", Second Edition, Pearson Education, 2005.

BM17E12 NANOTECHNOLOGY AND APPLICATIONS L T P C
3 0 0 3

OBJECTIVES

- To understand the basic scientific concepts underpinning nanoscience
- To understand the multidisciplinary aspects of synthesizing nanomaterials
- To understand the different types of nano materials
- To demonstrate specifically the characterization tools used in nanotechnology

- To appreciate the emerging role of nanotechnology in society, the regulatory framework within which it operates and the ethical issues it raises

UNIT INTRODUCTION 8

Scientific revolutions –Time and length scale in structures – Definition of a nanosystem – Dimensionality and size dependent phenomena – Surface to volume ratio. Properties at nanoscale (optical, mechanical, electronic, and magnetic). Definition, Objective and goal of Nanotechnology, Importance of Nanoscale, revolution of Nanotechnology.

UNIT II GENERAL METHODS OF SYNTHESIS 12

Nanoparticles through homogeneous and heterogeneous nucleation-Growth controlled by surface and diffusion process- Oswald ripening process - influence of reducing agents.
Fabrication methods – Top down processes: Milling, lithographics, Machining process, vapor deposition. Bottom–Up process: Colloidal and Sol – gel methods, electro deposition, Self Assembly

UNIT III NANOMATERIALS 9

Classification based on dimensionality- Quantum Dots, Wells and Wires- Carbon- based nano materials (buckyballs, nanotubes, graphene)– Metalbased nano materials (nanogold, nanosilver and metal oxides) -Nanocomposites- Nanopolymers – Nanoglasses –Nano ceramics -Biological nanomaterials.

UNIT IV EXPERIMENTAL TECHNIQUES 9

Characterization – X- ray diffraction (XRD), Scanning Electron Microscopy, Transmission Electron Microscope, Atomic force microscopy, Scanning Tunneling microscopy (STM), Scanning probe microscopy (SPM), Optical and Raman spectroscopy.

UNIT V NANOTECHNOLOGY IN HEALTH CARE 7

Properties of nanocarriers; drug delivery systems used in nanomedicine; Enhanced Permeability and Retention effect; Blood-brain barrier; Active and passive targeting of diseased cells; Nanotechnology in defense - environmental application, Health and environmental impacts of nanotechnology.

TOTAL: 45 PERIODS

OUTCOMES:

On completion of the course students will be able to

- Thorough knowledge of the general principles of physics, chemistry, electronics and biology that play a role on the nanometer scale
- Understanding the essential concepts used in nanotechnology, synthesis and fabrication
- Understanding of materials and their properties at the atomic and nanometer level, including an understanding of the intimate relationship between material scale (nanostructure) and the properties/functionality of materials
- Having a sound grounding knowledge in the characterization techniques
- Demonstrate the socioeconomic impact of nanotechnology and ethical issues associated with it.

TEXT BOOKS:

1. Edelstein. A.S. and R.C. Cammearata, eds., “Nanomaterials: Synthesis, Properties and Applications”, Institute of Physics Publishing, Bristol and Philadelphia, 1996.
2. John Dinardo. N, “Nanoscale charecterisation of surfaces & Interfaces”, 2nd edition, Weinheim Cambridge, Wiley-VCH, 2000

3. Bio-Nanotechnology_ Concepts and applications. Madhuri Sharon, Maheshwar Sharon,Sunil Pandey and Goldie Oza, Ane Books Pvt Ltd, 1 edition 2012

REFERENCES:

1. Timp .G, "Nanotechnology", AIP press/Springer, 1999.
2. Akhlesh Lakhtakia (Editor),"The Hand Book of Nano Technology, Nanometer Structure, Theory, Modeling and Simulations". Prentice-Hall of India (P) Ltd, New Delhi, 2007.
3. Niemeyer C. M., "Nanobiotechnology: Concepts, Applications and Perspectives", Wiley – VCH, 2006.

BM17E13	REHABILITATION ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To interactively and effectively introduce students to the field of rehabilitation.
- Discuss the Rehabilitation Counseling profession accurately and comprehensively and describe the philosophical, historical, and legislative aspects of the Rehabilitation profession
- To provide insight into the psychosocial responses to having a motor disability and assist devices for motor disabilities
- Learn therapeutic Exercise Techniques and Understand orthopedic prosthetics and orthotics in rehabilitation.
- To gain knowledge on assist devices for management of communicational disabilities
- To describe essential principles, methods, and strategies of assessment of individuals with disabilities in VR settings

UNIT I INTRODUCTION TO REHABILITATION 9

Principles of Assistive Technology Assessment, Principles of Rehabilitation Engineering- Key Engineering Principles, Key Ergonomic Principles - Practice of Rehabilitation and Assistive Technology. Epidemiology of Rehabilitation, Health, Levels of Prevention, Preventive Rehabilitation, Diagnosis of Disability, Functional Diagnosis, Importance of Psychiatry in Functional diagnosis, Impairment disability handicap, Primary & secondary Disabilities, Rehabilitation team-Classification of members.

UNIT II MOTOR REHABILITATION 9

General orthotics, Classification of orthotics-functional & regional, General principles of Orthosis, Calipers- FO, AFO, KAFO, HKAFO. Prosthetic devices- body powered, Externally powered limb prosthetics, Myoelectric hand and arm prosthetics. FES System: Restoration of hand function; restoration of standing and walking. Hybrid Assistive systems (HAS) Active prostheses. Active Above knee Prosthesis. Myoelectric hand and arm prostheses. The MARCUS Intelligent Hand Prosthesis

UNIT III THERAPEUTIC EXERCISE TECHNIQUE& WHEELED MOBILITY 9

Co-ordination exercises, Frenkels exercises, Gait analyses-Pathological Gaits, Gait Training, Relaxation exercises-Methods for training Relaxation, Strengthening exercises-Strength training, Types of Contraction, Mobilisation exercises, Endurance exercises.
History and Categories of Wheelchairs. Wheelchair Structure and Component Design. Ergonomics of wheel chair propulsion. Power Wheelchair Electrical System.

UNIT IV PRINCIPLES IN MANAGEMENT OF COMMUNICATION: 9

Impairment-introduction to communication, Aphasia, Types of aphasia, Treatment of aphasic patient, Augmentative communication-general form of communication, Types of visual aids - Ultra

sonic and laser canes, Intra ocular lens, Braille Reader, Hearing aids-Types of hearing aid, Cochlear implantation ,Writing aids.

