Department of Biomedical Engineering

B.Tech.

in

Biomedical Engineering

2015 Regulation

Curriculum and Syllabus

KALASALINGAM ACADEMY OF RESEARCH AND EDUCATION
(Kalasalingam University)
Anand Nagar, Krishnankoil – 626 126

VISION AND MISSION

INSTITUTION

VISION: ***To be a Centre of Excellence of International Repute in Education and Research.***

MISSION: ***To Produce Technically Competent, Socially Committed Technocrats and Administrators through Quality Education and Research.***

DEPARTMENT

VISION: ***To be a globally recognized Centre of Excellence in the field of Biomedical Engineering for the advancement of human health.***

MISSION: ***To produce skilled Biomedical Engineers, who are technically competent and socially committed, by imparting interdisciplinary education in the field of Biomedical Engineering***

Program Educational Objectives (PEOs)

PEO1 Graduates would have attained a basic competency in the field of Biomedical Engineering for pursuing advanced courses in Biomedical Engineering and allied fields

PEO2 Graduates would be successful as entrepreneurs or attain responsible positions in government, biomedical and allied industries and, research centres.

PEO3 Graduates would exhibit effective communication and leadership skills and contribute to the advancement of human healthcare through life-long learning.

ABET Student Outcomes (ASOs)

ASO1: An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.

ASO2: An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.

ASO3: An ability to communicate effectively with a range of audiences.

ASO4: An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.

ASO5: An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.

ASO6: An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.

ASO7: An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

Mapping of ABET Student Outcomes and PEOs

ASOs / PEOs	PEO 1	PEO 2	PEO 3
ASO 1	✓		
ASO 2	✓		
ASO 3	✓		✓
ASO 4		✓	✓
ASO 5		✓	✓
ASO 6		✓	
ASO 7		✓	

NBA Program Outcomes (POs) and Program Specific Outcomes (PSOs)

PO1 – Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2 – Problem analysis: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3 – 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.

PO4 – 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.

PO5 – 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.

PO6 – 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.

PO7 – Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of need for sustainable development.

PO8 – Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9 – Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10 – 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.

PO11 – 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.

PO12 – 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.

PSO1 - Utilization of Acquired knowledge: The ability of a graduate to utilize the knowledge acquired through the study of Mathematics, Basic Sciences, Biology, Environmental impact and needs, Core-engineering and, Human Anatomy and Physiology constituting the fundamentals of Biomedical Engineering.

PSO2 Recognize and Resolve Complications: The ability of a graduate to Analyze, Interpret, Model, Design, Recognize and Resolve Complications arising in the domain of Biomedical Engineering, and to satisfy the requirements of health-care industries/organizations.

PSO3 - Self-sustainability: The ability of a graduate to be self-sustainable, and to be positioned as a Leader, Administrator, Entrepreneur, or to be a supporter for a

multidisciplinary team designated to meet the specified target with standards through an elitist approach.

PSO4 - Well-being of Humanity: The ability of a graduate to be committed with the context of coalescing Pedagogical, Socio-ethical and Professional practices on proceeding with the knowledge gained through Biomedical Engineering for the well-being of Humanity.

POs' Consistency with Department PEOs'

PEO/PO, PSO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
PEO1	✓	✓	✓		✓	-	-	-	-	-	-	✓	✓	✓	-	✓
PEO2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
PEO3	-	-	-	-	-	-	-	✓	✓	✓	✓	✓	-	-	✓	✓

DEPARTMENT OF BIOMEDICAL ENGINEERING

2015 REGULATION CURICULLUM

SEMESTER I					
Code No	**Course**	**L**	**T**	**P**	**C**
HSS101	English for technical communication I	2	0	0	2
MAT103	Mathematics I	3	0	0	3
PHY131	Physics I	3	0	0	3
CHY106	Chemistry	3	0	0	3
CSE102/ MEC101	Programming Languages/Engineering Drawing	2	0	0	2
EEE101/ CIV101	Basic Electrical and Electronics Engineering / Basic Civil and Mechanical Engineering	3	1	0	4
MEC181	Work Shop	0	0	3	1
PHY182	Physics Laboratory	0	0	3	1
TOTAL		**16**	**1**	**6**	**19**
SEMESTER II					
Code No	**Course**	**L**	**T**	**P**	**C**
HSS102	English for Technical Communication II	2	0	0	2
MAT104	Mathematics II	3	0	0	3
PHY132	Physics II	3	0	0	3
EEE101/ CIV101	Basic Electrical and Electronics Engineering/ Basic Civil and Mechanical Engineering	3	1	0	4
CHY102	Environmental Sciences	2	0	0	2
CSE102/ MEC101	Programming Languages/Engineering Drawing	2	0	0	2
BME101	Cell Biology for Biomedical Engineers	3	0	0	3
CHY182	Chemistry Laboratory	0	0	3	1
CSE181	Programming Languages Laboratory	0	0	3	1

HSS036	Soft Skills-I	0	0	0	1
TOTAL		**18**	**1**	**6**	**22**
SEMESTER III					
Code No	**Course**	**L**	**T**	**P**	**C**
MAT202	Mathematics III	3	0	0	3
BME201	Medical Physics	3	0	0	3
EEE203	Electric Circuit Analysis*	3	0	1	4
EIE207	Electronic Devices and Circuits	3	0	0	3
BME202	Human Anatomy and Physiology	3	0	0	3
BME208	Clinical Biochemistry	3	0	0	3
BME281	Electronic Devices and Circuits Laboratory**	0	0	3	2
BME282	Biochemistry and Human Physiology Laboratory	0	0	3	2
HSS037	Soft Skills-II	0	0	0	1
TOTAL		**18**	**0**	**7**	**24**
SEMESTER IV					
Code No	**Course**	**L**	**T**	**P**	**C**
MAT215	Mathematics IV	3	0	0	3
BME203	Biosensors and Transducers	3	0	0	3
BME204	Integrated Circuits	3	1	0	4
BME205	Biomechanics	3	1	0	4
BME206	Biomaterials and Artificial Organs	3	0	0	3
BME207	Pathology and Microbiology	3	0	0	3
BME283	Integrated Circuits Laboratory **	0	0	3	2
BME284	Pathology and Microbiology Laboratory	0	0	3	2
BME285	Biosensors and Transducers laboratory	0	0	3	2
HSS038	Soft skills-III	0	0	0	1
TOTAL		**18**	**2**	**9**	**27**
SEMESTER V					
Code No	**Course**	**L**	**T**	**P**	**C**
ECE304	Microprocessors and Microcontrollers	3	1	0	4

BME301	Biocontrol Systems*	3	0	1	4
BME302	Biomedical Instrumentation	3	1	0	4
BME303	Hospital Management	3	0	0	3
BME***	Major Elective I	3	0	0	3
***	Minor Elective I	3	0	0	3
BME381	Biomedical Instrumentation Laboratory**	0	0	3	2
ECE385	Microprocessor and Microcontroller Laboratory	0	0	3	2
BME398	Community Service Project - Phase I	0	0	3	1
TOTAL		**18**	**2**	**10**	**26**
SEMESTER VI					
Code No	**Course**	**L**	**T**	**P**	**C**
BME304	Biomedical Signal Processing	3	1	0	4
BME305	Diagnostic and Therapeutic Equipment	3	1	0	4
BME***	Major Elective II	3	0	0	3
BME***	Minor Elective II	3	0	0	3
***	Free Elective I	3	0	0	3
HSS***	Humanities Elective I	3	0	0	3
BME383	Biomedical Signal Processing laboratory**	0	0	3	2
BME384	Diagnostic and Therapeutic Equipment Laboratory	0	0	3	2
BME399	Community Service Project - Phase II	0	0	3	2
Total		**18**	**2**	**9**	**26**
SEMESTER VII					
Code No	**Course**	**L**	**T**	**P**	**C**
BME401	Medical Imaging Techniques	3	1	0	4
BME402	Embedded systems in Medicine*	3	0	1	4
BME***	Major Elective III	3	0	0	3
BME***	Major Elective IV	3	0	0	3
***	Free Elective II	3	0	0	3

HSS***	Humanities Elective II	3	0	0	3
BME481	Medical Image Processing Laboratory**	0	0	3	2
BME482	Hospital Training/Visit	0	0	3	2
TOTAL		18	1	6	24
SEMESTER VIII					
Code No	Course	L	T	P	C
BME***	Self-Study Elective	3	0	0	3
BME499	Project Work	0	0	24	10
Total		**3**	**0**	**24**	**13**

Total number of Credits: 181

MAJOR ELECTIVES FOR V SEMESTER					
Code No	**Course**	**L**	**T**	**P**	**C**
BME 306	Radiological Equipments	3	0	0	3
BME 307	Fiber Optics and Lasers in Medicine	3	0	0	3
BME 308	Biofluids and Dynamics	3	0	0	3
BME 309	Bioinformatics	3	0	0	3
BME 310	Computers in Medicine	3	0	0	3
MAJOR ELECTIVES FOR VI SEMESTER					
Code No	**Course**	**L**	**T**	**P**	**C**
BME 311	Rehabilitation Engineering	3	0	0	3
BME 312	Virtual Reality	3	0	0	3
BME 313	Modeling of Physiological Systems	3	0	0	3
BME 314	Telemedicine	3	0	0	3
BME 315	Internet of Things	3	0	0	3
MAJOR ELECTIVES FOR VII SEMESTER					
Code No	**Course**	**L**	**T**	**P**	**C**
BME 403	Drug delivery system	3	0	0	3
BME 404	Nanotechnology in Medicine	3	0	0	3

BME 405	Bio MEMS	3	0	0	3
BME 406	Tissue Engineering	3	0	0	3
BME 407	Bioethics, IPR and Standards	3	0	0	3
BME 408	Clinical Engineering	3	0	0	3
SELF STUDY ELECTIVES					
Code No	**Course**	**L**	**T**	**P**	**C**
BME 319	Biometric Systems	3	0	0	3
BME 320	Speech Processing	3	0	0	3
BME 321	Biomedical Waste Management	3	0	0	3
BME 409	Wearable systems	3	0	0	3
BME 410	Sports and Biomedical Engineering	3	0	0	3
MINOR ELECTIVES					
Code No	**Course**	**L**	**T**	**P**	**C**
ECE 309	VLSI Design	3	0	0	3
CSE326	Cloud Computing	3	0	0	3
CSE457	Networks and Protocols for instrumentation	3	0	0	3
BIT 411	Bioresource Technology	3	0	0	3
BIT419	Molecular Diagnostics And Therapeutics	3	0	0	3
B1T409	Cancer Biology	3	0	0	3
BIT311	Health Care Biotechnology	3	0	0	3
ECE325	Robotics and Automation	3	0	0	3
CHE358	Transport Phenomena in Biological Systems	3	0	0	3
HUMANITIES ELECTIVES					
Code No	**Course**	**L**	**T**	**P**	**C**
HSS001	Total Quality Management	3	0	0	3

HSS 002	Engineering Management	3	0	0	3
HSS004	Industrial Psychology	3	0	0	3
HSS005	Consumer Psychology	3	0	0	3
HSS006	Professional Ethics	3	0	0	3
HSS007	Operations Management	3	0	0	3
HSS008	Introduction to Economics	3	0	0	3
HSS010	International Trade and Finance	3	0	0	3
HSS011	Information Systems for Managerial Decision Making	3	0	0	3
HSS014	Introduction to Marketing Management	3	0	0	3
HSS017	International Economics	3	0	0	3
HSS018	Communication Skills	3	0	0	3
HSS022	Banking Theory and Practice	3	0	0	3
HONORS					
Code No	**Course**	**L**	**T**	**P**	**C**
BME322	Mechanics of Biological systems	3	0	0	3
BME323	Design of Biomedical Instruments	3	0	0	3
BME414	Neural Engineering	3	0	0	3
BME415	Advanced Digital Signal Processing	3	0	0	3
FREE ELECTIVES					
Code No	**Course**	**L**	**T**	**P**	**C**
BPY502	Laser Physics	3	0	0	3
BPY503	Nonlinear Optics	3	0	0	3
BPY504	Radiation Physics	3	0	0	3

BPY506	Nuclear Physics	3	0	0	3
BPY507	Space Physics	3	0	0	3
BCY501	Nano Chemistry	3	0	0	3
BCY504	Applied Chemistry	3	0	0	3
BMA332	Mathematical Modelling	3	0	0	3
BCY506	Environmental Chemistry	3	0	0	3
BMA331	Combinatorics	3	0	0	3
BCY505	Instrumental Methods of Analysis	3	0	0	3

* THEORY WITH PRACTICAL COMPONENTS
**LABORATORY WITH MINI PROJECT

SEMESTER I

HSS101	ENGLISH FOR TECHNICAL COMMUNICATIONS - I (Common to all branches)	L	T	P	C
		2	0	0	2

Prerequisite: Basic English

Objective(s): To improve the student's listening, speaking, reading and writing skills

Course Outcome(s)

At the end of the course students will be able to

CO1 Cognize more about the English grammar

CO2 Work on their vocabulary development by listening to audio, media etc.,

CO3 Develop their basic communication skills in English.

CO4 To inculcate the habit of reading to improve their general knowledge

CO5 Refine their writing skills through formal letters, essays, etc.

Mapping of COs and POs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		M					H		H			
CO2									H			
CO3				H					H			
CO4									H		M	
CO5						M			H	M		

UNIT I FOCUS ON LANGUAGE

Parts of speech - nominal compounds, noun phrases - relative pronoun - adjective - numerical, comparison and contrast, collocation and word combinations - verb - preposition and relative - conjunction- connectives, expressions of purpose and function, cause and effect - articles - adjectives - sentence pattern - tenses - voice - rewriting the sentences in impersonal/abbreviated passive grammatical structures - concord - sentence level verb noun agreement - gerund - rewriting infinitive into gerund - imperative - rewriting imperative into recommendation using should - word

formation - varied grammatical function of the same word - affixes - prefix and suffix, number prefix, negative prefix - reported speech - editing strategies - conditional structures - real, unreal, no possibility, zero condition - writing formal definition - abbreviation and acronym - idioms and phrases - varieties of English - British versus American.

UNIT II LISTENING SKILLS

Comprehension practice - vocabulary development - familiarity to varied types of spoken English and accents - developing ability to understand audio and video media - aiming at overcoming barriers to listening - listening to documentaries, radio news broadcasts, TV news telecasts - active listening in discussions and to lectures - taking notes while listening - extracting information from listening.

UNIT III SPEAKING SKILLS

Oral practice - role play - interplay - seminar - transcoding visual into oral - participating in short and longer conversation - voice record, replay, correction of intonation, pronunciation and flow of speech - phonemes - vowels, consonants, stress, rhythm, intonation - group discussion - participative learning - acquiring proficiency, fluency, accuracy in oral communication - speaking practice - developing confidence - extempore speech - learning professional/conversational etiquette.

UNIT IV READING SKILLS

Vocabulary extension - improving vocabulary - intensive reading - reading strategies - identifying topic sentence - guessing meaning from content - picking out specific information - professional reading - reading practice - predicting the content, critical and analytical reading - reading articles in English newspapers, sports magazines, encyclopedias - reading aloud, use of stress and intonation - reading and comprehending technical materials - cloze reading.

UNIT V WRITING SKILLS

Discourse cohesion - improving writing skills, avoiding common grammatical errors in academic writing - extending the hints - writing shorter sentences - punctuation - dialogue writing - paragraph writing, problems and solutions, achieving coherence, transition words, sequence words - essays of descriptive and argumentative - writing instructions, use of imperatives - jumbled sentences into sequential paragraph using linguistic clues - report writing - technical reports, industry visit reports, events reports - writing recommendations - letter writing - formal and informal letters - job application and resume, permission for in-plant training, business correspondence letters, calling for quotation, placing order, lodging complaint, persuasive letters - assignment writing - mini-project - transcoding - transferring of information from text to pictorial/graphical representation and vice versa.

TEXT BOOK

1. Rizvi M Ashraf, Effective Technical Communication, Tata McGraw-Hill, 2005

REFERENCES

1. Daniel Jones, English Pronouncing Dictionary, Universal Book Stall, New Delhi, 17th Edition, 2000
2. Geoffrey Leech, Fan Svartvik, A Communicative Grammar of English, Pearson Education Asia, 1994
3. Hornby, AS, Oxford Advanced Learner•s Dictionary of Current English, OUP, 7th Edition, 2005
4. Manivannan G, English for Engineers - A Book on Scientific and Technical Writing, Govi Publications, 2005

MAT 103	MATHEMATICS I (Common to all Branches)	L	T	P	C
		3	0	0	3

Prerequisite Basic Mathematics

Objective(s) To inculcate basic engineering mathematic principles

Course Outcome(s)

CO1 Find the Eigen values of a matrix and to use Cayley-Hamilton theorem for finding the inverse of a matrix.

CO2 Explain the concept of curvature and to find envelope of a curve.

CO3 Apply partial derivatives to find maxima and minima.

CO4 Solve second order linear differential equations with constant coefficients, Cauchy's equation and Legendre's equation.

CO5 Understand the geometry of sphere, plane and straight line in the three dimensional space.

Mapping of COs and POs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	M	M									
CO2	M			M							
CO3	M	M		M	M						
CO4	M			H							
CO5	M			M				M			

UNIT I MATRICES

Review of linear algebra - Matrix operations - Addition, scalar multiplication, multiplication, transpose, adjoint and their properties - Special types of matrices - Null, identity, diagonal, triangular, symmetric, Skew-symmetric, Hermitian, Skew-Hermitian, orthogonal, unitary, normal - Rank - Consistency of a system of linear equations - Solution of the matrix equation $Ax = b$, Row - Reduced echelon form

UNIT II EIGEN VALUE PROBLEMS

Eigen value and eigen vector of real matrix - properties of eigen values and

eigen vectors - Cayley - Hamilton theorem - Orthogonal transformation of a real symmetric matrix to diagonal form - Reduction of quadratic form to canonical form by orthogonal transformation - Index, signature and nature of quadratic form

UNIT III DIFFERENTIAL CALCULUS

Review of limits - Continuity and differentiability - Curvature - Cartesian and Parametric co-ordinates - Centre and radius of curvature - Circle of curvature - Evolutes - Involutes - Envelopes - Partial differentiation - Euler•s theorem for homogeneous functions -Total differential - Taylor•s expansion (two variables) - Maxima and Minima for functions of two variables - Method of Lagrangian multiplier – Jacobians

UNIT IV THREE DIMENSIONAL ANALYTICAL GEOMETRY

Direction cosines and ratios - Angle between two lines - Equations of a plane - Equations of straight line - Coplanar lines - Shortest distance between two skew lines - Sphere - Tangent plane - Plane section of a sphere - Orthogonal spheres

UNIT V ORDINARY DIFFERENTIAL EQUATIONS

Solutions of second and higher order linear ODE with constant coefficients - Cauchy•s and Legendre•s linear equations - Simultaneous first order linear equations with constant coefficients - Method of variation of parameters

TEXT BOOKS

1. Kreyszig, E, Advanced Engineering Mathematics, John Wiley and Sons (Asia) Limited, Singapore , 8th Edn., 2001
2. Arumugam, S., Thangapandi Isaac, A., Somasundaram, A., Engineering Mathematics Volume I, Scitech Publications (India) Pvt. Ltd., Chennai, 2nd Edn., Reprint 2000, 1999

REFERENCES

1. Grewal , B.S., Grewal, J.S., Higher Engineering Mathematics, Khanna Publishers, New Delhi, 37th Edition., 5th Reprint 2004, 2003
2. Venkataraman, M. K., Engineering Mathematics First Year, The National Publishing Company, Chennai, 2nd Edition., Reprint 2001, 2000

PHY131	ENGINEERING PHYSICS I (Common to all Branches)	L	T	P	C
		3	0	0	3

Prerequisite: Basic Sciences

Objective(s): To enrich the students with Basic Physics concepts

Course Outcome(s)

At the end of this course, students will be able

CO1 To interpret theories on acoustics and sound waves

CO2 To demonstrate the different types of laser sources

CO3 To understand the concepts of Quantum Mechanics

CO4 To refine their ideas about radiography techniques

CO5 To experiment time variation and its relativity

Mapping of COs and POs												
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	H		M									
CO2	H			H			H					
CO3	H											
CO4		H										
CO5							M					

UNIT I ACOUSTICS AND STRUCTURE OF SOLIDS

Classification of sound, reverberation, Sabine•s formula, common acoustical defects and remedies, classification of solids, crystal structures, X-ray diffraction, crystal growth, crystal defects

UNIT II LASER AND FIBRE OPTICS

Interaction of radiation with matter , quantum mechanical view , three and four Level laser system, Holography, construction and reconstruction of hologram, Engineering and medical applications, introduction of fibre optics, classification of fibre, Engineering and medical applications

UNIT III QUANTUM PHYSICS

Inadequacy of classical mechanics, Black body radiation, Planck•s law, Photo electric effect, Compton effect, Einstein•s photoelectric equation, Schrödinger wave equation, particle in one, three dimensional box.

UNIT IV NON-DESTRUCTIVE TESTING

Liquid penetrant, magnetic particle and eddy current methods, X-ray radiography, fluoroscopy, Gamma ray radiography, ultrasonic scanning methods, ultrasonic flaw detector, thermography.

UNIT V RELATIVITY

Frame of reference, Newtonian relativity, Galilean Transformation equations, Ether hypothesis, Michelson-Morley experiment, special theory of relativity, Lorentz transformation equations, length contraction, time dilation, relativity of simultaneity, addition of velocities, variation of mass with velocity, mass-energy equivalence, Minkowski•s four dimensional space, time continuum.

TEXT BOOKS

1. P.K. Palanisamy, *f*Engineering Physics,„ Scitech Publications (India), Pvt Ltd., Chennai, 2009.
2. S.O. Pillai and D.N. Sankar, A text book of Engineering Physics. New Age International Publication, New Delhi, 2008.

REFERENCES

1. Murthy V.S.R., Jena AK, Gupta K.P. and Murthy G.S., Structures and Properties of Engineering Materials, Tata McGraw , Hill Publishing Company Limited, New Delhi, 2003.
2. Gaur R.K. & Gupta S.L., Engineering Physics, Dhanpat Rai publications (P) Ltd., New Delhi, 2001.
3. Ali Omar. M, Elementary Solid State Physics, Pearson Education (Singapore), Indian Branch, New Delhi.
4. William F. Smith, Foundations of materials science and Engineering, 3rd Edition, Tata McGraw-Hill, New York, 2003.
5. Rajput B.S Pragati Prakashan, Advanced Quantum Mechanics, New Market, Begum Bridge, Meerut.
6. Hand book of Electronics, Gupta S.L. Kumar V Pragati Prakashan, New Market, Begum Bridge, Meerut.
7. Arthur Beiser, Concepts of Modern Physics - Tata McGraw , Hill Publishing Company Limited, New Delhi, 5th Edition, 2000.

CHY 106	ENGINEERING CHEMISTRY	L	T	P	C
		3	0	0	3

Prerequisite **Basics in science**

Objective(s) To gain knowledge on chemical principles for Engineering domain

Course Outcome(s)

At the end of this course, students will be able

CO1 To assess the quality parameters of water

CO2 To gather the knowledge in basic concepts of thermodynamics

CO3 To describe the principles of chemical & electrochemical reactions and prevention of corrosion of materials, fuel cells

CO4 To experiment the preparation, properties and applications of polymers and nano-materials

CO5 To discuss the principles, instrumentations and applications of analytical techniques

Mapping of COs and POs												
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1			M			H						
CO2		M										
CO3	H			M								
CO4				M								
CO5				M								

UNIT I WATER TECHNOLOGY

Water quality parameters - Definition and expression - Importance and determination of Dissolved oxygen (DO) content in water-Estimation of hardness (EDTA method)- Problems-Determination of alkalinity- Water softening (zeolite) - Demineralisation (Ion- exchangers) and desalination , Boiler feed water-Domestic water treatment.

UNIT II MACROSCOPIC PROPERTIES OF SYSTEMS IN EQUILIBRIUM

Basic concepts of thermodynamics- Mathematical form of First law and its limitations-Enthalpy- Applications of first law (relation between C_p and C_v only) - Second law of thermodynamics (Clausius and Kelvin statement) - Entropy changes for reversible and isothermal processes - Problems-Entropy of phase transitions-Problems- Free energy and work function, Gibbs-Helmholtz equation- Applications-Problems-Van't Hoff isotherm and isochore-Applications-Problems- Phase equilibria- Application to one component systems, two component systems(Pb-Ag).

UNIT III ELECTRODICS

Electrochemical series and its applications -Reference electrodes (H_2 and calomel electrodes)- Determination of single electrode potential by using reference electrodes - -EMF measurements and its applications- problems-Nernst equation-Problems- Electrochemical energy systems: primary and secondary batteries, fuel cells, solar cell- Chemical structure, electronic

behaviours and applications of conducting polymers.-Principles of chemical and electrochemical corrosion - Corrosion control (Sacrificial anode and impressed current methods).

UNIT IV ENGINEERING MATERIALS

Introduction, Classifications, Types, Preparation, Characteristics, Properties and applications of Polymers (polyethylene, TEFLON, PET, PVC, PC, Nylon6, 6, PU),rubbers (Natural and Synthetic) and composites materials(FRC and FRP) – Free radical Mechanism – Thermoplastic & Thermosetting Plastics. Nanomaterials – Introduction, properties and application

UNITV INSTRUMENTAL METHODS OF ANALYSIS

Fundamental principles, theory, instrumentation and applications of UV-Visible spectroscopy, Gas Chromatography (GC), Thermogravimetric analysis (TGA), Differential Thermal Analysis (DTA), Scanning Electron Microscopy (SEM), principles, theory, instrumentation and applications of Atomic Absorption Spectroscopy(AAS).

TEXT BOOKS

1. Atkins P. W., Physical Chemistry, Sixth Edition, Oxford University Press, 1998.
2. Jain P.C. and Monica J., " Engineering Chemistry ", Dhanpat Rai Publications Co.,(P) Ltd., New Delhi, 14th Edition 2002.
3. Sharma, B.K., "Instrumental Methods of Analysis ", Goel publishing House, 12th Edition, 2001.

REFERENCES

1. Puri B. R., Sharma L. R., and Pathania M.S., ƒPrinciples of Physical Chemistry,,, Vishal Publishing Co., 2008.
2. Kuriakose, J.C. and Rajaram J., " Chemistry in Engineering and Technology ", Vol. I
   and II, Tata McGraw-Hill Publications Co.Ltd, New Delhi ,1996.

3. Kund and Jain, " Physical Chemistry ", S. Chand and Company, Delhi, 1996.
4. Gordon M.Barrow, " Physical Chemistry ", Sixth Edition, Tata McGraw Hill, 1998.
5. Willard, H.H., Merritt. I.I., Dean J.A., and Settle, F.A., "Instrumental methods of analysis", Sixth Edition, CBS publishers, 1986.
6. Vogel A.I., " Quantitative Inorganic Chemical Analysis ", V. Edition, 1989.
7. Rouessac, F., " Chemical Analysis-Modern instrumental methods and techniques ", Wiley- Publishers, 1999.
8. J.B Park, " Biomaterials Science and Engineering", Plenum Press, NewYork, 1984.
9. T.Pradeep, "Nano: The Essentials". Mc-Graw Hills, 2008
10. C.N.R.Rqao. a.Muller, A.K.Cheetham, " The Chemistry of Nanomaterials: synthesis, Properties and Applications" WILEY-VCH Verlag GmbH & Co. KGaA,. Weinheim, 2004.

MEC101	ENGINEERING DRAWING (Common to all Branches)	L	T	P	C
		1	0	3	2

Prerequisite: **Basics on geometrical Drawings**

Objective(s): Aims to introduce the concept of graphic communication by developing their drawing skills

Course Outcome(s)

CO1 Know the purpose, procedures, materials, standards and conventional symbols

CO2 Create and read engineering drawing using standard views and convert pictorial (3D) drawings through orthographic(2D) drawings and vice versa

CO3 Know the principles, projections, distinguish the types of projections and first angle projections of various angles like straight lines, planes and solids

CO4 Explain the principle and application of sectioning

CO5 Understand and apply the concepts of development of surfaces

Mapping of COs and POs												
CO	**PO1**	**PO2**	**H**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	H		H									
CO2		M	H	H								
CO3			H									
CO4			H									
CO5			H									

UNIT I INTRODUCTION

Importance of graphics , use of drafting instruments , BIS conventions and specifications , size, layout and folding of drawing sheets , lettering dimensioning and scales - orthographic principles , missing view - free hand sketching in first angle projection from pictorial views.

UNIT II PROJECTION OF POINTS, STRAIGHT LINES AND PLANES

Projection of points, located in all quadrants - projection of straight lines located in the first quadrant, determination of true lengths and true inclinations, location of traces - projection of polygonal surface and circular lamina located in first quadrant inclined to one or both reference planes.

UNIT III PROJECTION OF SOLIDS AND SECTION OF SOLIDS

Projection of solids like prisms, pyramids, cylinder and cone when the axis is inclined to one reference plane by change of position method , types of section , full section and half section -conventional section lines - section of simple solids like prisms, pyramids, cylinder and cone in vertical position by cutting planes inclined to any one of the reference planes, obtaining true shape of section

UNIT IV DEVELOPMENT OF SURFACES

Development of lateral surfaces of simple and truncated solids , prisms,

pyramids, cylinders and cones - development of lateral surfaces of combined solids.

UNIT V ISOMETRIC AND PERSPECTIVE PROJECTION

Principles of isometric projection , isometric view and projections of simple solids, truncated prisms, pyramids, cylinders and cones - Orthographic to isometric view , Introduction to perspective projection.

TEXT BOOK

1. Basant Aggarwal and C. Aggarwal, Engineering Drawing, Tata McGraw-Hill publishing company,New Delhi , 2008

REFERENCES

1. Shah, M.B., and Rana, B.C., Engineering Drawing, Pearson Education, New Delhi, 2005.
2. Nataraajan, K.V., A text book of Engineering Graphics, Dhanalakshmi Publishers, Chennai, 2006.
3. Bhatt, N.D., Engineering Drawing, Charotar publishing House, New Delhi, 46th Edition, 2003.
4. Luzadder and Duff, Fundamentals of Engineering Drawing, Prentice Hall of India Pvt Ltd, New Delhi, XI Edition, 2001.
5. Venugopal, K., Engineering Graphics, New Age International (P) Limited, 2002

EEE101	**BASIC ELECTRICAL AND ELECTRONICS ENGINEERING (Common to all Branches)**	**L**	**T**	**P**	**C**
		3	**1**	**0**	**4**

Prerequisite: **Basics in Physics**

Objective(s): To have basic knowledge on DC and AC circuits, machines and devices

Course Outcome(s):

Upon completion of the course, the students would be able to

CO1 Interpret the basic electrical and electronics circuits

CO2 Understand the DC and AC single phase and three phase fundamentals

CO3 Understand the working principle of various Electrical AC and DC machines

CO4 Gets the knowledge about various Analog type measuring instruments and house wiring.