UNIT V VIRTUAL REALITY IN REHABILITATION 9

Introduction to virtual reality, Virtual reality based rehabilitation, Hand motor recovery systems with Phantom haptics, Robotics and Virtual Reality Applications in Mobility Rehabilitation.

TOTAL: 45 PERIODS

OUTCOMES:

On completion of the course students will be able to

- use rehabilitation technology for improving optimal health.
- select the appropriate rehabilitation concept for various disabilities and Compare the different methods of orthopaedic prosthetics and orthotics for rehabilitation.
- design and develop orthotic and prosthetic and Repair and maintain power wheel chair.
- implement proper sensory augmentation and substitution.
- apply the essential principles, methods, and strategies in assessment of individuals with disabilities in VR settings.

TEXT BOOKS:

1. Joseph D Bronzino, “The Biomedical Engineering Handbook”. 2nd edition, CRC Press, 2000.
2. Rory A Cooper (Editor), Hisaichi Ohnabe (Editor), Douglas A. Hobson (Editor), 'An Introduction to Rehabilitation Engineering (Series in Medical Physics and Biomedical Engineering' CRC Press, 2006.
3. Sunder 'Textbook of Rehabilitation' , Jaypee Brothers Medical Publishers Pvt. Ltd, New Delhi, 2nd Edition, Reprint 2007

REFERENCES:

1. Robinson C.J,“ Rehabilitation Engineering”, CRC Press. 1995
2. Ballabio E. et al,“ Rehabilitation Technology”, IOS Press. 1993.
3. Handbook of “Physical Medicine & Rehabilitation”, W.B.Saunders Publication, 2003.
4. Hanfredclynes, “Biomedical Engineering System”, McGraw Hill, 1999
5. Sashi S Kommu; Rehabilitation Robotics,1 edition,CRC Press,2007

BM17E14 MEDICAL SAFETY AND QUALITY ASSURANCE L T P C
2 0 0 2

OBJECTIVES

- To understand how safety is important for health care systems.
- To know about various electrical and radiation hazardous.
- To know how to assess medical devices and quality of healthcare provided

UNIT I HOSPITAL SAFETY 10

Security & Safety of Hospital -Property, Staff & Patients, Safety precautions, Disposal of Biological waste. Safe medical devices – device requirements - devices for varying age – initial inspection – maintenance. Safe handling and operation, Reporting, Bed rails, Flawed mechanics, removable parts and packaging. Personal protective Equipment.

UNIT II ELECTRICAL SAFETY AND RADIOLOGICAL SAFETY 11

Physiological effects of electricity - Electrical faults in medical devices - Micro shock, Macro shock, Leakage current, Electrical isolation - Grounding system - Electrical safety analyzer - Emergency

power system - Uninterrupted power supply. Fundamentals of radiation detection. Molecular medicine and radiation safety. Classification of UV radiation - Biological effects of UV - Hazards associated with UV radiation - UV monitor and control measures. Classifications of LASER - radiation hazards - control measures. Guidelines for CT installations. MRI safety guidelines.

UNIT III QUALITY ASSESSMENT IN HEALTHCARE 9

Quality management, risk management, types of responsibilities – CSR, Individual and institutional responsibility. MDRA and medical device standards, ICRP regulations for radiation safety, Methods adopted to monitor the standards. Evaluation of hospital services – six sigma way, Quality Assurance in Hospitals Sop's – Patient Orientation for Total Patient Satisfaction. 5S techniques. TQM in Health care organization-Quality assurance methods, QA in (Medical Imaging & Nuclear medicine) Diagnostic services

TOTAL: 30 PERIODS

OUTCOMES:

On completion of the course students will be able to

- Gain knowledge about safety devices necessary for health care system can be identified
- Demonstrate various techniques to shield patient from electrical and radiation hazardous.
- Implement the various methods to monitor and assess quality in healthcare

TEXT BOOKS:

1. Bertil Jacobson and Alan Murray, "Medical Devices use and safety", Reed Elsevier India Pvt. Ltd, New Delhi, 2011.
2. Massimo A.G.Mitolo, Electrical Safety of Low-voltage System, Mc Graw Hill, 2009

REFERENCES:

1. Steve Webb, "The Physics of Medical Imaging", Taylor & Francis, New York, 1988.
2. G.D.Kunder, S.Gopinath, A.Katakam, "Hospital Planning, Design and Management", Tata Mcgraw Hil publishers, New Delhi, 1998.
3. Joseph J. Carr and John M. Brown, "Introduction to Biomedical equipment technology", John Willey and sons, New York, 1997.

BM17E15 MEDICAL ROBOTICS L T P C
2 0 0 2

OBJECTIVES

- To gain knowledge about the basic concepts of robots and types of robots.
- To understand manipulators, actuators and grippers and sensors.
- To know the various applications of surgical robots.
- To introduce various applications of robotics in rehabilitation.

UNIT I INTRODUCTION OF ROBOTICS 10

Introduction to Robotics and its history, Overview of robot subsystems, Degrees of freedom, configurations and concept of workspace, Automation, Mechanisms and movements, Dynamic stabilization, Actuators and Grippers, Kinematics & Inverse Kinematics, Sensors and controllers.

UNIT II SURGICAL ROBOTICS 10

Da Vinci Surgical System, Image guided robotic systems for focal ultrasound based surgical applications, System concept for robotic Tele-surgical system, Urologic applications, Cardiac surgery, Neuro-surgery, Pediatric and General Surgery, Gynecologic Surgery, Nanorobotics.

UNIT III REHABILITATION ROBOTICS 10

Pediatric Rehabilitation, Portable Robot for Tele-rehabilitation, Prosthetic Devices for Upper Limb Amputees, Machine for Injured Fingers, Exoskeleton-Based Exercisers for the Disabilities of the Upper Arm and Hand, Tremor Suppression, Facial Automaton Tool for People with Autism.

TOTAL: 30 PERIODS

OUTCOMES:

On completion of the course students will be able to

- Identify the components required to design a robot.
- Know the utilization of robotics in medical field.
- Understand the basic concepts of rehabilitation robotics

TEXTBOOKS:

1. Nagrath and Mittal, "Robotics and Control", Tata McGraw-Hill, First edition, 2003.
2. Jacob Rosen, Blake Hannaford & Richard M Satava, "Surgical Robotics: System Applications & Visions", Springer 2011.