CO5 Get the knowledge about the application of basic Electronics devices for domestic and industries

Mapping of COs and POs												
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1										H		
CO2										H		
CO3										H		
CO4			M							H		
CO5			M	M						H		

UNIT I - DC CIRCUITS AND AC CIRCUITS

Electrical quantities - resistors - inductors - capacitors - Ohms Law - Kirchoffs Laws - series and parallel circuits - analysis of DC circuits - mesh, nodal - simple problems. Sinusoidal functions - phasor representation - RMS Effective values - form and peak factors - RLC circuits - power and power factor - analysis of 3 phase AC circuits - simple problems.

UNIT II - ELECTRICAL MACHINES

Construction and principle of operation of DC machines - generator, motor - single phase transformers - alternators - three phase and single phase induction motors.

UNIT III - MEASURING INSTRUMENTS AND WIRING CIRCUITS

Moving coil and moving iron instruments - dynamometer type wattmeter - induction type energy meter. Domestic wiring - accessories - types - staircase wiring - fluorescent tube circuits - simple layout - earthing.

UNIT IV- ELECTRONIC DEVICES

Basic concepts of PN junction diodes - zener diode - bipolar junction transistor - uni polar devices - FET, MOSFET, UJT - thyristor - photoelectric devices.

UNIT V - ELECTRONIC CIRCUITS

Half wave and full wave rectifier - amplifier - oscillator - RC integrator and differentiator circuits - diode clampers and clippers - multivibrators - schmitt trigger.

TEXT BOOKS

1. V.K. Mehta, *f*Principles of Electrical Engineering and Electronics,,, S. Chand & Company Ltd, 2008.
2. Kothari D P and Nagrath I J, "Basic Electrical Engineering", Tata McGraw Hill, 1991.
3. Mithal G K, Electronic Devices & Circuits, Khanna Publications, 1997.

REFERENCES

1. T. Thyagarajan, *f*Fundamentals of Electrical and Electronics Engineering,,, SciTech publications (Ind.) Pvt. Ltd., 3rd Edition, October 2000.
2. Muraleedharan K.A, Muthususbramanian R and Salivahanan S, "Basic Electrical, Electronics and Computer Engineering" Tata McGraw Hill, 1999.

MEC181	WORKSHOP	L	T	P	C
		0	0	3	1

Prerequisite: Basic skills

Objective(s): To practically gain knowledge on basic engineering

Course Outcome(s):

CO1 To work with basic carpentry tools

CO2 To practically utilize fitting tools

CO3 To play with metals

CO4 To understand drilling concepts

CO5 To demonstrate plumbing

Mapping of COs and POs												
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1			M									
CO2			M									
CO3			M									
CO4			M									
CO5	M											

CARPENTRY

Carpentry tools - practice in marking, sawing, planing and chiseling , making simple joints: lap joint, T-joint, dovetail joint, mortise and tenon joint.

FITTING

Fitting tools - practice in marking, filing, punching, hacksawing - fitting to size and drilling - making of simple mating profiles: V, square, dovetail, half round joints.

SHEET METAL

Study of press, die and tools - sheet metal layout - development of lateral surfaces -simple exercises: blanking, forming, bending and flanging.

DRILLING

Drilling and tapping in drilling machines

Demonstration on:

1. Welding operations like butt joint and lap joints in Arc welding
2. Foundry operations like mould preparation for split pattern
3. Smithy operations like the production of hexagonal bolt
4. Preparation of plumbing line sketches , basic pipe connections involving the fittings like valves, taps, couplings, unions, reducers, elbows and other components used in household fittings.

PHY182	PHYSICS LABORATORY	L	T	P	C
		0	0	3	1

Prerequisite: Basic sciences

Objective(s): To understand the engineering physics concepts practically

Course Outcome(s):

Upon completion of the course, the students would be able to

CO1 Learn the practical understanding of the mechanical properties such as modulus, moment of inertia, gravitational force, stress, strain, etc

CO2 Understand and apply the optical phenomena like diffraction, interference, etc.

CO3 Understand the thermal conductivity and also thermal behaviour of the specimen

CO4 Acquire practical skill to analyze the fluid state mechanism

CO5 Find thickness of very thin objects

Mapping of COs and POs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H		H									
CO2			H									
CO3			H									
CO4			H									
CO5			M									

LIST OF EXPERIMENTS

1. To determine the acceleration due to gravity using Compound Pendulum
2. To determine the Rigidity Modulus of wire using Torsional Pendulum
3. To find thickness of the given two glass plates using single optic lever.
4. To determine the thermal conductivity of a bad conductor
5. To determine the refractive index of the material of the prism.
6. To find the number of rulings per cm length of the given transmission grating.
7. To determine the particle Size Using Laser
8. To determine the coefficient of viscosity of the liquid by Poiseuille•s

method

9. To determine the young•s modulus of given material using Uniform Bending
10. To Determine the thickness of a given material using Air wedge method
11. To determine the focal length of a biconvex lens using Newton•s Rings method
12. To determine the velocity of ultrasonic waves in the given medium using ultrasonic Interferometer.
13. To determine the Band gap determination of a semiconductor
14. To find the value of Hall coefficient of Semi-conductor
15. To find the value of Planck's constant by using a photoelectric cell
16. To find the dielectric constant of liquids

SEMESTER II

HSS102	ENGLISH FOR TECHNICAL COMMUNICATIONS II (Common to all Branches)	L	T	P	C
		3	0	0	2

Prerequisite: **HSS101**

Objective(s): To improve the student's communication skills

Course Outcome(s):

CO1 Identify the errors in sentence structures

CO2 Construct grammatically correct sentences

CO3 Effectively construct utterances for a Dialogue

CO4 Prepare various components of official communication like Memos, Circulars, Notices and Agendas

CO5 Recall Mechanics of Manuscript Preparation

Mapping of COs and POs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M								H			
CO2									H			
CO3	H								H			
CO4									H			
CO5									H			

UNIT I - ASPECTS OF COMMUNICATION

Communication through Words- Process of communication- Barriers to communication- Importance of communication- Corporate communication. Communication through Body Language- Personal Appearance- Posture – Gestures- Facial Expression- Eye Contact. Space Distancing. Communication through Technology-Word Processor- Desk top Publisher (DTP)- Power point Presentation- Electronic Mail-Voice Mail. Language Components- The Auxiliaries- be and its forms; Have and its forms; do and its forms.

UNIT II - ORAL COMMUNICATION:

Dyadic Communication- Face –to-Face Conversation- Interview-Instruction-Dictation. Public Speaking and Oral Presentation. Preparatory Steps-Structuring the contents- Audience Awareness-Modes of Delivery-vocal

Aspects- Time Management- Speeches for Special Occasions. Group Discussion- Group Dynamics- Purposes Organization. Language Components-Modal Auxiliaries.

UNIT III - WRITTEN COMMUNICATION:

Reading Comprehension-Reading Techniques- Helpful hints for Comprehension exercise. Précis Writing- Forms of Condensation-Skills Required for Précis Preparation- Guideline- Practical Hints. Style of Writing- Importance of Professional Writing- Features of Written Communication- Choice of Words and Phrases- Sentence Structure- Paragraph Structure- Topic Sentences. Language Components- Verbs-mood, Indicative mood, Imperative mood & Subjunctive Mood.

UNIT IV - BUSINESS AND TECHNICAL REPORTS:

Forms of reports- Preparing Questionnaires- Letter Reports- Memo Reports- Formal Reports. Memorandum Writing- Contents- Types – Structure. Introduction to Official Communication- Notices- Agenda – Minutes. Language Components- Adverbs-Interrogative Adverbs & Relative Adverbs- Position of Adverbs

UNIT V - MECHANICS OF MANUSCRIPT PREPARATION:

Editing and proof reading- proof reading symbols- Punctuation- Capitalization. Words often Confused- Words commonly spelt wrongly. Common Errors- use of Pronouns- use of Verbs- use of Infinitives, Gerunds and Participles- Use of Prepositions. Language Components- Conjunctions – Coordinating Conjunctions- Subordinating Conjunctions.

TEXT BOOKS

1. Krihsna Mohan and Meera Banergji ; Developing Communication Skills, 2nd edition, Macmillan, 2009

REFERENCES

2. David Green : Contemporary English Grammar, Structures and Composition. Chennai: Macmillan, 2000.

3. Krishna Mohan and Meenakshi Raman. Effective English Communication. New Delhi; Tata McGraw-Hill Education Private Ltd. 2009.
4. Oxford Advanced learner's English Dictionary, 9th edition, 2015
5. M. Ashraf Rizvi. Effective Technical Communication. Tata McGraw-Hill Publishers, 2010

MAT104	MATHEMATICS II (Common to all Branches)	L	T	P	C
		3	0	0	3

Prerequisite: **MAT101**

Objective(s): To analyze the concepts of integrals, analytic functions and differential equations

Course Outcome(s)

Upon complertion of the course, the students would be able to

CO1 Explain the concept of double integral and triple integral.

CO2 Explain the concept of Gradient, divergence and curl.

CO3 Explain the concept of line, volume and surface integrals.

CO4 Evaluate certain real integrals using residue theorem.

CO5 Apply differential equations for Physical problems.

Mapping of COs and POs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H			H								
CO2				H								
CO3	M			H								
CO4		M		H								
CO5				H								

UNIT I - MULTIPLE INTEGRALS

Review of Riemann integrals - Double integration , Cartesian and polar coordinates , change of order of integration , change of variable between Cartesian and polar , Area as double integral , Triple integration in Cartesian, cylindrical and spherical polar coordinates , volume as triple integral

UNIT II - MULTIPLE INTEGRALS

Review of Riemann integrals - Double integration , Cartesian and polar coordinates , change of order of integration , change of variable between Cartesian and polar , Area as double integral , Triple integration in Cartesian, cylindrical and spherical polar coordinates , volume as triple integral

UNIT III - ANALYTIC FUNCTION AND CONFORMAL MAPPING

Function of a complex variable , Analytic function , Necessary conditions , Cauchy , Riemann equations , Sufficient conditions (excluding proof) , Properties of analytic function , Harmonic conjugate , Construction of Analytic functions - Conformal mapping - w = z+a, az, 1/z, e^z , sin z, cos z and bilinear transformation , fixed points , cross ratio

UNIT IV - COMPLEX INTEGRATION

Statement and application of Cauchy•s integral theorem and integral formula , Taylor and Laurent expansions , Isolated singularities , Residues - Cauchy•s residue theorem - Contour integration over unit circle and semicircular contours (excluding poles on boundaries)-evaluation of real integrals using contour integration

UNIT V - APPLICATIONS OF ORDINARY DIFFERENTIAL EQUATIONS

Solutions of ODE related to Electric Circuit, bending of beams, motion of a particle in a resisting medium and simple harmonic motion.

TEXT BOOKS

1. Kreyszig, E, Advanced Engineering Mathematics, John Wiley and Sons (Asia) Limited, Singapore, 8th Edition, 2001
2. Arumugam, S., Thangapandi Isaac, A., Somasundaram, A., Engineering Mathematics Volume II, Scitech Publications (India) Pvt.

Ltd., Chennai, 1st Edition., Reprint 2000, 1999

REFERENCES

1. Grewal , B.S., Grewal, J.S., Higher Engineering Mathematics, Khanna Publishers, New Delhi, 37th Edition., 5th Reprint 2004, 2003
2. Venkataraman, M. K., Engineering Mathematics First Year, The National Publishing Company, Chennai, 2nd Edition., Reprint 2001, 2000
3. Venkataraman, M. K., Engineering Mathematics III A, The National Publishing Company, Chennai, 11th Edition., Reprint 2002

PHY 132	PHYSICS II (Common to all Branches)	L	T	P	C
		3	0	0	3

Prerequisite: Basic Knowledge about structure of solids and its types

Objective(s): To gain vast details about the different types of materials and their properties

Course Outcome(s):

Upon completion of the course, the students would be able to

CO1 Understand the free electron theories, formation of energy bands, energy distribution and also the electron behavior in solids

CO2 Understand the free electron theories, formation of energy bands, energy distribution and also the electron behavior in solids

CO3 Understand the free electron theories, formation of energy bands, energy distribution and also the electron behavior in solids

CO4 Learn how to prepare some new materials like metallic glasses, nano-materials, shape memory alloys, nonlinear materials to improve the technology.

CO5 Understand the free electron theories, formation of energy bands, energy distribution and also the electron behavior in solids

Mapping of COs and POs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H		M									
CO2			H					M				
CO3	M		M							M		

CO4			M									
CO5			M									

UNIT I - CONDUCTING AND SUPERCONDUCTING MATERIALS

Classical free electron theory of metals – drawbacks - Quantum free electron theory of metals and its importance (Qualitative) - Fermi distribution function – Density of energy states and carrier concentration in metals – Fermi energy – Band theory of solids – classification of solids Superconductor - definition– Meissner effect– type I &II super conductors– BCS theory (qualitative) – high temperature superconductors – Josephson effect – quantum interference (qualitative)– SQUID – applications.

UNIT II - SEMICONDUCTING MATERIALS

Intrinsic semiconductors - carrier concentration (derivation) – Fermi energy – Variation of Fermi energy level with temperature - Mobility and electrical conductivity – Band gap determination - Extrinsic semiconductors - carrier concentration in n-type (derivation) - Variation of Fermi level with temperature and impurity concentration – Variation of Electrical conductivity with temperature – Hall effect – Experiment and applications of Hall effect

UNIT III - MAGNETIC AND DIELECTRIC MATERIALS

Origin of magnetic moment–Bohr magneton–comparison of Dia, Para and Ferromagnetism– Domain theory – Hysteresis – soft and hard magnetic materials – anti ferro magnetic materials – Ferrites and its applications

Electrical susceptibility – dielectric constant – electronic, ionic, orientational and space charge polarization – frequency and temperature dependence of polarisation – internal field – Claussius – Mosottirelation (derivation) – dielectric loss– dielectric breakdown

UNIT IV - ADVANCED MATERIALS

Metallic glasses – Preparation, properties and applications - Shape memory alloys –characteristics, properties and applications of Nitinol – Nanomaterials - introduction and properties– synthesis– chemical vapour

deposition – pulsed laser deposition – Non linear materials – Harmonic generation - Bio-materials – Classification and applications - Liquid Crystals: types –nematic, cholesteric, smectic– modes: dynamic scattering, twisted nematic – display systems

UNIT V - MATERIALS CHARACTERIZATION

Structural Analysis: X-ray diffraction methods - Powder method – Scherrer formula for estimation of Crystallite size. Morphology: Scanning electron microscopy (SEM) - Atomic force microscopy - Instrumentation and result analysis. Thermal Analytical Techniques: Principles, methodology and use of differential thermal analysis and thermo gravimetric analysis

TEXT BOOKS

1. Selvanayagam, S. & Mani, P. Engineering Physics-II, DHANAM Publications, Chennai, 2014.

REFERENCES

1. Raghavan, V., Materials Science And Engineering: A First Course, 5th Ed, Prentice- Hall of India Pvt. Ltd., 2009
2. William F.Smith, Foundations of Materials Science and Engineering, 3rd Edition McGraw-Hill, New York, 2003.
3. Charles Kittel, Introduction to Solid State Physics, 8th Edition, Wiely, 2004
4. Cullity B. D, Stock. S.R., Elements of x-ray diffraction. Prentice Hall, 3rd edition, 2001
5. John C. Vickerman, Ian Gilmore, Surface Analysis: Principle Techniques" John Wiley & Sons, 2nd edition, 2009.
6. Hobarth Willard, Lynne Merritt, John Dean, Instrumental Methods of Analysis, Wadsworth Publishing Company, 7 Sub edition, 1988.
7. Introduction to thermal analysis by M.E. Brown, Springer, 2001.
8. Thin Film Fundamentals, A.Goswami, New Age International Publishers, New Delhi, 2008

CIV101	BASIC CIVIL AND MECHANICAL ENGINEERING	L	T	P	C
		3	1	0	4

Prerequisite: Basic Sciences

Objective(s): To have a brief idea about civil and Mechanical Engineering

Course Outcome(s):

Upon completion of the course, the students would be able to

CO1 To understand the technology behind buildings

CO2 To inculcate knowledge about transportation engineering

CO3 To analyse the ideas about boilers and turbines

CO4 To gain knowledge on working of power plants

CO5 To describe the techniques of production engineering

Mapping of COs and POs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M				M							
CO2	M									M		
CO3	M											
CO4	M											
CO5	M											

CIVIL ENGINEERING

UNIT I - BUILDINGS

Characteristics of good building materials such as stones, bricks, plywood and ceramic tiles, timber, cement, aggregates and concrete - Basic functions of buildings , Major components of buildings , Foundations - Purpose of a foundation , Bearing capacity of soils , types of foundations. Proper methods of construction of Brick masonry , Stone masonry , Hollow Block masonry. Beams , Lintels , Columns , Flooring , Damp proof course , surface finishes , Doors and windows , Roofing.

UNIT II -TRANSPORTATION ENGINEERING

Principles and Classification of surveying, Chain surveying, Compass surveying and leveling - Importance of roads , Classification of Highways , water bound macadam, bituminous and cement concrete roads , . Railways - Importance of railways , Gauges , Components of apermanent way. Bridges - Components of Culverts , Causeways, Slab Bridge, T-beam and slab bridge, Suspension bridge

MECHANICAL ENGINEERING

UNIT III - BOILERS AND TURBINES

Boilers - boiler mountings and accessories , Cochran boiler, Locomotive boiler, Babcock and Wilcox boiler, fire and water tube boilers - Steam turbine - single stage impulse turbine, Parson's reaction turbine, difference between impulse and reaction turbines.

UNIT IV - POWER PLANTS AND INTERNAL COMBUSTION (IC) ENGINE

Classification of power plants , steam, nuclear, diesel and hydro power plants - Alternate sources of energy - solar, wind, tidal, geothermal, ocean thermal energy conversion. , IC engine - components, working of four and two stroke petrol and diesel engines.

UNIT V - PRODUCTION TECHNOLOGY

Metal casting and forming process , patterns, moulding, melting of cast iron, casting , forging , rolling , extrusion , drawing - Metal joining process - welding , arc welding, gas welding, brazing and soldering - Metal machining , lathe, drilling machine, milling machine, shaping machine, planing machine, introduction to Computer Numerical Control machining.

TEXT BOOK

1. Shanmugam, G,, and Palanichamy, M.S., Basic Civil and Mechanical Engineering, Tata McGraw Hill Publishing Co., New Delhi, 1996.

REFERENCES

1. Khanna, K., Justo C E G, Highway Engineering, Khanna Publishers, Roorkee, 2001
2. Arora S.P. and Bindra S.P., Building Construction, Planning Techniques and Method of Construction, Dhanpat Rai and Sons, New Delhi, 1997.
3. Venugopal K., Basic Mechanical Engineering, Anuradha Publications, Kumbakonam, 2000.
4. Shanmugam G., Basic Mechanical Engineering, Tata McGraw Hill Publishing Co.,New Delhi, 2001.

CHY102	ENVIRONMENTAL SCIENCES (Common to all Branches)	L	T	P	C
		2	0	0	2

Prerequisite: Basics in Science

Objective(s): To know more about the environmental sciences and pollution control

Course Outcome(s):

CO1 Know the importance of environmental studies and methods of conservation of natural resources.

CO2 Describe the structure and function of an ecosystem and Identify the values and conservation of bio-diversity.

CO3 Explain the causes, effects and control measures of various types of pollutions.

CO4 Select the appropriate methods for waste management.

CO5 Recall social issues and legal provision.

Mapping of COs and Pos												
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	H											
CO2					M							
CO3				H								
CO4			H									
CO5						H					H	

UNIT I - NATURE OF ENVIRONMENTAL STUDIES AND NATURAL RESOURCES:

Definition, scope, and importance of environmental sciences -Need for public awareness- Natural resources: Forest resources, Water resources, Mineral resources, Energy resources, Land resources - Role of an individual in conservation of natural resources.

UNIT II - ECOSYSTEM AND BIODIVERSITY:

Concept of an ecosystem - Structure and function of an ecosystem - Energy flow in the ecosystem - Food chains, food webs and ecological pyramids - Ecological succession - Biodiversity – Definition, value of biodiversity- Hot spots of biodiversity - Threats to biodiversity - Endangered and endemic species of India - Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity

UNIT III - ENVIRONMENTAL POLLUTION:

Types, sources, consequences and control measures of water pollution, ecological and biochemical aspects of water pollution - Sources, effects and control measures of Air pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution and Nuclear pollution - Climate change, global warming, acid rain, Tropospheric chemistry of zone-ozone layer depletion, nuclear accidents and holocaust- Role of an individual in prevention of pollution.

UNIT IV - MANAGEMENT OF ENVIRONMENTAL POLLUTION:

Causes, effects, treatments methods and control measures of solid waste, municipal waste, hazardous waste and biomedical waste - Waste minimization techniques - Cleaner Technology- Green Chemistry- Principles and its role in

controlling environmental pollution-Disaster management: floods, earthquake, cyclone, landslides and Tsunami.

UNIT V - SOCIAL ISSUES AND THE ENVIRONMENT:

Water conservation, rain water harvesting- Resettlement and rehabilitation of people- Wasteland reclamation - Environmental impact assessment- Precautionary and polluters pay principle- environment protection act – air (prevention and control of pollution) act – water (prevention and control of pollution) act – Issues involved in enforcement of environmental legislation - Population explosion – Family Welfare Programmes - Environment and human health - Human Rights - Women and Child Welfare

TEXT BOOKS:

1. Sawyer C. N, McCarty P. L, and Parkin G. F., Chemistry for Environmental Engineering, McGraw-Hill, Inc., New York, 5th edition, 2002.
2. Dhameja, S. K., Environmental engineering and Management, S. K. Kataria and sons, New Delhi, 1st edition 2010.
3. Gilbert M.Masters, "Introduction to Environmental Engineering and Science", pearson education Pvt., Ltd., Third edition, 2007.
4. Townsend C., Harper J and Michael Begon, "Essentials of Ecology", Blackwell science, 3rd edition , 2008

REFERENCE BOOKS:

1. Miller T.G. Jr., Environmental science, wadsworth Publishing Co. USA, 14th edition 2013.
2. Bharucha erach, "The Biodiversity of India", mapin publishing Pvt. Ltd., Ahmedabad India, 2006
3. Trivedi R.K., "Handbook of Environmental Laws", Rules, Guidelines, Compliances and Standards, Vol. I and II, Enviro media.
4. Cunningham, W.P.Cooper, T.H.Gorhani, "Environmental Encyclopedia", Jaico Publ., House, Mumbai, 2001.
5. Wager K.D., "Environmental Management", W.B. Saunders Co., Philadelphia, USA, 1998.

6. Trivedi R.K. and P.K. Goel, “Introduction to air pollution”, techno-science publications

CSE 102	PROGRAMMING LANGUAGES (Common to all Branches)	L	T	P	C
		3	0	0	3

Prerequisite: Basics in Mathematics, Computing

Objective(s): To understand the concepts of C, Memory Management and UNIX

Course Outcome(s):

CO1 Learn the basics of computer programming concepts using C programming language involving decision structures, and loops

CO2 Understand how to include functions and structure as part of the solution

CO3 Utilize pointers & arrays to efficiently solve problems and understand the dynamics of memory

CO4 Understand the file system and operations on files

CO5 Understand the file system and operations on files

Mapping of COs and Pos

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H											
CO2												
CO3				H								
CO4					M							
CO5									M			

UNIT I - BASIC ELEMENTS OF C & CONTROL STATMENTS

Introduction to C programming , C character set , Identifiers, keywords, data types, constants, variable, declarations, expressions, statements, symbolic constants, Operators and Expressions-Operator precedence and associativity of operators -Input and Output Functions-Library Functions - Header Files - Simple Computational problems. Decision Making: if statement - if-else statement - else-if ladder , Looping statements , While , do-while- Still more looping-For statement, Nested control statements- switch statement , the break statement - : Operator - Continue statement - goto statement , Problems using Control Structures.

UNIT II - USER DEFINED FUNCTION FUNCTIONS & STORAGE CLASSES

Need for User defined functions, a multifunction program- Elements of user defined functions- Definition of Functions- Return values and their Types- Function Calls-Function declaration-Category of functions- Nesting of functions , Recursion- Problems on functions & recursion functions. Storage Classes -Automatic Variables -External Variables , Static and Register Variables.

UNIT III - ARRAYS AND POINTERS

Defining and Processing an Array - Passing Arrays to Functions - Multidimensional Arrays - Arrays and Strings - Enumerated data types- Programs using sorting, searching and merging of arrays. Pointer Fundaments - Pointer Declarations - Passing Pointers to Functions - Arrays and Pointers - Pointers and One-Dimensional Arrays - Pointers and Multidimensional Arrays - Operations on Pointers-Programs using Pointers with Functions.

UNIT IV - DYNAMIC MEMORY MANAGEMENT, STRUCTURES & UNIONS

Dynamic Memory Allocation , Allocating a Block of memory, multiple blocks, releasing used space, altering the size of block. , Defining a Structure - Processing a Structure , User defined Data Types , Nested structure - Structures and Pointers - Passing Structures to Functions - Self Referential Structures- Arrays and & Structures Union.

UNIT V – DATA FILES AND UNIX OS

Opening and Closing a Data File - Creating a Data File , Reading & writing a data file. Processing and Updating of Data Files - Unformatted Data Files - Programs using merging, searching of data file contents. Introduction to

Operating System. Shell fundamentals- shell commands , File commands- Directory commands-Miscellaneous commands

TEXT BOOK

1. Byron S. Gottfried, Programming with C, Second Edition, Tata McGraw Hill, 2006

REFERENCES

1. Brian W. Kerninghan and Dennis M.Richie, *f*The C Programming language,„ Pearson Education, 2005.
2. Johnsonbaugh R.and Kalin M, *f*Applications Programming in ANSI C,„ Third Edition, Pearson Education, 2003.
3. E. Balagurusamy *f* Programming in ANSI C,, fourth edition TMH 2008
4. V.Rajaraman *f*Computer Basics and C Programming,, PHI 2008
5. Stephen Kochan and Patrick Wood, UNIX Shell Programming, Third Edition, Pearson education, 200

BME101	CELL BIOLOGY FOR BIOMEDICAL ENGINEERS	L	T	P	C
		3	0	0	3

Prerequisite: Basic Biology

Objective(s): To understand the basic concepts of cell, microscopes and genetics

Course Outcome(s):

CO1 Distinguish prokaryotic cell from eukaryotic cell and describe the structure and function of different parts of a eukaryotic cell

CO2 Explain the mitosis and meiosis cell division and the consequences

CO3 Explain different types of microscopes and their main uses

CO4 Appreciate the discovery of Mendelian laws

CO5 Explain different types of microscopes and their main uses

Mapping of COs and Pos												
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1			H									
CO2							H	H				
CO3		M					H					
CO4												
CO5											H	

UNIT I - STRUCTURE AND FUNCTION OF CELL ORGANELLES

History of cell - Development of cell theory - General organization of eukaryotic cell - Organization of cell membrane , Cell permeability , Differentiations of the cell membrane -Intercellular communications and Gap junctions , Cytoskeleton and cell motility - Microtubules, microfilaments and intermediate filaments , Endoplasmic reticulum and protein segregation , Golgi complex and cell secretion - Lysosomes, endocytosis, coated vesicles, endosomes and peroxisomes , Mitochondria and Oxidative Phosphorylation , nucleus, ribosomes- nucleolus, chromatin and chromosomes.

UNIT II - CELL CYCLE AND CELL DIVISION

The cell cycle , Regulation - Role of cyclins and Cdks, Cell cycle check points, General description and different stages of mitosis and meiosis , Functional role of mitotic apparatus , Consequences of meiosis and types of meiosis , difference between mitosis and meiosis.

UNIT III - TYPES OF MICROSCOPES AND APPLICATIONS

Microscopy , Simple and Compound Microscope, Different types of light microscope and their applications, Confocal microscope, Electron microscopes- Transmission Electron Microscope and Scanning Electron Microscope, - Sample preparation for light microscopy and electron microscopy.

UNIT IV - HUMAN GENETICS

The human chromosome, Mendelian Laws, chromosome abnormalities - Genotype and allelic frequencies-Inborn-errors of metabolism - polygenic and multifactorial inheritance , Sex determination - Role of Y chromosome - Mutation - Gene mutation.

UNIT V - CELL AND TISSUE CULTURE

Introduction, primary and established cell lines, Kinetics of cell growth, Interaction among cells, genetics of cultured cells, Metabolism, Animal cell and tissue culture, Animal tissue culture media, biology of Stem cells, apoptosis, cell to cell interaction and communication

TEXT BOOKS

1. De Robertis, E.D.P. and De Robertis, E.M.F., Cell and Molecular Biology, Lippincott Williams & Wilkins, Philadelphia, USA, 8th Edition, 2010.
2. Gerald Karp, Cell and Molecular Biology - Concepts and Experiments, John Wiley & Sons, USA, 7th Edition, 2013.
3. Gardner, E.J., Simmons, M.J. Snustad, D.P. Principles of Genetics Wiley-India Ltd, New Delhi , 8th Edition, 2008.
4. John Kuo, Electron Microscopy: Methods and Protocols, Humana Press, 3rd Edition 2013
5. Strachan, T., and Read A.P. Human Molecular Genetics, Garland Publishing, 3rd Edition, 2004.
6. Gupta.M.L, and Jangir.M.L.,Cell biology – fundamentals and Applications, 2nd edition, 2001

CHY 182	CHEMISTRY LABORATORY	L	T	P	C
		0	0	3	1

Prerequisite: Basics in Science

Objective(s): To Carry out Basic Chemical Processes

Course Outcome(s):

The Students will be able to

CO1 Estimate hardness of water

CO2 Determine alkalinity, dissolved oxygen rate constant

CO3 Utilize flame photometry

CO4 Practically understand spectrophotometry

CO5 Get clear ideas about conductometric titrations

Mapping of COs and POs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M											
CO2		M										
CO3			H									
CO4			H									
CO5			M									

List of Experiments:

1. Estimation of hardness of water sample by EDTA method
2. Determination of alkalinity of given water sample
3. Determination of dissolved oxygen in a water sample
4. Determination of rate constant of a reaction (Ester hydrolysis)
5. Estimation of hydrochloric acid by pH titration
6. Estimation of chloride ion in a given water sample
7. Determination of sodium and potassium by flame photometry
8. Estimation of ferrous ion by potentiometric method
9. Estimation of iron by spectrophotometry using 1,10-phenanthroline
10. Determination of strength of mixture of acids using strong base by conductometric titration
11. Estimation of fluoride ion by spectrophotometry
12. Conductometric titration of strong acid with strong base

CSE102	PROGRAMMING LANGUAGES LABORATORY	L	T	P	C
		0	0	3	1

Prerequisite: Programming Language(CSE102)

Objectives:

This course is designed to provide a comprehensive study and implementation of the C programming language. It stresses the strengths of C, which provide students with the means of writing efficient, maintainable, and portable code. The nature of C language is emphasized in the wide variety of examples and applications. It is used to learn and acquire art of computer programming. It will serve as a basis to know about some popular programming languages and how to choose Programming language for solving a problem.