REFERENCES:

1. Howie Choset, Kevin Lynch, Seth Hutchinson, George Kantor, Wolfram Burgard, Lydia Kavraki and Sebastian Thurn, "Principles of Robot Motion: Theory, Algorithms, and Implementations", Prentice Hall of India, First edition, 2005.
2. Fu.K.S, Gonzalez.R.C., Lee, C.S.G, "Robotics, control", sensing, Vision and Intelligence, Tata McGraw Hill International, First edition, 2008.
3. Barbara Webb and Thomas Consi. R, "BioRobotics: Methods & Applications", AAAI Press/MIT Press, First Edition, 2001.
4. Constantinos Mavroidis, Antoine Ferreira, "Nanorobotics: Current approaches and Techniques" , Springer 2011.
5. Sashi S Kommu; Rehabilitation Robotics,1 edition,CRC Press,2007

BM17E16 BIOMETRIC SYSTEMS L T P C
2 0 0 2

OBJECTIVES

- To understand the technologies of fingerprint, iris, face and speech recognition
- To identify issues in the realistic evaluation of biometrics based systems.

UNIT I INTRODUCTION TO BIOMETRICS 9

Introduction and back ground – biometric technologies- passive biometrics –active biometrics - Biometric systems- data acquisition methods – Enrollment – templates – Algorithm – verification – Biometric applications – biometric characteristics -Authentication technologies - Need for strong authentication - Protecting privacy.

UNIT II FINGERPRINT & IRIS SCAN TECHNOLOGY 10

History of fingerprint pattern recognition - General description of fingerprints - Finger print feature processing techniques –fingerprint enhancement – Feature extraction – fingerprint classification – fingerprint matching – Iris scan Introduction, Anatomical and Physiological underpinnings, Components, Sensing, Iris Scan Representation and Matching, Iris Scan Strengths and Weaknesses.

UNIT III MULTIMODAL BIOMETRICS AND PERFORMANCE EVALUATION 11

Introduction to face recognition, components, Facial Scan Technologies- Face Detection, Face Recognition- Representation and Classification, Voice scan – components, features and model, Introduction to multimodal biometric system - Integration strategies –Architecture – level of fusion – combination strategy – training and adaptability – examples of multimodal biometric systems – Performance evaluation and quality assessment.

TOTAL: 30 PERIODS

OUTCOMES:

On completion of the course students will be able to

- Choose a biometric for specific application
- Design a simple authentication system
- Implement multimodal biometric system in real time.

TEXT BOOKS:

1. James Wayman, Anil Jain, Davide Maltoni, Dario Maio, "Biometric Systems, Technology Design and Performance Evaluation", Springer, 2005
2. S.Y. Kung, S.H. Lin, M.W.Mak, "Biometric Authentication: A Machine Learning Approach" Prentice Hall, 2005

REFERENCES:

1. Paul Reid, "Biometrics for Network Security", Pearson Education, 2004.
2. Nalini K Ratha, Ruud Bolle, "Automatic fingerprint Recognition System", Springer, 2003
3. L C Jain, I Hayashi, S B Lee, U Halici, "Intelligent Biometric Techniques in Fingerprint and Face Recognition" CRC Press, 1999.
4. John Chirillo, Scott Blaul, "Implementing Biometric Security", John Wiley, 2003.
5. Arun A. Ross, Karthik Nanda Kumar, Anil K. Jain, "Handbook of Multibiometrics", Springer, 2006.

BM17E17	MEDICAL TEXTILES	L	T	P	C
		1	0	0	1

OBJECTIVES

- To understand the technologies of medical textiles
- To understand the general property of fabric materials
- To know the various medical application of textiles.

UNIT I INTRODUCTION TO MEDICAL TEXTILES 8

Medical textile products and their applications - sutures - bandages - surgical implants - non-surgical implants - extracorporeal devices - health care products - hygiene product - non-woven technology - medical textile testing.

UNIT II COATING IN MEDICAL TEXTILES AND FACEMASK 9

Fabric coating: properties - polymer coatings - coating methods - medical applications -lamination: methods and applications. Safety issues, effectiveness, types, recommendations, production & testing. Electro spun Nan membranes for medical application-Process, parameters, polymers used & medical applications.

TOTAL: 15 PERIODS

OUTCOMES:

On completion of the course students will be able to

- Demonstrate knowledge engineering principles underlying biometric systems.

- Analyze design basic biometric system applications.

TEXT BOOK:

1. Volkmar T. Bartels, “Handbook of Medical Textiles”, Woodhead Publishing, 2011.

REFERENCE:

1. Subhash Anand, “Medical textiles and biomaterials for healthcare”, Woodhead, 2006.

BM17E18 ENTREPRENEURSHIP IN BIOMEDICAL ENGINEERING L T P C
1 0 0 1

OBJECTIVES

- To understand the characteristics and functions of an entrepreneur.
- To know about various components of an effective business model.
- To gain knowledge in financing and marketing strategies.

UNIT I INTRODUCTION TO ENTREPRENEURSHIP 8

Definition - characteristics and functions of an entrepreneur - common myths about entrepreneurs - importance or entrepreneurship. Creativity and innovation: The role of creativity - the innovation process - sources of new ideas - methods of generating ideas - creative problem solving - entrepreneurial process, The importance of a business model- components of an effective business model - case studies in developing and writing the business plan.

UNIT II FINANCING & MARKETING 7

Determining financial needs - sources of financing - equity and debt funding. Marketing function: Industry analysis - competitor analysis - marketing research for the new venture - defining the purpose or objectives - gathering data from secondary sources - gathering information from primary sources - analyzing and interpreting the results - the marketing process, ethics and business decisions.

TOTAL: 15 PERIODS

OUTCOMES:

On completion of the course students will be able to

- Write effective business plan to become a successful entrepreneur.
- Identify the sources of finance for startups.

TEXT BOOKS:

1. Robert D Hisrich, Michael P Peters & Dean Shepherd, “Entrepreneurship”, Tata McGraw Hill, 2007.
2. Donald F.Kuratko and Richard M.Hodgetts, “Entrepreneurship”, South-Western/Cengage Learning, 2008.

REFERENCES:

1. Thomas W.Zimmerer, Norman M.Scarborough, Essentials of Entrepreneurship and Small Business Management, Prentice Hall of India, 2009.
2. Marc J Dollinger, Entrepreneurship - Strategies and Resources, Pearson Education, 2003.
3. Mary Coulter, Entrepreneurship in Action, Prentice Hall of India, New Delhi, 2006.