COURSE OUTCOMES:

CO1: Understand problem analysis, algorithm design, and program implementation

CO2: Write modular, efficient and readable C programs

CO3: Design modular programs with structured programming constructs

CO4: Ability to formulate problems and implement algorithms in C and work in a team to develop projects

Mapping of COs and POs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M											
CO2		M										
CO3			H									
CO4	L	M	H								L	M

LIST OF EXPERIMENTS

APPLICATION PACKAGES

- Word Processing
- Spreadsheet
- Powerpoint
- Database Management

C PROGRAMMING

- Basics
- Operators and Expressions
- I/O formatting
- Control Statements

ARRAYS AND FUNCTIONS

- Arrays
- String Manipulation
- Functions

POINTERS, STRUCTURES AND FILES

- Pointers
- Structures and Unions
- File Handling

UNIX PROGRAMMING

- Basic Unix Commands
- Basic Shell Programming

WEB RESOURCES

- http://computer.howstuffworks.com/c.htm
- http://www.le.ac.uk/cc/tutorials/c/
- http://www.eskimo.com/~scs/cclass/notes/top.html (for notes)
- http://www.cprogramming.com/tutorial.html
- www.programiz.com/c-programming/c-recursion
- https://onlinecourses.nptel.ac.in/iitk_cs_101
- freevideolectures.com / Programming / IIT Kharagpur
- https://www.coursera.org/course/cprogramming
- programming-in-c-january-iap-2010/
- http://www.iu.hio.no/~mark/ctutorial/ctutorial.html

- http://www.cs.cf.ac.uk/dave/c/
- http://www.di-mgt.com.au/cprog.html (c complex code examples)
- http://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-087-practicalprogramming- in-c-january-iap-2010/
- http://www.esscc.uq.edu.au/~ksteube/bshell/

SEMESTER III

MAT 202	MATHEMATICS-III	L	T	P	C
		3	0	0	3

Prerequisite: MAT103, MAT104

Objective(s):

1. To demonstrate how differential equations can be useful in solving many types of problems in particular, to show how to translate problems into the language of differential equations, to find or numerically approximate the solution of the resulting differential equation subject to given conditions, and to interpret the solutions obtained.
2. To study Fourier series and solve boundary values problems.
3. To understand Fourier Transform, the convergence issues, relation to Fourier series.
4. To understand the properties of Fourier Transform, use these to derive Fourier Transforms for related signals.
5. To know the various definitions of the Fourier Transforms, sufficient conditions for its existence how to compute inverse Fourier Transform.
6. To know the various rules (convolution Theorem etc) for the Fourier and z-transform and how to use them.

Course Outcome(s):

Upon completion of the course, the student should be able to:

CO1 Evaluate integrals and solve boundary value problems using Laplace transform.

CO2 Solve standard type of first order partial differential equations and higher order partial differential equations with constant coefficients.

CO3 Apply the concept of Fourier series to find the sum of certain series.

CO4 Solve difference equations using Z-transform.

CO5 Find Fourier, Sine and Cosine transforms of given functions

Mapping of COs and POs												
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	H	M										
CO2	H	M										
CO3	H	M										
CO4	H	M										
CO5	H	M										

UNIT I: PARTIAL DIFFERENTIAL EQUATIONS

Formation of PDE - Solution of standard types of first order PDE - Lagrange's linear equation - Linear PDE of second and higher order with constant coefficients

UNIT II: LAPLACE TRANSFORM

Definition of Laplace transform - Linearity property - condition for existence of Laplace transform - First and second shifting properties - Laplace transform of derivatives and integrals - Unit step functions - Diarc delta-function - Differentiation and integration of transforms - Convolution theorem - Inversion - Periodic functions - Evaluation of integrals by Laplace transform - Solution of boundary value problems

UNIT III: FOURIER SERIES

Dirichlet's conditions - General Fourier series - odd and even functions - Half range sine and cosine series - complex form of Fourier series - Parseval's identity - Harmonic analysis

UNIT IV: Z – TRANSFORM

Z-transform - elementary properties - Inverse Z-transform –Initial and Final value Theorems - Convolution theorem - formation of difference equation - Solution of difference equation using Z-transform.

UNIT V: FOURIER TRANSFORM

Fourier Integral formula - Fourier Transform - Fourier sine and cosine transforms - Linearity, Scaling, frequency shifting and time shifting properties - Self reciprocity of Fourier Transform - Convolution theorem – Parseval's Identity.

TEXT BOOK:

1. Kreyszig, E., Advanced Engineering Mathematics, John Wiley and Sons (Asia) Limited, Singapore, 8th Edition, 2001.
2. Arumugam, S., Thangapandi Isaac, A., Somasundaram, A., Engineering Mathematics Volume II, Scitech Publications (India) Pvt. Ltd., Chennai, 1st Edn., Reprint 2000, 1999

REFERENCE BOOKS

1. Grewal, B.S., Grewal, J.S., Higher Engineering Mathematics, Khanna Publishers, New Delhi, 37th Edition, 5th Reprint 2004, 2003
2. Venkataraman, M. K., Engineering Mathematics –III A, The National Publishing Company, Chennai, 11th Edition., Reprint 2002, 1998

BME201	Medical Physics	L	T	P	C
		3	0	0	3

Prerequisite: PHY101, PHY132

Objective(s):

1. To obtain knowledge of the normal structure and function of the body and its major organ systems with emphasis on content applicable to clinical diagnostic imaging and/or radiation oncology.
2. To understand radiation and radioactivity, its properties, units of measure, dosimetry measurement concepts and methods.

Course Outcome(s):

Upon completion of the course, the student should be able to:

CO1 Interpret the non-ionizing radiation and its application in medical field

CO2 Relate the utilization of ultrasound in medicine

CO3 Illustrate the production of radioactive nucleotides

CO4 Classify the different radiations and its interactions with matter

CO5 Compare the effects of radiation and its units

Mapping of COs and POs												
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	M	M	M	H								L
CO2	M		L		M							M
CO3	M	H	M		M	M	M					M
CO4	M	H		L								L
CO5	M	M	L	L		H	M					H

UNIT I NON IONIZING RADIATION AND ITS MEDICAL APPLICATION

Non-ionizing Electromagnetic Radiation: 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, Thermography– Application

UNIT II SOUND IN MEDICINE

Physics of sound, Normal sound levels –ultrasound fundamentals – Generation of ultrasound

(Ultrasound Transducer) - Interaction of Ultrasound with matter; Cavitations, Reflection, Transmission-Scanning systems – Artefacts- Ultrasound- Doppler-Double Doppler shift-Clinical Applications

UNIT III PRINCIPLES OF RADIOACTIVE NUCLIDES

Radioactive Decay – Spontaneous Emission – Isometric Transition – Gamma ray emission, alpha, beta, Positron decay, electron capture, Sources of Radioisotopes Natural and Artificial radioactivity, Radionuclide used in Medicine and Technology ,Decay series, Production of radionuclide – Cyclotron produced Radionuclide- Reactor produced Radio- nuclide-fission and electron Capture reaction, radionuclide Generator-Technetium generator.

UNIT IV INTERACTION OF RADIATION WITH MATTER

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.

UNIT V BASIC RADIATION QUANTITIES

Introduction -exposure- Inverse square law-KERMA-Kerma and absorbed dose –stopping power - relationship between the dosimetric quantities - Bremsstrahlung radiation, Bragg's curve- concept of LD 50- Stochastic and Non-stochastic effects, Different radiation Unit, Roentgen, gray, Sievert.

TEXT BOOKS:

1. John R Cameran , James G Skofronick "Medical Physics", 2nd edition, John-Wiley & Sons. 2012
2. W.J.Meredith and J.B. Massey "Fundamental Physics of Radiology" 3rd edition, Varghese Publishing house. 2013
3. Paul Davidovits "Physics in biology and Medicine" 4th edition, Academic Press Inc. 2012
4. P.Uma Devi, A.Nagarathnam , B S SatishRao , "Introduction to Radiation Biology" B.I Chur Chill Livingstone pvt Ltd, 2000

REFERENCES:

1. S.Webb " The Physics of Medical Imaging", Taylor and Francis, 1988
2. J.P.Woodcock, Ultrasonic,Medical Physics Handbook series 1, Adam Hilger, Bristol, 2002
3. Hylton B.Meire and Pat Farrant "Basic Ultrasound" John Wiley & Sons, 1995

EIE 207	ELECTRONIC DEVICES AND CIRCUITS	L	T	P	C
		3	1	0	4

Prerequisite: EEE101

Objective(s):

1. To provide an overview of the principles, operation and application of the analog building blocks like diodes, BJT, FET etc for performing various functions.
2. To provide an overview of amplifiers, feedback amplifiers and oscillators.

Course Outcome(s):

Upon completion of the course, the student should be able to:

CO1 Classify the basic electronic devices and Describe the Semiconductor diode characteristics

CO2 Compare and contrast BJT and FET amplifiers

CO3 Discuss the principles of feedback amplifiers and utilization of Oscillators

CO4 Present alternative theories on Power amplifiers

CO5 Demonstrate the Rectifiers and regulators and its uses

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	L	L	L				L				
CO2	M	L						L				
CO3	M	M	H	M				L				
CO4	M	M	H	M				L				
CO5	M	M	H	M				L				

UNIT I - ELECTRON BALLISTICS AND SEMICONDUCTORS

Classification of devices of an electrical circuit - basic devices - resistors-controlled sources, diode – capacitors – inductors - ideal transformers - semiconductor diode characteristics - semiconductor equations - carrier statistics - Poisson's and continuity equations - fermi-dirac statistics and boltzmann approximation to the fermi-drac statistics - semiconductor diodes - barrier formation in metal-semiconductor junctions, PN homo junctions – hetero junctions - some applications of diodes

UNIT II - BJT & FET AMPLIFIERS

Fundamentals of Transistors - biasing circuits for BJT - DC - AC Load linear stability factor analysis - temperature compensation methods - biasing circuits of FET's - MOSFET's - FET - MOSFET amplifiers - analysis & design of CC - CE - CB configurations - RC coupled & transformer coupled

multistage amplifiers - frequency response of amplifiers - analysis & design of CS, CD, CG amplifier, thermal runaway in BJT & FET amplifiers

UNIT III - FEEDBACK AMPLIFIERS AND OSCILLATORS

General feedback structure - properties of negative feedback – four basic feedback topologies - series – shunt, series-series, shunt-shunt, shunt-series feedback amplifier - determination of loop gain - stability problem - effect of feedback on amplifier performance - voltage shunt - voltage series - current series - current shunt feedback configurations - concept of stability - nyquist criterion - basic principles of sinusoidal oscillator - RC oscillators – wein bridge and phases half tuned oscillators – collpit – hartley - clap - crystal oscillators

UNIT IV - POWER AMPLIFIERS

Type of power amplifiers - Class A amplifier with resistive and transformer coupled load - efficiency of Class B - complementary symmetry amplifiers – heat sinks - switching power amplifiers - harmonic distortion – efficiency - relative performance - cascade amplifier

UNIT V – RECTIFIERS & POWER SUPPLIES

Half-wave - full-wave - bridge rectifiers with resistive load -.analysis for V_{dc} & ripple voltage with filters - voltage multipliers – Zener diode regulator - Electronically regulated D.C power supplies - Line regulation - output resistance - temperature coefficient

TEXT BOOKS

1. Jacob Millman and Christos C. Halkias, Electronic Devices and Circuits, Tata McGraw–Hill, 3rd edition, 2010.
2. David A. Bell., Electronic Devices and Circuits, Prentice Hall of India, 5th Edition, 2008
3. Simon M. Sze, Semiconductor Devices & Technology, John Wiley & Sons (Asia) Pvt. Ltd Wiley publishers., 3rd edition, 2012

REFERENCES

1. Donald A .Neaman, Semiconductor Physics and Devices, Tata McGraw-Hill, 3rd edition, 2002
2. Salivahanan. S., et al., Electronic Devices and Circuits, Tata McGraw Hill , 1st edition, Reprint 2001
3. A.P. Malvino, Electronic Principles, Tata McGraw Hill, 3rd edition, Tata McGraw Hill, New york., 5th edition., 1998

EEE203	ELECTRIC CIRCUIT ANALYSIS *	L	T	P	C
		3	0	1	4

Prerequisite: EEE101

Objective(s): To study, understand and analyze the basics of electric circuits and networks

Course Outcome(s):

Upon completion of the course, the student should be able to:

CO1 Describe the various types of Sources and Network and Apply Mesh, Nodal analysis to solve DC circuits.

CO2 Analyze the AC and DC circuits using various network theorems.

CO3 Analyze Coupled circuits with help of Inductance and can be able to develop the phasor concepts in three phase circuits

CO4 Examine the transient response of RL, RC and RLC circuits.

CO5 Construct two port networks and can evaluate its concepts.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	M	H									
CO2	H	H	H	H								M
CO3	H	H	H	H								M
CO4	H	H	H	M								M
CO5	H	H	H	H								

UNIT – I INTRODUCTION TO ELECTRIC CIRCUITS

Laws of Electric circuits – ohms, Kirchoff – dual network – matrix representations and solution of AC and DC networks, analysis of AC and DC circuits – mesh, nodal – concept of impedance and admittance – resonance – series, parallel – bandwidth and Q-Factor

UNIT – II NETWORK THEOREMS AND TRANSFORMATIONS

Transformations – voltage and current source – star, delta transformations – theorems – superposition, reciprocity, substitution, maximum power transfer, Thevenin's, Norton's, Tellegan's and Millman's theorems, **Multisim based Network Theorems Verification.**

UNIT – III COUPLED AND THREE PHASE CIRCUITS

Coupled circuits – co–efficient of coupling – self and mutual inductances – analysis of coupled circuits – three phase circuits – balanced circuits – star and delta connected loads – phase sequence – unbalanced circuits – solution of unbalanced star and delta connected loads – power measurement by two wattmeter method, **Multisim based analysis of coupled circuits.**

UNIT – IV TRANSIENT ANALYSIS

Source free response – RL, RC & RLC circuits – forced response – RL, RC & RLC circuits – time constant, natural frequency of oscillation of circuits – Laplace transform application – RL, RC & RLC circuits – concept of complex frequency, **Multisim based RLC circuits with DC and sinusoidal excitation**

UNIT – V TWO PORT NETWORKS

Driving point and transfer impedance/admittance – voltage and current ratios of two port networks – admittance, impedance, hybrid, transmission and image parameters for two port networks – impedance matching – equivalent π and T Networks **Multisim based analysis of two port networks**

TEXT BOOK

1. Sudhakar, A., Shyam Mohan ,S.P., Circuits and Network Analysis and Synthesis, 4th Edition, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 2010

REFERENCES

1. Dorf R.C., Introduction to Electric Circuits, John Wiley & Sons Inc, New York, Second Edition, 2003.
2. Charles K.Alexander, Mathew N.O. Sadiku., Fundamentals of Electric Circuit, TataMcGraw Hill, N.Y, 2003.
3. Edminister, J.A., Theory and Problems of Electric Circuits, Schaum's outline series TataMcGraw Hill Book Company, 2nd Edition, 1983.

BME202	HUMAN ANATOMY AND PHYSIOLOGY	L	T	P	C
		3	0	0	3

Prerequisite: BME101, Basics in Biology

Objective(s):

1. Know basic structural and functional elements of human body.
2. Learn organs and structures involving in system formation and functions.
3. Understand all systems in the human body.

Course Outcome(s):

At the end of this course, students will be able

CO1 Describe basic building blocks of human body and can identify the anatomical position of each organs.