BM17E19 HUMAN VALUES AND MEDICAL ETHICS L T P C
1 0 0 1

OBJECTIVES

- To create awareness on core values that shape their professional as well as personal life
- To understand various social issues, industrial standards, code of ethics and role of professional ethics in Medical field

UNIT I HUMAN VALUES 7

Morals, Values and Ethics – Integrity – Work Ethic – Service Learning – Civic Virtue – Respect for Others – Living Peacefully – caring – Sharing – Honesty – Courage – Valuing Time – Co-operation – Commitment – Empathy – Self-Confidence – Character – Spirituality

UNIT II MEDICAL ETHICS 8

Physician, Nurse, and Patient: The Practice of Medicine - Paternalism and Autonomy - Privacy and Confidentiality - Informed Consent - Gender, Culture, and Race - Ethical Issues in Human Enhancement - Issues of Life and Death: Euthanasia and Abortion - Ethical Issues in Transplantation - International Public Health Policy and Ethics

TOTAL: 15 PERIODS

OUTCOMES:

On completion of the course students will be able to

- Apply the core values professionally for the betterment of society and to improve oneself.
- Comply within ethical principles to resolve issues arising in professional lives.

TEXT BOOKS:

1. Lawrence E. Harrison, Samuel P. Huntington , “Culture Matters: How Values Shape Human Progress”, Basic Books Publications, 2001
2. Michael Boylan, “Medical Ethics”, 2nd Edition, John Wiley & Sons Inc, 2014

PROFESSIONAL ELECTIVES - III and IV

BM17E20 NEURAL ENGINEERING L T P C
3 0 0 3

OBJECTIVES

- To introduce physiological concepts of nerve impulse.
- To introduce various techniques to study central and peripheral nerve function.
- To give an insight about brain computer interface.
- To introduce about various BCI techniques.
- To understand the various applications of BCI

UNIT I NERVE EXCITABILITY AND ELECTROMYOGRAPHY 8

Nerve Excitability: Functional insights derived from axonal structures, Nerve excitability findings in Neurologic diseases: Chemotherapy induced neurotoxicity, Porphyric Neuropathy, Inflammatory Neuropathy and its Treatment, Spinal Cord Injury; Nerve conduction studies, Microneurography and its potential clinical applications. Clinical Electromyography (EMG), Quantitative EMG, Neuromuscular Ultrasound as a compliment to the electro diagnostic evaluation, Electrophysiological study of Disorders of Neuromuscular Junction: H-Reflex and F-Reflex, Blink reflex and other cranial nerve reflexes, Electrophysiological evaluation of movement disorders, Evaluation of autonomic nervous system.

UNIT II ELECTROENCEPHALOGRAPHY 10

Electroencephalography (EEG): General Principles and Clinical Applications, Neonatal and Pediatric EEG, EEG Artifacts and Benign Variants, Video EEG monitoring for epilepsy, Invasive Clinical Neurophysiology in Epilepsy and movement disorders, Topographic mapping, Frequency analysis and other quantitative techniques in EEG, Intraoperative EEG monitoring during carotid endarterectomy and cardiac surgery, Magneto encephalography.

UNIT III EVOKED POTENTIALS 9

Evoked Potentials and Related Techniques: Visual Evoked potentials (VEPs), Electro retinography and other diagnostic approaches to the Visual System, VEPs in infants and children, Brainstem Auditory Evoked Potentials (AEPs), Brainstem AEPs in infants and children, Somatosensory evoked potentials, Diagnostic and therapeutic role of Magnetic stimulation in neurology.

UNIT IV INTRODUCTION TO BCI 9

Introduction - Brain structure and function, Brain Computer Interface Types -Invasive BCI Acquisition Techniques -Partially Invasive BCI Acquisition Techniques - Non Invasive BCI Acquisition Techniques, BCI Monitoring Hardware and Software.

UNIT V BRAIN ACTIVATION AND BCI APPLICATIONS 9

Brain activation patterns - Spikes, Oscillatory potential and ERD, Slow cortical potentials, Movement related potentials-Mu rhythms, motor imagery, Potentials related to cognitive tasks. Applications of BCI.

TOTAL: 45 PERIODS

OUTCOMES:

On completion of the course students will be able to

- Understand the physiology behind generation of nerve impulses.
- Describe various techniques used to evaluate the functioning of central and peripheral nervous system.
- Differentiate between a normal and abnormal signal coming from a healthy and a diseased nervous system respectively.
- Identify the various brain computer interface techniques.
- Discuss the different brain activation patterns.

TEXT BOOKS:

1. Michael J.Aminoffs. “Electrodiagnosis in Clinical Neurology”, Sixth Edition, Elsevier Saunders, 2012.
2. Kim E. Barette, Scott Boitano et. al., “Ganong’s review of Medical Physiology”, 23rd Edition, Mc Graw Hill Medical, 2010.
3. Rajesh.P.N.Rao, “Brain-Computer Interfacing: An Introduction”, First edition,Cambridge University Press, 2013.

REFERENCES:

1. Eric R. Kandel et. al., “Principles of Neural Science”, Fifth Edition, McGraw-Hill, New York, 2013.
2. R. Cooper, et. al, “Techniques in Clinical Neurophysiology: A Practical Manual”, Elsevier, Amsterdam, The Netherlands, 2005.
3. Ella Hassianien. A and Azar. A. T, “Brain-Computer Interfaces Current Trends and Applications”, Springer 2015.
4. Jonathan Wolpaw and Elizabeth Winter Wolpaw, “Brain-Computer Interfaces: Principles and Practice”, Oxford University Press, USA, 2012.

BM17E21	BIOMEMS	L T P C 3 0 0 3

OBJECTIVES

- Learn various MEMS fabrication techniques.
- Understand different types of sensors and actuators and their principles of operation at the micro scale level.
- Know the application of MEMS in different field of medicine.

UNIT I MEMS MATERIALS AND FABRICATION 9

Typical MEMs and Microsystems, materials for MEMS - active substrate materials-Silicon and its compounds, Silicon piezoresistors, Gallium Arsenide, quartz, polymers. Micromachining photolithography, thin film deposition, doping, etching, bulk machining, wafer bonding, LIGA.

UNIT II MECHANICAL AND THERMAL SENSORS AND ACTUATORS 9

Mechanics for MEMs design- static bending of thin plates, mechanical vibration, thermo mechanics, fracture and thin film mechanics. Mechanical sensors and actuators – beam and cantilever –microplates, strain, pressure and flow measurements, Thermal sensors and actuators-actuator based on thermal expansion, thermal couples, thermal resistor, Shape memory alloys-Inertia sensor, flow sensor

UNIT III ELECTROSTATIC AND PIEZOELECTRIC SENSORS AND ACTUATORS 9

Parallel plate capacitor, pull in effect, Electrostatic sensors and actuators- Inertia sensor, Pressure sensor, flow sensor, tactile sensor, comb drive. Properties of piezoelectric materials, Piezoelectric sensor and actuator – inchworm motor, inertia sensor, flow sensor.