CO2 Explain different types and properties of muscular and skeletal system

CO3 Categorize the organs and its functions associated with circulation of blood

CO4 Demonstrate the passage of neural signals within the human body

CO5 Compare the physiology of the special senses and can describe the mechanism involved in Urinary system

Mapping of COs and POs												
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	M										

CO2	M	M										
CO3	M	M										
CO4	M	M										
CO5	M	M										

UNIT I - CELL, TISSUE AND ORGANS:

Overview of Cell membrane and organelles, Membrane potential, Nernst equation, GHK equation, Action Potential, Generation and Conduction. Introduction to human body, Anatomical position: terminology, regions and planes.

Blood Cells - RBC,WBC, Platelets, Blood Transfusion, Immune system

UNIT II - MUSCULAR AND SKELETAL SYSTEM:

Muscular System:Type of muscles, properties of muscles (excitability and contractility, all or none law, refractory period, fatigue and elasticity)

Skeletal System & Joints: Types of bones, classification, Structure and composition of bone, cartilage, tendon, ligament, Classification of joints, structure of synovial joint, major joints of the body

UNIT III - CARDIAC AND RESPIRATORY SYSTEM:

Circulatory System: Structure and function of heart, blood vessels, Heart valves and sounds, Cardiac cycle, Cardiac output, Coronary, systematic and pulmonary circulation, Blood Pressure and feedback control

Respiratory system: Respiratory pathways (upper and lower), Mechanism of respiration, respiratory membrane and gaseous exchange, Pulmonary function test, feedback control mechanism of respiration.

UNIT IV - NERVOUS SYSTEM

Structure of a Neuron – Types of Neuron. Synapses and types. Conduction of action potential in neuron.

Brain – Divisions of brain lobes - Cortical localizations and functions - EEG.

Spinal cord – Tracts of spinal cord - Reflex mechanism – Types of reflex.

Autonomic nervous system and its functions.
Endocrine Glands

UNIT V URINARY AND SPECIAL SENSORY SYSTEM

Urinary system: Structure of Kidney and Nephron. Mechanism of Urine formation and acid base regulation – Urinary reflex – Skin and sweat glands - Homeostasis

Special senses: Optics of Eye – Retina - Photochemistry of Vision – Accommodation Neurophysiology of Vision – EOG. Structure and functions Internal Ear - Mechanism of Hearing – Auditory pathway, Hearing Tests.

TEXT BOOK:

1. Ross and Wilson,"Anatomy and Physiology in Health and Illness", ELBS pub, 2010.
2. Guyton and Hall,"Textbook of Medical Physiology, 12th ed.", Saunders, 2011.
3. Tortora and Grabowski,"Principles of Anatomy and Physiology", Wiley, 2011.

REFERENCES:

1. Gillian Pocock, Christopher D. Richards, The human Body – An introduction for Biomedical and Health Sciences, Oxford University Press, USA, 2009
2. William F.Ganong, "Review of Medical Physiology", 22nd Edition, Mc Graw Hill, New Delhi, 2005
3. Eldra Pearl Solomon, "Introduction to Human Anatomy and Physiology", W.B. Saunders Company, Harcourt Brace Jovanovich, 2003.

BME208	CLINICAL BIOCHEMISTRY	L	T	P	C
		3	0	0	3

Prerequisite: BME101, Basics in Biology

Objective(s): Familiarized with the Classification, structure and properties of carbohydrates, Lipids, Protein and Enzyme.

Course Outcome(s):

The Student will be able to

CO1 Describe the role of biomolecules and their applications

CO2 Calculate the pH of required buffers

CO3 Classify vitamins and their deficiency symptoms

CO4 Compare the structures of amino acids and lipids

CO5 Explain the role of hydrogen bonds in DNA structure

	POs											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	M				M						
CO2	M	M				M						
CO3	M	M				M						
CO4	M	M				M						
CO5	M	M				M						

UNIT I BASIC PRINCIPLES AND CHEMISTRY OF LIFE

Solution of non electrolytes & Electrolytes: Concentration expressions, ideal solutions, colligative properties. Arrhenius theory, strong electrolytes - Ionic equilibrium, Electromotive force. Bonds: ionic bonding, Ion-dipole. Covalent, H-bonds, Vander Waals interaction, Hydrophobic and hydrophilic interactions. Water as a biological solvent and its role in biological processes; Calculation of pH, Henderson-Hasselbalch equation, concept of buffer, strength of buffer, range of buffer, important biological buffers; isotopes and

their use in biology.

UNIT II CARBOHYDRATES AND VITAMINS

Classification, structure and reactions of monosaccharides, and disaccharides, Polysaccharides , structural polysaccharides and storage polysaccharides; Homopolysaccharide and Hetero-polysaccharides; vitamins , Fat soluble and water soluble vitamins; Classification, structures and physiological functions

UNIT III AMINOACIDS AND PROTEINS

Structure and characteristics of amino acids - Peptide bond stability and formation-Structural organization of proteins - primary, secondary, tertiary, quaternary and subunit structure of protein - Conformation of proteins globular and fibrous proteins

UNIT IV LIPIDS

Structure, and properties classification of lipids, fatty acids, waxes, phospholipids, cerebrosides, lipoproteins and gangliosides- Prostaglandins - prostacyclins, leukotrienes, thromboxanes and physiological implications- Steroids and bile acids.

UNIT V NUCLEIC ACIDS

Structure of purines, pyrimidine, nucleosides and nucleotides - stability and formation of phosphodiester bond - Watson and Crick model of DNA; calculation of Tm for oligonuclotides; Types of RNA- Structure of tRNA

TEXT BOOKS

1. Nelson.D.L, Cox. M. M., Lehninger•s Principle of biochemistry. 5th ed. Freeman, 2008.
2. Murray. R.K., Granner, D.K., Mayes. P. A. and Rodwell, V.W., Harpers Biochemistry, McGraw Hill, 27th Edition, 2006.

REFERENCES

1. Berg. J.M., Tymoczko.J.L., Stryer, L., Biochemistry, Freeman, 6th edition, 2006.
2. Zubay , Biochemistry, William C. Brown Publication, 4th Edition, 1998.
3. Voet, D., Voet, G., Biochemistry, John Wiley and Sons, Singapore, 3rdEdition, 2001.

BME281	ELECTRONIC DEVICES AND CIRCUITS LABORATORY**	L	T	P	C
		0	0	3	2

Prerequisite : EEE101, EIE207

Objective(s): The aim of this course is to familiarize the student with the principle of operation, capabilities and limitation of various electron devices, and circuits which will be useful to design any electronic circuits.

Course Outcome(s):

Upon completion of the course, students will be able to

CO1 Acquire the knowledge on the characteristics of all diodes and transistors

CO2 Design and Analyze the characteristics of diodes, amplifiers and oscillators

CO3 Interpret the characteristics through experimental observation

CO4 Implement the experiment skills further to solve the Engineering problems

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	M	M	L		L	M	M	H	M	M	M
CO2	M	M	M	H		L	M	L	H	M	M	L
CO3	L	M	L	L		L	L	L	H	M	M	L
CO4	M	M	M	M		L	L	L	H	M	M	L

LIST OF EXPERIMENTS

1. Characteristics of PN Junction Diode & Zener diode
2. Transistor Biasing with and without stabilization
3. Input and Output characteristics of Transistor and H parameter evaluation
4. Transistor as an Amplifier
5. FET characteristics and Evaluation of its parameters
6. MOSFET characteristics
7. UJT characteristics
8. IGPT characteristics
9. FET biasing methods
10. BJT and FET as a switch
11. Class B Complementary symmetry power amplifier
12. Half and full wave rectifiers
13. Differential amplifier using BJT
14. Two stage RC coupled amplifier – Frequency response
15. Phase shift oscillator using BJT/FET

Mini Project has to be done by students based on the laboratory techniques studied. Assessment will be done based on the Project report and functioning of the design.

BME282	BIOCHEMISTRY AND HUMAN PHYSIOLOGY LABORATORY	L	T	P	C
		0	0	3	2

Prerequisite: Basic Biology

Objective(s): To provide practice on:

- Estimation and quantification of biomolecules.
- Separation of macromolecules

Course Outcome(s):

Upon completion of the course, students will be able to

CO1 Acquire the knowledge on the properties of all macronutrients

CO2 Estimation and separation of macronutrients by various techniques

CO3 Inferring the result through experimental observation

	POs											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	M											
CO2		H		H	M	H						M
CO3				H	M	H						M

LIST OF EXPERIMENTS:

1. General tests for carbohydrates, proteins and lipids.
2. Preparation of serum and plasma from blood.
3. Estimation of blood glucose.
4. Estimation of creatinine
5. Estimation of urea
6. Estimation of cholesterol
7. Assay of SGOT/SGPT
8. Separation of proteins by SDS electrophoresis
9. Separation of amino acids by thin layer chromatography
10. Separation of DNA by agarose gel electrophoresis
11. ESR, PCV, MCH, MCV, MCHC, total count of RBCs and hemoglobin estimation
12. Differential count of different WBCs and Blood group identification
13. Ishihara chart for color blindness and Snellen's chart for myopia and hyperopia by letters reading and ophthalmoscope to view retina
14. Weber's and Rinnee's test for auditory conduction

SEMESTER IV

MAT215	Mathematics-IV	L	T	P	C
		3	0	0	3

Prerequisite: MAT101

Objective(s):

1. To provide the students with a fundamental understanding of probabilistic methods in engineering.
2. To acquire skills in handling situations involving one or more random variables,
3. To introduce the notion of sampling distributions and make students to acquire knowledge of statistical techniques useful in various engineering applications
4. To familiarize the students with statistical methods designed to contribute to the process of making scientific judgments in the face of uncertainty and variation.

Course Outcome(s):

At the end of this course, students will be able

CO1 Understand addition theorem, the multiplication theorem and other important theorems on probability and their use in solving problems in various diversified situations.

CO2 Demonstrate the concept of joint, marginal and conditional probability distribution involving two random variables

CO3 Explain and illustrate the concept of a random variable and its probability distributions.

CO4 Evaluate the statistical properties of random variables and can handle probabilistic transformations.

CO5 Understand and apply concepts of Numerical methods in various fields of engineering.

Mapping of COs and POs												
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	H	H	H									
CO2	H	H	H									
CO3	M	M	M									
CO4	M	M	M									
CO5	L	L	L									

UNIT I - PROBABILITY & RANDOM VARIABLES

Classical, relative frequency and axiomatic definitions of probability, addition rule and conditional probability, multiplication rule, total probability, Baye's Theorem, and independence. Discrete, continuous and mixed random variables, probability mass, probability density and cumulative distribution functions, mathematical expectation, moments, moment generating function.

UNIT II - STANDARD DISTRIBUTIONS

Binomial, Geometric, Poisson, Exponential, Gamma, Normal distributions, Function of Random Variables. Joint, marginal and conditional distributions, correlation, regression lines.

UNIT III - RANDOM PROCESSES

Classification, Stationary and Markov processes, Binomial process, Poisson process, Sine–wave process, Ergodic processes.

UNIT IV - CORRELATION FUNCTION AND SPECTRAL DENSITY

Auto correlation for discrete and continuous processes, Cross correlation functions, Correlation integrals. Applications, Linear systems with random inputs. Power spectral density, Cross spectral density, Applications to linear systems with random inputs.

UNIT V - NUMERICAL METHODS

Newton's forward and backward difference formulae – Lagranges interpolation formulae – Divided differences. Initial value problems for ordinary differential equations: Fourth order Runge–Kutta method. Milne's predictor corrector method.

TEXT BOOK:

1. Kapur, J.N. and Saxena, H. C., Mathematical Statistics, S. Chand & Company Ltd., New Delhi, 2013.

REFERENCE BOOKS:

1. Veerarajan, T. Probability, Statistics and Random Processes, Tata McGraw Hill Publishing company, New Delhi, 2004.
2. Flynn, M., Probability, Random Variables and Random Process, Harper and Row Publishers, New York, 1990.
3. Peebles, Jr., Probability, Random Variables and Random Signal Principles, McGraw Hill Publishers, 2000.
4. Arumugam, S. et al., Numerical Methods, SciTech Publications (Ind) Pvt Ltd, Chennai. 2010

WEB RESOURCES:

1) www.mhhe.com/math/advmath/rosen/index.mhtml#aboutau
2) www.cs.stedwards.edu/-phil/Math24/Letures/index.htm

BME203	BIOSENSORS AND TRANSDUCERS	L	T	P	C
		3	0	0	3

Prerequisite: EEE101

Objective(s):

1. Understand the purpose of measurement, the methods of measurements, errors associated with measurements.
2. Know the principle of transduction, classifications and the characteristics of different transducers and study its Biomedical applications.

Course Outcome(s):

Upon completion of the course, the student should be able to:

CO1 Describe the different types of transducers and its purposes.

CO2 Explain the distinction between the biochemical transducers and its interaction with tissue.

CO3 Create new devices based on the principle of optical sensors

CO4 Identify multiple perspectives of Biological sensors

CO5 Describe the functioning of chemical sensors

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	L	L	L									
CO2	M	M	M	M								M
CO3	M	M	H	H								M
CO4	L	L	L	L								M
CO5	L	L	L	L								

UNIT – I SCIENCE OF MEASUREMENT & CHARACTERISTICS OF TRANSDUCERS

Units - standards – calibration methods – static ca libration – classification of errors – error analysis – statistical methods – odds and uncertainty - static characteristics – dynamic characteristics – mathematical model of transducers – zero - first-order - second-order tra nsducers – response to standard inputs

UNIT II TRANSDUCERS PRINCIPLES:

Classification, static and dynamic characteristic of transducers, Temperature transducers: RTD, Thermistor, Thermocouple, Displacement transducers: Potentiometer, resistive strain gauges, capacitive transducer, Pressure transducer: LVDT, semiconductor transducers, catheter tip transducers, Piezoelectric transducer, Photoelectric transducers, Flow transducers: magnetic, resistive and ultrasonic

UNIT – III BIOCHEMICAL TRANSDUCERS:

Electrode theory, electrode impedance, metal-electrolyte interface and electrode-tissue interface, Electrodes: hydrogen electrodes, Ag/AgCl electrodes, Calomel electrodes, specific ion electrodes, pH electrode, O2 and CO2 electrode.

UNIT – IV BIOLOGICAL SENSORS:

Receptors in the human body, Ion exchange membrane electrodes, enzymatic biosensors, Basic principles of MOSFET biosensors & BIOMEMS, basic idea about Smart sensors. Biomedical Measurements: Body temperature measurement, endoscopes and biopsy, Catheters, blood flow measurement, biomedical sensor for ionizing radiations, medial ultrasonic transducers, infrared radiation measurement, flow sensor for respiration measurements, sensors for blood pH and gases.

UNIT – V CHEMICAL BIOSENSORS

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

TEXT BOOKS:

1. A.K.Sawhney, "Electrical & Electronics Measurement and Instrumentation",10th edition, Dhanpat Rai & Co, New Delhi, 2010.
2. Khandpur R.S, "Handbook of Biomedical Instrumentation", 3rd edition Tata McGraw-Hill, New Delhi, 2014.

REFERENCES:

1. Ernest O Doebelin and Dhanesh N Manik, Measurement systems, Application and design, 5th edition, Mc Graw-Hill, 2007.
2. Leslie Cromwell, "Biomedical Instrumentation and measurement", Prentice hall of India, New Delhi, 2007.

3. John G. Webster, “Medical Instrumentation Application and Design”, John Wiley and sons, New York, 2004.
4. L.A Geddas and L.E.Baker, “Principles of Applied Biomedical Instrumentation”, John Wiley and Sons, Third Edition, Reprint 2008.
5. Albert D.Helfrick and William D. Cooper. Modern Electronic Instrumentation and Measurement Techniques”, Prentice Hall of India, 2007.