UNIT IV MICROFLUIDIC SYSTEMS 9

Fluid dynamics, continuity equation, momentum equation, equation of motion, laminar flow in circular conduits, fluid flow in microconduits, in submicrometer and nanoscale. Microscale fluid, expression for liquid flow in a channel, fluid actuation methods, dielectrophoresis, microfluid dispenser, microneedle, micropumps-continuous flow system, micromixers

UNIT V APPLICATIONS OF BIOMEMS 9

CAD for MEMs, Drug delivery, micro total analysis systems (MicroTAS) detection and measurement methods, microsystem approaches to polymerase chain reaction (PCR),DNA sensor, MEMS based drug delivery, Biosensors- sensors for glucose, uric acid, urea and triglyceride sensor.

TOTAL: 45 PERIODS

OUTCOMES:

On completion of the course students will be able to

- Describe the various MEMS fabrication techniques.
- Outline different types of mechanical and thermal actuators and sensors**.**
- Explain different types of electrostatic and piezoelectric actuators and sensors**.**
- Analyze the fluid dynamics in Micro conduits and its applications.
- Illustrate various medical applications of MEMS.

TEXT BOOKS:

1. Tai Ran Hsu, “MEMS and Microsystems Design and Manufacture”, Tata McGraw Hill Publishing Company, New Delhi, 2002. (Unit I, II, III & IV).
2. Wanjun Wang, Stephen A.Soper, “BioMEMs: Technologies and Applications”, CRC Press, New York, 2007.(Unit V).

REFERENCES:

1. Marc J. Madou "Fundamentals of Microfabrication: the Science of Miniaturization", CRC Press,2002.
2. Nadim Maluf, Kirt Williams. "An introduction to Microelectro Mechancial Systems Engineering", Second Edition, Artech House Inc, MA, 2004.
3. Chang Liu,' Foundations of MEMS', Pearson Education International, New Jersey, USA,2006
4. Nitaigour Premchand Mahalik, "MEMS", Tata McGraw Hill Publishing Company, New Delhi, 2007

BM17E22	MEDICAL INFORMATICS	L	T	P	C
		3	0	0	3

OBJECTIVE

- To learn and adapt ICT applications in health informatics

UNIT I INTRODUCTION TO MEDICAL INFORMATICS 9

Introduction - Medical Informatics – Structure of Medical Informatics- Computer based medical information retrieval, Functional capabilities of a computerized Hospital Information System, Health Informatics – Medical Informatics, Bioinformatics, Clinical informatics, Nursing informatics, Public health informatics.

UNIT II MEDICAL DATA STORAGE AND AUTOMATION 9

Representation of healthcare Data, Relational, Hierarchical and network Approach, Data modeling for patient database development. Automated clinical laboratories-Automated methods in hematology, cytology and histology, Intelligent Laboratory Information System - Computer assisted medical imaging, Radiation therapy and planning, EBM, Bioethics

UNIT III MEDICAL STANDARDS AND COMPUTERIZED PATIENT RECORD 9

Medical Standard Organization JCI, JCAHO, NABL. Evolution of Medical Standards – IEEE 11073 - HL7 – DICOM – IRMA - LOINC – HIPAA. Computer based Patient Records-History taking by computer, Dialogue with the computer, Components and functionality of CPR, Development tools, CPR in Radiology, Clinical information system, Computerized prescriptions for patients.

UNIT IV HEALTH INFORMATICS 9

Bioinformatics Databases, Bio-information technologies, Genome Analysis, Semantic web and Bioinformatics, Genome projects. Clinical information system, data for decision making, Medical diagnostic and decision support systems, Decision analysis in health informatics.

UNIT V RECENT TRENDS IN MEDICAL INFORMATICS 9

Virtual reality applications in medicine, Computer assisted surgical techniques-Virtual endoscopy, Computer assisted surgery, Surgical simulation. Computer assisted medical education, Computer assisted patient education and health . Telemedicine, virtual Hospitals - Smart Medical Homes – Personalized e-health services.

TOTAL: 45 PERIODS

OUTCOMES:

On completion of the course students will be able to

- Discuss the structure of medical Informatics and functional capabilities of Hospital Information System.
- Describe the need of computers in medical imaging and automation in clinical laboratory.

- Describe the need of medical standards.
- Develop Health informatics Module.
- Identify recent trends and different ICT applications in medical Informatics.

TEXT BOOKS:

1. Mohan Bansal, “Medical informatics”, Tata McGraw Hill Publishing Ltd, 2003
2. R.D.Lele, “Computers in medicine progress in medical informatics”, Tata Mcgraw Hill, 2005

REFERENCES:

1. Alain Venot, Anita Burgun, Catherine Quantin, “Medical Informatics, e-Health: Fundamentals and Applications”, Springer Science & Business Media, 2013
2. Edward H. Shortliffe, James J. Cimino, “Biomedical Informatics: Computer Applications in Health Care and Biomedicine”, Springer Science & Business Media, 2013
3. Orpita Bosu and Simminder Kaur Thukral, “Bioinformatics Databases, Tools and Algorithms”, Oxford University press, 2007.
4. Shui Qing Ye, “Bioinformatics: A Practical Approach” , CRC Press, 2007

BM17E23 HEALTHCARE PRODUCT DEVELOPMENT L T P C
3 0 0 3

OBJECTIVES

- To understand the global trends and development methodologies of various types of healthcare products and services
- To Understand requirement engineering and know how to collect, analyze and arrive at new product development with regulatory norms
- To understand market strategy in converting a design into a product

UNIT I PRODUCT LIFE CYCLE FOR MEDICAL DEVICES 9

Introduction-FDA total product life cycle- European commission product life cycle-Product life cycle management, current good manufacturing practices, end user purchasing stakeholders, operational asset management- Medical device integration into existing workflow- Managing risk in healthcare technology, existing point-of-care protocols. Engineering assessment of medical device failure.

UNIT II REGULATORY PROCESS IN CLINICAL RESEARCH 9

History and role of regulations in clinical research, Indian Regulatory laws, Schedule Y, registration of new drugs, requirements for registration, regulatory environment and practices, US regulatory system, EU regulatory affairs, non-disclosure agreement, GMP regulations, patent and patent laws.

UNIT III DRUG DISCOVERY 9

Drug design-Ligand based, Structure based, Active site identification, rational drug discovery High throughput screening, Structure Activity Relationship(SAR), Quantitative Structure Activity Relationship (QSAR), Computer assisted drug designing (CADD).

Terminology in clinical research, Preclinical phases, first in human trials, Single ascending dose and multiple ascending dose studies, Exploratory clinical trials, Confirmatory clinical trials, post marketing surveillance.

UNIT IV TESTING AND VALIDATION 9

Introduction to Biostatistics, Statistical analysis for product and design validation, Clinical trials, Calibration, Challenges in biomedical research, Case study on launch of new biomedical device.

UNIT V BUSINESS DYNAMICS ENGINEERING SERVICES INDUSTRY 9

The Industry - Engineering Services Industry - Product development in Industry versus Academia - The IPD Essentials - Introduction to vertical specific product development processes - Manufacturing/Purchase and Assembly of Systems - Integration of Mechanical, Embedded and S/W systems – Product development Trade-offs - Intellectual Property Rights and Confidentiality - Security and configuration management.

TOTAL: 45 PERIODS

OUTCOMES:

On completion of the course students will be able to

- Propose a new biomedical product and explain the clinical need
- Solve specific problems independently with necessary regulatory and safety norms
- Device equipment for drug manufacturing and testing
- Develop documentation, test specifications and coordinate with various teams for validation and testing
- To know the market requirement and customize the product

TEXT BOOKS:

1. Beth Ann Fiedler, Managing medical devices within a regulatory framework, Elsevier, 2017
2. Benjamin Blass, Basic Principles of Drug Discovery and Development, 1st Edition, Elsevier.
3. Ezekiel J. Emanuel, Ethical and Regulatory Aspects of Clinical Research: Readings and Commentary, 1st Ed., The Johns Hopkins University Press; first Edition, 2003.
4. Davis, Organizational Behavior, Tata McGraw Hill, Eleventh Edition, New Delhi, 2005.
5. Ira R. Berry,The Pharmaceutical Regulatory Process (Drugs and the Pharmaceutical Sciences), First Edition., Informa HealthCare, 2004.

BM17E24 EMBEDDED SYSTEMS AND APPLICATION DEVELOPMENT

L	T	P	C
3	0	0	3

OBJECTIVES

- Understand the fundamentals of Embedded processor Modeling , Bus Communication in processors, Input/output interfacing
- Get introduced on processor scheduling algorithms , Basics of Real time operating system

UNIT I INTRODUCTION TO EMBEDDED SYSTEMS 8

Introduction to Embedded Systems – The build process for embedded systems- Structural units in Embedded processor , selection of processor & memory devices- DMA – Memory management methods- Timer and Counting devices, Watchdog Timer, Real Time Clock- Software Development tools-IDE, assembler, compiler, linker, simulator, debugger.

UNIT II EMBEDDED NETWORKING AND INTERRUPTS SERVICE MECHANISM 10

Embedded Networking: Introduction, I/O Device Ports & Buses– Serial Bus communication protocols-RS232 standard – RS485 –USB- CAN Bus – Inter Integrated Circuits (I2C) – interrupt sources, Programmed-I/O busy-wait approach without interrupt service mechanism-ISR concept—

multiple interrupts – context and periods for context switching, interrupt latency and deadline – Device Driver– Introduction to Basic Concept of Parallel port & Serial port Device Drivers.

UNIT III RTOS BASED EMBEDDED SYSTEM DESIGN 9

Introduction to basic concepts of RTOS- Need, Task, process & threads, interrupt routines in RTOS, Multiprocessing and Multitasking, Preemptive and non-preemptive scheduling, Task communication shared memory, message passing-, Inter process Communication – synchronization between processes-semaphores, Mailbox, pipes, priority inversion, priority inheritance, comparison of Real time Operating systems: VxWorks, RT Linux

UNIT IV FUNDAMENTALS OF UML 9

Overview of UML, Scope of UML, Conceptual model of UML, Architectural – Metamodel, Unified Software Development Lifecycle-UML Diagram- Timing ,Task Diagram Modeling techniques - structural, Behavioral, Activity Diagrams-simple patterns

UNIT V EMBEDDED SYSTEM APPLICATION DEVELOPMENT 9

Objective, Need, different Phases & Modeling of the EDLC-choice of Target Architectures for Embedded Application Development-for Control Dominated-Data Dominated Systems-Case studies on Digital Camera, Adaptive Cruise control in a Car, Mobile Phone software for key inputs.

TOTAL: 45 PERIODS

OUTCOMES:

On completion of the course students will be able to

- Design & develop computational processors & automated process with improved design strategies.
- Implement UML and models for real time applications.
- Employable and develop entrepreneurship capacity due to knowledge up gradation on recent trends in embedded systems design.
- Explain on aspects required in developing a new embedded processor, different Phases & Modeling of embedded system
- Apply the concepts for real time applications

TEXT BOOKS:

1. Rajkamal, “Embedded system-Architecture, Programming, Design”, TMH,2011
2. Peckol, “Embedded system Design”,JohnWiley&Sons,2010

REFERENCES:

1. Lyla B Das, “Embedded Systems-An Integrated Approach”, Pearson Publications, 2013
2. Elicia White, “Making Embedded Systems”, O’Reilly Series,SPD,2011
3. Bruce Powel Douglass, “Real-Time UML Workshop for Embedded Systems”, Elsevier, 2011.

BM17E25 BIOELECTROMAGNETISM AND COMPATIBILITY L T P C
2 0 0 2

OBJECTIVES:

- To understand behavior of EMF with respect to time and its impact on medical devices
- To gain knowledge on the electric impedances of living tissues: dielectric and conductive properties of biological media

UNIT I TIME VARYING ELECTRIC AND MAGNETIC FIELDS 10

Faraday's law, Transformer and Motional Induction, Maxwell's equation from Faraday's law, Self and Mutual Inductance, Displacement current, Maxwell's equation from Ampere's law and its in consistency, Boundary relation, Poynting Vector, Comparison of field and circuit theory, Circuit application of Pointing Vector.

UNIT II ELECTROMAGNETIC RADIATION AND ITS INTERACTION WITH BIOLOGICAL SYSTEMS 10

Electrical properties of human system – conductivity, permittivity, impedance; human body as volume conductor, source field models, inductive power transfer in implanted devices, RF/microwave interaction mechanism with human system and its effects, therapeutic applications of microwaves.