BME204	INTEGRATED CIRCUITS	L	T	P	C
		3	1	0	4

Prerequisite: EEE203

Objective(s): To understand, analyze and design new circuit based medical devices utilizing both analog and digital integrated circuits.

Course Outcome(s):

CO1 Demonstrate and analyze the number systems that can be used to model new devices

CO2 Design sequential logic circuits using state table and state diagram

CO3 Discuss and apply the concepts of op-amps to device new circuits

CO4 Analyze the ICs that can be used as Signal generators

CO5 Apply ICs for various applications

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	M	H									
CO2	H	H	H	H								M
CO3	H	H	H	H								M
CO4	H	H	H	M								M
CO5	H	H	H	H								

UNIT I NUMBER SYSTEMS AND LOGIC GATES

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

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

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

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

555 Timer (internal diagram) and its applications – monostable 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

TEXT BOOKS:

1. M. Morris Mano , "Digital Logic and Computer design " Prentice Hall 2004.
2. Ramakant A. Gayakwad , "Op-AMP and Linear ICs", 4th Edition, Prentice Hall, 2000

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.
4. Charles H. Roth, Jr, "Fundamentals of Logic Design", Fourth Edition, Jaico Books, 2002

BME205	BIOMECHANICS	L	T	P	C
		3	0	0	3

Prerequisite : BME202

Objective(s):

1. Be exposed to principles of mechanics of physiological systems.
2. Be familiar with the mathematical models used in the analysis of biomechanical systems

Course Outcome(s):

At the end of this course, students will be able

CO1 To describe movement (kinematics) and to consider the role of force in movement (kinetics)

CO2 Analyze the mechanical principles of biofluids

CO3 Illustrate the techniques behind Biosolid mechanics

CO4 Design devices to meet the orthopaedic applications.

CO5 Model new devices to meet many applications considering ergonomics

CO	POs											
	1	2	3	4	5	6	7	8	9	10	11	12
CO1	M	L	H	H		M	M	L				M
CO2	M	M	H	M	M	H	L				L	M
CO3	L	L	M		M		M					
CO4	M	H	H		M	H	L					L
CO5	M	M	H		H	H						M

UNIT I INTRODUCTION TO MECHANICS

Principles of Mechanics, Vector mechanics, Mechanics of motion - Newton's laws of motion, Kinetics, Kinematics of motion, Fluid mechanics – Euler equations and Navier Stoke's equations, Viscoelasticity, Constitutive equations, Stress transformations, Strain energy function.

UNIT II BIOFLUID MECHANICS

Introduction, viscosity and capillary viscometer, Rheological properties of blood, laminar flow, Couette flow and Hagen-poiseuille equation, turbulent flow. Cardiovascular system - biological and mechanical valves development, artificial heart valves testing of valves, Structure, functions, material properties and modeling of Blood vessels.

UNIT III BIOSOLID MECHANICS

Hard Tissues: Bone structure & composition mechanical properties of bone, cortical and cancellous bones, viscoelastic properties, Maxwell & Voight models – anisotropy. Soft Tissues: Structure, functions, material properties and modeling of Soft Tissues: Cartilage, Tendon, Ligament, Muscle.

UNIT IV BIOMECHANICS OF JOINTS AND IMPLANTS

Skeletal joints, forces and stresses in human joints, Analysis of rigid bodies in equilibrium, free body diagrams, types of joint, biomechanical analysis of elbow, shoulder, spinal column, hip knee and ankle. Design of orthopedic implant, specifications for a prosthetic joint, biocompatibility, requirement of a biomaterial, characteristics of different types of biomaterials, manufacturing process of implants, fixation of implants.

UNIT V MODELLING AND ERGONOMICS

Introduction to Finite Element Analysis, Analysis of bio mechanical systems using Finite element methods, Graphical design. Ergonomics- Gait analysis, Design of work station, Sports biomechanics, Injury mechanics.

TEXT BOOKS:

1. Y.C. Fung, "Bio-Mechanics- Mechanical Properties of Tissues", Springer-Verlag, 1998.
2. Duane Knudson, "Fundamentals of Biomechanics", Second Edition Springer Science+Business Media, 2007
3. Marcelo Epstein, "The Elements of Continuum Biomechanics", ISBN: 978-1-119-99923-2, 2012.

REFERENCES:

1. . Jay D. Humphrey, Sherry De Lange, "An Introduction to Biomechanics: Solids and Fluids, Analysis and Design" , Springer Science+Business Media, 2004.
3. Shrawan Kumar, "Biomechanics in Ergonomics", Second Edition, CRC Press 2007.

TEXT BOOKS

1. Buddy D.Ratner and Allan S.Hoffman Biomaterials Science "An Introduction to Material in Medicine" Third Edition, 2013.

2. Jonathan Black, Biological Performance of materials, Fundamentals of Biocompatibility, Marcel Dekker Inc., 4th edition New York, 2005

3.Joon Park, R S Lakes, Biomaterials: An Introduction, Springer science and Business Media, 2007

4. Sujatha.V..Bhat, Biomaterials,II Edition Alpha Science 2005

REFERENCES

1. D. F. Williams (editor), Material Science and Technology - A comprehensive treatment, Vol. 14, Medical and Dental Materials, VCH Publishers Inc., New York, 1992.

3 Amit Bandhyopadhya, Susmita Bose, Characterization of Biomaterials, Newnes, 2013

BME206	**BIOMATERIALS AND ARTIFICIAL ORGANS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
Pre-requisite: BME202BME101		**Course Category: Core**			
		Course Type: Theory			

Objective(s): To understand and analyze the different types of Biomaterials and design new materials and organs to meet the medical needs

Course Outcome(s):

Upon completion of this course, the students will be able to

CO1 Experiment with the classes of materials that can be used for medical applications

CO2 Illustrate the response of human body towards the application of biomaterial and the characterization methodologies for biomaterials

CO3 Apply the Biomaterials as drug delivery systems and in ophthalmology

CO4 Perform combination of materials that could be used as a tissue replacement implants to meet desired needs within the realistic constraints.

CO5 Understand and design artificial organs

CO	**POs**											
	1	2	3	4	5	6	7	8	9	10	11	12
CO1						H	M	M				
CO2							M					
CO3			M			M	L	L				
CO4			M		L	H	H	H				
CO5			H		M	H	M	M				

UNIT I CLASSES OF MATERIALS USED IN MEDICINE (9 HOURS)

Classification of Biomaterials: Metals and alloys; stainless steel, cobalt based alloys, titanium based materials – ceramics – bioinert ceramics – carbon, alumina, zircona and titania – bioactive ceramics – bioactive glass and glass ceramics, calcium phosphate ceramics – polymers – PMMA bone cement, articulating component – UHMWPE – composites, matrix and filter components, Surface properties and Bulk mechanical properties.

UNIT II BIOLOGICAL PERFORMANCE OF MATERIALS (9 HOURS)

Biocompatibility-Tissue Compatibility – material response:– deformation and failure – friction and wear – Host response – Inflammatory process – capsule formation – coagulation and hemolysis – approach to thromboresistant material development –carcinogenesis. Biocompatibility testing:-in vitro and in vivo studies of biocompatibility.

UNIT III OPHTHALMOLOGIC APPLICATIONS AND DRUG DELIVERY SYSTEMS (9 HOURS)

Materials for ophthalmology – contact lens and intraocular lens materials – Corneal Implants-Implants for Glaucoma-Implants for Retinal Detachment surgery- drug delivery systems:-Diffusion Controlled-Water penetration controlled –Chemically Controlled-Regulated Systems

UNIT IV TISSUE REPLACEMENT IMPLANTS (9 HOURS)

Small intestinal submucosa and other decellularized matrix biomaterials for tissue repair. Soft tissue replacements, sutures, surgical tapes, adhesive, Percutaneous and skin implants, maxillofacial augmentation, Vascular grafts, hard tissue replacement Implants, joint replacements, Dental Implants, Pancreas replacement.

UNIT V ARTIFICIAL ORGANS (9 HOURS)

Artificial blood, artificial skin, Artificial Heart, Prosthetic Cardiac Valves, Artificial lung (oxygenator), Artificial Kidney (Dialyzer membrane)

TEXT BOOKS

1. Buddy D.Ratner and Allan S.Hoffman Biomaterials Science "An Introduction to Material in Medicine" Third Edition, 2013.

2. Jonathan Black, Biological Performance of materials, Fundamentals of Biocompatibility, Marcel Dekker Inc., 4th edition New York, 2005

3.Joon Park, R S Lakes, Biomaterials: An Introduction, Springer science and Business Media, 2007

4. Sujatha.V..Bhat, Biomaterials,II Edition Alpha Science 2005

REFERENCES

1. Amit Bandhyopadhya, Susmita Bose, Characterization of Biomaterials, Newnes, 2013

BME207	PATHOLOGY AND MICROBIOLOGY	L	T	P	C
		3	0	0	3

Prerequisite: BME101, BME202

Objective(s):

1. Attain knowledge on the structural and functional aspects of microorganisms that interferes with the health of living organisms.
2. Know the etiology and remedy in treating the pathological diseases.

Course Outcome(s):

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

CO1 Illustrate the different types of Cell degeneration, how and when it gets repaired

CO2 Demonstrate the different pathologic conditions related to the body fluids

CO3 Compare the structure and function of different types of microorganisms.

CO4 Demonstrate the various culture techniques for growing microbes and to visualize them through staining

CO5 Interpret the response of human body when a microbe enters the

human system and the techniques to confirm the presence of microbe.

Mapping of COs and POs												
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	M	M										
CO2	M	M										
CO3	M	M										
CO4					M	H						
CO5					M	H						

UNIT I CELL DEGENERATION, REPAIR AND NEOPLASIA

Cell injury and Necrosis, Apoptosis, Intracellular accumulations, Pathological calcification, cellular adaptations of growth and differentiation, Inflammation and Repair including fracture healing, Neoplasia, Classification, Benign and Malignant tumors, carcinogenesis, spread of tumors. Autopsy and biopsy.

UNIT II FLUID AND HEMODYNAMIC DERRANGEMENTS

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

UNIT III STRUCTURE AND FUNCTION OF MICRO ORGANISMS

Structure of the bacterial cell wall, appendages of bacteria - Pili and flagella, capsule, slime and bacterial endospores, Over view of Viruses, Structure, classification and multiplication of fungi, Life history of yeast and bacteriophages..

UNIT IV MICROBIAL CULTURES

Morphological features and structural organization of bacteria, growth curve, identification of bacteria , culture media and its types , culture techniques and observation of culture. Principle of Light and electron Microscope. Staining techniques: Simple, gram and AFB staining

UNIT V IMMUNOLOGY

Natural and artificial immunity, opsonization, phagocytosis, inflammation, Immune deficiency syndrome, antibodies and its types, antigen and antibody reactions, immunological techniques: immune diffusion, immuno electrophoresis, RIA and ELISA, monoclonal antibodies. Disease caused by bacteria, fungi, protozoal, virus and helminthes.

TEXT BOOKS:

1. Ramzi S Cotran, Vinay Kumar & Stanley L Robbins, "Pathologic Basis of Diseases", 7th edition, WB Saunders Co. 2005 (Units I & II).
2. Prescott, Harley and Klein, "Microbiology", 7th edition, McGraw Hill, 2007 (Units III, IV and V)

REFERENCES:

1. Underwood JCE: General and Systematic Pathology Churchill Livingstone, 3rd edition, 2000.
2. Ananthanarayanan & Panicker, "Microbiology" Orientblackswan, 2005.
3. Dubey RC and Maheswari DK. "A Text Book of Microbiology" Chand & Company Ltd, 2007

BME283	INTEGRATED CIRCUITS LABORATORY**	L	T	P	C
		0	0	3	2

Prerequisite: BME281, BME204, EEE203

Objective(s): To design new medical devices based on analog and digital ICs

Course Outcome(s):

CO1 Acquire the knowledge on the ICs utilized for different circuits

CO2 Design and Analyze the circuits based on truth table or the required frequency

CO3 Interpret the characteristics through experimental observation

CO4 Implement the experiment skills further to solve the Engineering problems

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	L	M	M	L		L	M	M	H	M	M	M
CO2	M	M	M	H		L	M	L	H	M	M	L
CO3	L	M	L	L		L	L	L	H	M	M	L
CO4	M	M	M	M		L	L	L	H	M	M	L

LIST OF EXPERIMENTS

1. Realization of Logic gates. (AND, OR, NOT, NAND, NOR, XOR, EXNOR)
2. Adder and Subtractors
3. Code converters. (BCD to 7 segments, BCD to Excess-3, Gray to binary, Binary to Gray)
4. Combinational logic design using Encoders and Decoders.
5. Combinational logic design using Multiplexers and Demultiplexer.

6. Realization of RS, JK, T, D Flip flops circuits
7. Measurement of Op-amp Parameters
8. Determination of Frequency response of Op-Amp
9. Operational Amplifier applications using single phase & dual phase supply
10. 2 stage and 3 stage Instrumentation Amplifier
11. Open Loop operation of Op-amp -Comparators - Zero crossing detector – Schmitt Trigger
12. Astable Mutivibrator using op-amp - Square, Triangular and rectangular Wave Generators

Mini Project has to be done by students based on the laboratory techniques studied. Assessment will be done based on the Project report and functioning of the design.

BME284	PATHOLOGY AND MICROBIOLOGY LABORATORY	L	T	P	C
		0	0	3	2

Prerequisite: BME207

Objective(s): To visualize the slides of tumor and many other slides and interpret the result

Course Outcome(s):

CO1 Acquire the knowledge on the ICs utilized for different circuits

CO2 Design and Analyze the circuits based on truth table or the required frequency

CO3 Interpret the characteristics through experimental observation

Mapping of COs and POs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H											
CO2		H		M	M							
CO3	L		H		L	H						

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. Special stains – cresyl fast Blue (CFV)- Trichrome – oil red O – PAS
8. Simple Stain test
9. Gram Stain test
10. AFB Strain test
11. Slides of malyarial parasites, micro filaria and leishmania donovani.
12. Haematology slides of anemia and leukemia
13. Bleeding time and clotting time.
14. Study of bone marrow charts

BME285	BIOSENSORS AND TRANSDUCERS LABORATORY	L	T	P	C
		0	0	3	2

Prerequisite: BME281, BME204, EEE203

Objective(s): To understand the concepts of biosensors and transducers practically

Course Outcome(s):

CO1 Acquire the knowledge on the sensors utilized for different circuits

CO2 Design and Analyze the circuits by acquiring data from the sensors

CO3 Develop a module to record various physiological parameters and to interpret the characteristics through experimental observation

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	L	M	M	L		L	M	M	H	M	M	M
CO2	M	M	M	H		L	M	L	H	M	M	L
CO3	L	M	L	L		L	L	L	H	M	M	L

LIST OF EXPERIMENTS

1. Measurement of pressure using piezoelectric pick up.
2. Measurement of Pulse Rate using photo transducer
3. Measurement of Respiratory Rate using temperature transducer
4. Measurement of blood flow using electromagnetic flow transducer
5. Measurement of displacement using capacitive transducer and Inductive transducer
6. Measurement of SpO2 using optical transducer
7. Measurement of skin temperature by both contact and non-contact method
8. Measurement of chemical compounds using Load Cell
9. Measurement of blood glucose measurement using amperometric sensor
10. Non-invasive gas analyzer as an electronic nose
11. Wheatstone Bridge Circuit for Measurement of Resistance
12. Measurement of blood P^H using P^H electrode
13. Study of electronic stethoscope.
14. Study of hot-wire anemometry

SEMESTER V

ECE304	MICROPROCESSORS AND MICROCONTROLLERS	L	T	P	C
		3	1	0	4

Prerequisite: BME204, CSE102

Objective(s): To familiarize the students with To develop an in-depth understanding of the operation of microprocessors and microcontrollers, machine language programming & interfacing techniques

Course Outcome(s):

CO1 Describe the architecture, role of CPU, registers of intel microprocessors.