UNIT III ELECTROMAGNETIC INTERFERENCE AND COMPATIBILITY IN MEDICAL EQUIPMENTS 10

EMI-EMC definitions and Units of parameters; Sources and victim of EMI; Conducted and Radiated EMI Emission and Susceptibility, EM coupling, EMI control -Shielding, filtering and grounding, Standards for medical devices - ISO 14117:2012, IEC 60601-1-2, testing Case study on EM interference during MR imaging

TOTAL: 30 PERIODS

OUTCOMES:

On completion of the course students will be able to

- Apply the principles of EMF in real time
- Identify various causes and effects of EM interference in living body
- Design compatible circuits that could prevent medical devices from showing wrong results

TEXT BOOKS:

1. Clayton R.Paul, " Introduction to Electromagnetic Compatibility", John Wiley Publications, 2008
2. Bioelectromagnetism–"Principles and Applications of Bioelectric and Biomagnetic Fields" by Jaakko Malmivuo, Oxford University press, 1995

REFERENCES:

1. John D. Kraus & Keith R. Carver, "Electromagnetics", McGraw-Hill Inc. 1973
2. Edward Conrad Jordan, Keith George Balmain, "Electromagnetic waves and radiating systems", Prentice Hall, 1968.
3. Andre Vander Vorst, Arye Rosen, Youji Kotsuka, John Wiley & Sons,"RF/Microwave Interaction with Biological Tissues", Inc., 2006.

BM17E26 VIRTUAL REALITY IN MEDICAL APPLICATIONS L T P C
2 0 0 2

OBJECTIVES

- Understand the basics of a virtual reality and AR
- Know the different types of modalities used
- Understand the various prototypes used

UNIT I INTRODUCTION AND DEVELOPMENT PROCESS 11

What is VR/AR/HR/MR.? - state and history of VR - VR concepts – applications - gaming & entertainment - business & enterprises - visualization - AEC & MFG. VR types - cve, non-

immersive, immersive-VR devices- Stereo headphones, HMDs, controllers, haptic gears, ETDs, high-performance computer hardware, content creation & VR engines(Maya, Unreal, 3DS Max, Cinema4D, Blender, Softimage, Unity, String Ray, Critech, AR Toolkit)

UNIT II VR ON THE WEB & VR ON THE MOBILE 10

JS-pros and cons-building blocks (WebVR, WebGL, Three.js, device orientation events)-frameworks (A-frame, React VR)-Google VR for Android-Scripts, mobile device configuration, building to android-cameras and interaction-teleporting-spatial audio-Assessing human parameters-device development and drivers - Design Haptics

UNIT III FUTURE OF VR 9

Realization -adoption -virtual retina displays-Medical Applications with VR-Multi-sensory - geoscience VR- VR as a design tool-standards- Case studies-Medical App development

TOTAL: 30 PERIODS

OUTCOMES:

On completion of the course students will be able to

- Distinguish between VR with other similar technologies
- Identify the various technologies used in VR
- Apply VR techniques for various real time applications

TEXT BOOKS:

1. Jason Jerald, "The VR Book—Human Centered Design for Virtual Reality", Association for Computing Machinery and Morgan & Claypool New York, NY, USA © 2016
2. Dieter Schmalstieg & Tobias Hollerer, "Augmented Reality: Principles and Practice", Addison-Wesley Educational Publishers Inc, New Jersey, United States, 2016.

REFERENCES:

1. Steve Aukstakalnis, "Practical Augmented Reality: A Guide to the Technologies, Applications, and Human Factors for AR and VR", , Addison-Wesley Professional; 1st edition 2016
2. Robert Scoble & Shel Israel, "The Fourth Transformation: How Augmented Reality & Artificial Intelligence Will Change Everything", Patrick Brewster Press; 1st edition, 2016.
3. Tony Parisi, "Learning Virtual Reality: Developing Immersive Experiences and Applications for Desktop, Web, and Mobile", O'Reilly Media; 1st edition, 2015.

BM17E27 WEARABLE SYSTEMS L T P C
2 0 0 2

OBJECTIVES:

- Study about sensors and its application in wearable systems
- Learn about applications of wearable systems

UNIT I SENSORS AND SIGNAL PROCESSING 10

Need for wearable systems, Sensors for wearable systems-Inertia movement sensors, Respiration activity sensor, Inductive plethysmography, Impedance plethysmography, pneumography, Wearable ground reaction force sensor, GSR, Radiant thermal sensor, Wearable motion sensors, CMOS –Based Biosensors, Wearability issues -physical shape and placement of sensor, Technical challenges - sensor design, signal acquisition, light weight signal processing.

UNIT II ENERGY HARVESTING FOR WEARABLE DEVICES 10

Introduction to Solar cell, Vibration based, Thermal based, Principles of Energy Harvesting by Using Human Body Heat, Thermal electrical generators (TEGs) in wearable devices, Hybrid thermoelectric photovoltaic energy harvests, Thermopiles.

UNIT III WIRELESS HEALTH SYSTEMS 10

Need for wireless monitoring, Definition of Body area network, BAN and Healthcare, Technical Challenges- System security and reliability, BAN Architecture – Introduction, Wireless communication techniques. Bio hacking and regulatory considerations. Medical Diagnostics, Medical Patients Monitoring, Multi parameter monitoring, Neural recording, Gait analysis, Sports Medicine, Smart Fabrics

TOTAL: 30 PERIODS

OUTCOMES:

On completion of the course students will be able to

- Explain need of wireless health systems and the application of wearable systems
- Apply the energy harvesting techniques in the wearable devices
- Develop the wearable device for patient monitoring applications.

TEXT BOOKS:

1. Annalisa Bonfiglio,Danilo De Rossi ,"Wearable Monitoring Systems", Springer, 2011.
2. Sandeep K.S. Gupta,Tridib Mukherjee,Krishna Kumar Venkatasubramanian, "Body AreaNetworks Safety,Security, and Sustainability," Cambridge University Press, 2013.

REFERENCES:

1. Hang,Yuan-Ting,"wearable medical sensors and systems",Springer-2013
2. Mehmet R. Yuce,Jamil Y.Khan, "Wireless Body Area Networks Technology, Implementationand Applications",Pan Stanford Publishing, Singapore, 2012

BM17E28 TELEHEALTH TECHNOLOGY L T P C
1 0 0 1

OBJECTIVES

- Understand the key principles for Telehealth.
- Learn various technologies and standards related to telehealth

UNIT I FUNDAMENTALS OF TELEMEDICINE: 7

History of telemedicine, definition of telemedicine, tele-health, tele-care, scope, Telemedicine Systems – Functional diagram, benefits & limitations of telemedicine.

UNIT II TELEMEDICINE TECHNOLOGIES 8

Principles of Multimedia - Audio, video, still images, text and data, fax-type of communications and network: PSTN, POTS, ANT, ISDN, internet, air/ wireless communications, GSM satellite, micro wave, Mobile health and ubiquitous healthcare. Internet technology and telemedicine using world wide web (www). Clinical data – local and centralized. PACS architecture. Encryption, Cryptography.

TOTAL: 15 PERIODS

OUTCOMES:

On completion of the course students will be able to

- Design the wireless technology for telemedicine

- Implement the concepts of telemedicine for various applications

TEXTBOOKS:

1. Norris A C, "Essentials of Telemedicine and Telecare", John Wiley, New York, 2002.
2. H K Huang, "PACS and Imaging Informatics: Basic Principles and Applications" Wiley, New Jersey, 2010.
3. Khandpur R S, "Telemedicine – Technology and Applications", PHI Learning Pvt Ltd., New Delhi, 2017.

REFERENCES:

1. Wootton R. Craig, J., Patterson, V. (Eds.), Introduction to Telemedicine. Royal Society of Medicine Press Ltd (ISBN 1853156779), 2006.
2. Keith J Dreyer, Amit Mehta, James H Thrall, "Pacs: A Guide to the Digital Revolution", Springer, New York, 2002.
3. Olga Ferrer Roca, Marcelo Sosa Iudicissa, "Handbook of Telemedicine", IOS Press, Netherland, 2002.
4. Bemmel, J.H. van, Musen, M.A. (Eds.) (1997). Handbook of Medical Informatics. Heidelberg, Germany: Springer. (ISBN 3-540-63351-0)

BM17E29 INTERNET OF THINGS IN MEDICINE L T P C
1 0 0 1

OBJECTIVES

- To learn how the general Internet as well as Internet of Things works.
- To understand the computing tools used for Internet of Things.
- To know the applications of IoT in healthcare.

UNIT I BASICS OF IOT, NETWORKING & COMPUTING 8

IoT-An Architectural Overview, Devices and gateways, Local and wide area networking, Building a network – Requirements - Layering and protocols - Internet Architecture – Network software – Performance ; Link layer Services - Framing - Error Detection - Flow control, Fundamentals of Wireless Communication Technology, Introduction to Mobile Computing– Cloud computing

UNIT II IOT IN HEALTHCARE 7

Introduction to Raspberry Pi – Implementation of IoT with Raspberry Pi – Wearable Technologies and IOT - Electronic tattoos - Smart lenses for diabetics - Bio-monitoring drugs - AliveCor - eCall - Remote monitoring - Aging in place - Wireless patient Monitoring - Virtual consultation .

TOTAL: 15 PERIODS

OUTCOMES:

On completion of the course students will be able to

- Identify the required components and build different types of networks
- Apply IoT in medical field.

TEXT BOOKS

1. Olivier Hersent , David Boswarthick , Omar Elloumi, "The Internet of Things: Key Applications and Protocols", John Wiley and Sons Ltd, 2012.
2. Jan Holler, Vlasios Tsiatsis, Catherine Mulligan , "From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence", Elsevier Ltd, 2014

REFERENCES:

1. Prasant Kumar Pattnaik, Rajib Mall, "Fundamentals of Mobile Computing", PHI Learning Pvt. Ltd, New Delhi – 2012.
2. Larry L. Peterson, Bruce S. Davie, "Computer Networks: A systems approach", Fifth Edition, Morgan Kaufmann Publishers, 2011.

VALUE ADDED COURSES

BM17V11	INSTRUMENTATION AND SYSTEM DESIGN LABORATORY	L	T	P	C
		0	0	2	1

OBJECTIVES

- Design of Instrumentation amplifier.
- Design of active filters.
- Design of regulated power supply and design of V/I and I/V converters.
- Design of signal conditioning circuit for strain gauge and RTD.
- Preparation of documentation of instrumentation project and project scheduling (process flow sheet, instrument index sheet and instrument specifications sheet, job scheduling, installation procedures and safety regulations).

TOTAL: 30 PERIODS

LAB EQUIPMENTS REQUIRED PER BATCH (30 Students)

1. Dual power supply –5 Nos
2. Digital Multimeters –5 Nos
3. Resistors –10 No
4. Operational Amplifiers –5 Nos.
5. Capacitors -10 Nos
6. Signal generator -5 Nos
7. C.R.O -5 Nos
8. Transistor (NPN / PNP) -2 No
9. Dual power supply -5 Nos
10. Loop analyzer -5 Nos
11. RTD (Pt 100) -5 Nos
12. Temperature bath -5 Nos
13. Trim Pot -5 Nos

BM17V12	INTRODUCTION TO SCI LAB	L	T	P	C
		0	0	2	1

OBJECTIVES:

- To practice the basics of Scilab.
- To understand image segmentation algorithms.
- To simulate and process various biosignals.
- To design filters.

LIST OF EXPERIMENTS

Noise removal in an image and image restoration

1. Remove Salt and Pepper Noise
    a. Minimize Gaussian noise

   b. Median filter and Wiener filter
2. Reducing the number of colors in an image without dithering
3. Image segmentation using Snake algorithm
4. Linear regression of two variables
5. Add and remove noise from a simulated biosignal using singular value decomposition
6. Simulation and processing of respiration signal

TOTAL: 30 PERIODS

OUTCOMES:

On completion of the course students will be able to

- Implement image segmentation methods
- Generate and filter signals

REFERENCES:

1. http://cloud.scilab.in/
2. https://www.physionet.org/

LAB REQUIREMENTS FOR A SET OF 30 STUDENTS

30 systems installed with Scilab (open source software) with Internet.

BM17V13	INTRODUCTION TO R-LAB	L	T	P	C
		0	0	2	1

LIST OF EXPERIMENTS

1. Calculate the average inflammation, mean, standard deviation per day across all patients using arithmetic operators and plot the results.
2. For the given input data perform import operation and handle mixed data set on the spread sheet.
3. Perform data import operations using read function for the following data formats: SPSS, Stata, SAS, Octave, Minitab, Systat.
4. Perform standard deviation and enable plot operation for the imported data and represent it graphically using scatter plot, box plot,ggplot2 operators
5. Exhibit Probability Distribution function and estimate the distribution to extract the amount to diseased people on the given data.
6. Perform Time series and auto correlation operations on the CSV data using R
7. Using K-means Clustering perform multidimensional scaling to project the data into two Dimension.

TOTAL: 30 PERIODS

LAB REQUIREMENTS FOR 30 STUDENTS

1. 30 computers with R programming software installed along with internet facility.