CO2 Write an assembly language programs by using the knowledge on instruction set and programming of 8085 and 8086 processors.

CO3 Interface a peripheral with 8085/8086 processor.

CO4 Select a microcontroller required an application by using knowledge gained on architecture of microcontrollers.

CO5 Develop a microcontroller based system by acquiring knowledge on programming a microcontroller.

Mapping of COs and POs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M											
CO2					L							
CO3		M										
CO4	H											
CO5				L	M							

UNIT I 8085 PROCESSOR

Microprocessors Introduction: Computer and its organisation, Programming system, Address Bus, Data Bus and Control Bus, Tristate Bus, Clock generation, Connecting Microprocessor to I/O Devices, Data transfer schemes, Architectural Advancements, Evolution – 8085: Hardware Architecture, Instruction set and Programming

UNIT II 8086 PROCESSOR

8086: Hardware Architecture, Instruction set and Programming – Introduction to Architecture of: Intel's P5, Netburst, Core, Nehalem, Skylake, Bonnell, Goldmont and AMD's Bulldozer, Jaguar

UNIT III PROCESSOR - PERIPHERAL INTERFACING

8085 and 8086 Peripheral Interfacing

UNIT IV MICROCONTROLLERS

Introduction to Computing: Numbering and coding systems review, Digital primer, Semiconductor memory, Computer architecture – Embedded systems - Introduction to architecture of: Intel 8051, PIC 32, Cold fire 32bit, ARM Cortex A processor- Introduction to Arduino - AVR Microcontroller History and Features – AVR Architecture and Assembly Language Programming, Programming in C – I/O Port Programming – Instructions – Addressing Modes – Bit addressability – AVR Fuse bits – Timer, Counter programming – AVR Interrupts – SPI Bus protocol – SPI Programming in AVR

UNIT V MICROCONTROLLER **INTERFACING**

ATMEGA32 connection to RS232 – LCD Interfacing – Keyboard Interfacing – ATMEGA32 ADC features – Interfacing temperature sensor to AVR – DAC Interfacing – AVR connection to relay – AVR connection to solid state relay – DC motor interfacing – DC motor control using PWM – Seven Segment Decoder interfacing

TEXT BOOKS

1. Muhammad Ali Mazidi, Sarmad Naimi, Sepehr Naimi, AVR Microcontroller and Embedded Systems: Using Assembly and C, Pearson India, 2014
2. Krishna Kant, Microprocessors and Microcontrollers, PHI, 1st Edition, 2011

3. .ATmega48A/PA/88A/PA/168A/PA/328/P Complete Datasheet, ATMEL,2012

REFERENCES

1. Douglas Hall, S S S P Rao, Microprocessors and its Interfacing, TMH, 3rd Edition, 2012
2. Rafiquzzaman M, Microprocessors: Theory and Applications, PHI, 2008
3. N. Senthil Kumar, M. Saravanan, S. Jeevananthan and S. K. Shah, Microprocessors and Interfacing, Oxford Press India, 1st Edition, 2012
4. Dhananjay Gadre, Programming and Customizing the AVR Microcontroller, TMH, 1st Edition, 2009
5. Richard H. Barnett, Larry D. O'Cull, Sarah Alison Cox, Embedded C Programming and the ATMEL AVR, Cengage International, 2010
6. Dale Wheat, Arduino Internals, e-book (Google Books, Amazon.com), 2011.

BME301	BIOCONTROL SYSTEMS	L	T	P	C
		3	1	0	4

Prerequisite: EEE203, BME205, BME202

Objective(s): Analyze the time and frequency domains of the given system using different mathematical techniques

Course Outcome(s):

CO1 Demonstrate an understanding of mathematical techniques applied in realizing any physical system

CO2 Analyze and evaluate any given system in the time domain by applying time-domain specifications

CO3 Understand the various methodologies followed in state-space representation of a system

CO4 Understand and perform complex frequency domain analysis/response of a higher order control system, with the virtue of analyzing the gain and stability of the system

CO5 Model physiological control system using generalized system properties and elements

Mapping of COs and POs												
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	H											
CO2	H	H			M				H	H		
CO3	H	H							H	H		
CO4	H	H			M				H	H		
CO5	M											

UNIT I MODELING OF SYSTEMS

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

UNIT II TIME RESPONSE ANALYSIS

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. ***Time Response***

UNIT III STABILITY AND STATE SPACE ANALYSIS

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. State Space Theory: Introduction, State & state variables, Selection of state variables, state model, Non-homogenous solution, converting a transfer function to a state model.

UNIT IV FREQUENCY RESPONSE ANALYSIS

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 response frequency and bandwidth. ***frequency response analysis***.

UNIT V PHYSIOLOGICAL CONTROL SYSTEM

Example of physiological control system: Thermoregulatory system, muscle stretch reflex, difference between engineering and physiological control systems, generalized system properties, models with combination of system elements, linear models of physiological systems-Examples.

TEXT BOOKS:

1. M. Gopal "Control Systems Principles and Design", Tata McGraw Hill, 2002 (Units I, II, III & IV).
2. Michael C K Khoo, "Physiological Control Systems", IEEE Press, Prentice Hall of India, 2001(Unit V).

REFERENCES:

1. Benjamin C. Kuo, "Automatic Control Systems", Prentice Hall of India, 1995.
2. John Enderle Susan Blanchard, Joseph Bronzino "Introduction to Biomedical Engineering", second edition, Academic Press, 2005.
3. Richard C. Dorf, Robert H. Bishop, "Modern control systems", Pearson, 2004.

BME302	BIOMEDICAL INSTRUMENTATION	L	T	P	C
		3	0	0	3

Prerequisite: EIE207, BME204, BME203

Objective(s): To gain basic knowledge about Bio potentials, Bio electrodes and bio amplifiers and to give a complete exposure of various recording mechanism and to understand the basic principles, working of biomedical instruments.

Course Outcome(s):

CO1 To learn several signals that can be measured from the human body.

CO2 To study different types of electrodes used in bio-potential recording.

CO3 To understand how noise from the environment, instruments and other physiologic systems can create artifacts in instrumentation.

CO4 To understand the theory of how several sensors operate and use these sensors in practical.

CO5 To design the medical instrument to measure non electrical and analytical parameters.

	POs											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	H	L										
CO2	L	L										
CO3				H								
CO4	H	M										

UNIT I BIOELECTRODES AND BIOCHEMICAL SENSORS

Components of Medical Instrumentation – System Origin of Bio potential: Action Potential, Nernst Equation, Goldman equation, Hodgkin- Huxley model - Electrode electrolyte interface, Half-cell potential, Polarisable and Non-polarisable electrodes - Skin electrode interface – Bio-electrodes: Surface-, Micro-. Needle- electrodes - Equivalent circuits of electrodes – Biochemical-, and Transcutaneous- electrodes: pH, pO2 , pCO2 - Ion sensitive Field effect Transistors.

UNIT II BIOAMPLIFIERS, BIOELECTRIC SIGNALS, PCG AND THEIR RECORDING

Bioamplifiers- Carrier Amplifier, - Isolation Amplifier - Differential amplifier - Chopper Amplifier - Instrumentation Amplifier - Electrodes for ECG, EEG

and EMG - Einthoven triangle, Standard 12-lead configurations - ECG Machine - EMG machine – 10-20 electrodes placement system for EEG - EEG machine - Heart sound and characteristics

UNIT III MEASUREMENT OF NON-ELECTRICAL PARAMETERS

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 CARDIAC MEASUREMENTS AND DEVICES

Cardiac output Measuring techniques – Dye Dilution method, Thermo dilution method, BP method - Blood Flow measuring Techniques: Electromagnetic Type - Ultrasound Blood Flow meter, Laser Doppler Blood Flow meter - Cardiac Arrhythmias – Plethysmography - Cardiac Pacemakers – Defibrillator: AC-, and DC- types - Heart-Lung Machine (HLM) - Oxygenators

UNIT V ANALYTICAL EQUIPMENTS

Chemical Fibro sensors, Fluorescence sensors - Glucose Sensor - Blood cell counters - Coulter counter, Electrical Impedance Method , Optical Method - Colorimeter, Spectro photometer, Flame photometer – Chromatography - Mass Spectrometer - Electrical hazard – Micro- and Macro- shock - Patient safety procedures

TEXT BOOK:

1. Khandpur R.S, “Handbook of Biomedical Instrumentation”, Tata McGraw Hill, New Delhi, 2003.

REFERENCES:

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, 2006.
3. Joseph J. Carr and John M. Brown, "Introduction to Biomedical Equipment Technology", Pearson Education, 2004.
4. Richard Aston "Principles of Biomedical Instrumentation and Measurement", Merril Publishing Company, 1990.
5. L.A Geddas and L.E.Baker "Principles of Applied Biomedical Instrumentation" 2004.
6. John G. Webster, "Bioinstrumentation", John Willey and sons, New York, 2004.
7. Myer Kutz "Standard Handbook of Biomedical Engineering & Design", McGraw-Hill Publisher, 2003.

BME303	HOSPITAL MANAGEMENT	L	T	P	C
		3	0	0	3

Prerequisite: HSS036, HSS037

Objective(s): Understand the principles, practices and areas of application in Hospital management

Course Outcome(s):

CO1 To understand the principles, staffing and marketing processes, discussing their significance.

CO2 To manage their role in effective and efficient management of health care organizations.

CO3 To analyse the various regulations and standards to be followed in hospitals for safety.

CO4 To evaluate various aspects of equipment maintenance.

CO5 To apply the aspects of managing the hospital in terms of staff, marketing and the use of computers.

	POs											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1						L			M		M	
CO2									H	H	H	
CO3			M			H		H		M	L	
CO4						L		M	M	L	M	
CO5									H	M	L	

UNIT I HEALTH SYSTEM

Health organisation of the country, the state, the cities and the region, Health Financing System, Organisation of Technical Section.

UNIT II HOSPITAL ORGANISATION AND MANAGEMENT

Management of Hospital organisation, Nursing section Medical Sector, Central Services, Technical Department, Definition and Practice of Management by Objective, Transactional Analysis Human relation in Hospital, Importance to Team Work, Legal aspect in Hospital Management.

UNIT III REGULATORY REQUIREMENT AND HEAI TH CARE CODES

FDA Regulation, joint commission of Accreditation for Hospitals, National Fire Protection Association Standard, IRPC.

UNIT IV EQUIPMENT MAINTENANCE MANAGEMENT

Organising Maintenance Operations, Paper Work Control, Maintenance Job, Planning Maintenance Work Measurement and Standards, Preventive Maintenance, Maintenance Budgeting and Forecasting, Maintenance Training, Contract Mainframe.

UNIT V TRAINED TECHNICAL PERSONNEL

Function of Clinical Engineer, Role to be performed in Hospital, Man power Market, Professional Registration, Structure in hospital.

REFERENCE BOOKS

1. Cesar A. Caceres and Albert Zara, The practice of Clinical Engineering, Academic Press, 1977.
2. Webster, J.G. and Albert M. Cook, Clinical Engineering Principles and Practices, Prentice Hall Inc. Englewood Cliffs, 1979.
3. Antony Kelly, Maintenance planning and control, Butterworths London, 1984.
4. Hans Pfeiff, Vera Dammann (Ed.) Hospital Engineering in Developing Countries, Z report Eschborn, 1986.
5. Jacob Kline, Handbook of Bio Medical Engineering, Academic Press, San Diego 1988.
6. R.C. Goyal, Handbook of Hospital Personal Management, Prentice Hall of India, 1993.

BME381	BIOMEDICAL INSTRUMENTATION LABORATORY**	L	T	P	C
		0	0	3	2

Prerequisite: BME303

Objective(s): To provide hands on training on Measurement of physiological parameters, biochemical parameters measurement and bio-signal analysis.

Course Outcome(s):

Upon completion of the course, students will be able to

CO1 Understand the various bio-signal processing units like amplifiers, filters

CO2 Measure various electrical, non-electrical, chemical biological parameters.

CO3 Record, analysis and interrupt various bio-parameters.

CO4 Understand, analyse, and apply theoretical knowledge for a

particular application by implementing in a mini project.

	POs											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	H				H							
CO2							M				M	
CO3		L										
CO4	M	L										
CO5		M										

LIST OF EXPERIMENTS

1. Study of Biological Preamplifiers.
2. Recording of ECG signal.
3. Audiometer.
4. Recording of EMG.
5. Recording of various physiological parameters using patient monitoring system and telemetry units.
6. Measurement of pH, pO2 and conductivity.
7. Study and analysis of functioning and safety aspects of surgical diathermy.
8. Recording of EEG-Signal
9. Measurement and recording of peripheral blood flow
10. Measurement of visually evoked potential.
11. Study of characteristics of optical Isolation amplifier
12. Galvanic skin resistance (GSR) measurement

Mini Project has to be done by students based on the laboratory techniques studied. Assessment will be done based on the Project report and functioning of the design.

ECE 385	MICROPROCESSORS AND MICROCONTROLLERS LABORATORY	L	T	P	C
		0	0	3	2

Prerequisite : BME204, CSE102

Objective(s): To familiarise the students with Familiarize the architecture of 8085, 8086 processor, assembling language programming and interfacing with various modules. The student can also understand of AVR Microcontroller concepts, architecture, programming and application of Microcontrollers. Student able to do any type of VLSI, embedded systems, industrial and real time applications by knowing the concepts of Microprocessor and Microcontrollers

Course Outcome(s):

Upon completion of the course, students will be able to

CO1 Write Assembly Language Programs for Microprocessors and Microcontroller.

CO2 Interface various devices to a microprocessor/microcontroller, including memory.

CO3 Design and develop a microcontroller based systems as per the requirements

Mapping of COs and POs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	L	M	H				L					H
CO2	L	M	H				L					H
CO3	L	L	H	L	H	L	L	L	L	L	L	L

LIST OF EXPERIMENTS

Microprocessor Trainer kits: Familiarisation – Hardware, Software

8085 Programs

1. Addition of Two 8-Bit Numbers and Sum is 16 Bit; Addition of Two 16-Bit Numbers and Sum is 16-bit
2. Decimal Addition of Two 8-Bit Numbers and Sum is 8-bit
3. Square root of a number

8086 Programs

1. Multiply Two 8 Bit Numbers; Divide Two 8 Bit Numbers
2. Arrange ‘n’ Numbers in Descending Order
3. Find Factorial of a number

Microcontroller (AVR) Programs

4. (Use Arduino board to load ATMEL Studio Compiled programs) [I] [II] [III] [IV] [V]
5. Microcontroller Programming - Familiarisation
6. Using ATMEL Studio IDE
    a. Switching ON/OFF LED with Software Button Debounce
    b. Generate Square Wave, Sawtooth Wave, Triangular Wave using PWM
    c. Use ATMEGA timer to flash LED d. Display temperature using temperature sensor (ADC, Interrupts, LCD interface)
7. Using Arduino IDE
    a. Scroll a text on a 16x2 LCD screen
    b. Spin a DC (Toy) motor in either direction using H-bridge (Texas Instruments L293NE or Texas Instruments SN754410). Change motor direction based on comparing light intensity received by photo cell (LDR) with a threshold value
    c. Control a servo with LED movement indication and LCD position display
    d. Display temperature using TMP36 on first row of 16x2 LCD; Display Maximum, Minimum Temperatures on second row of 16x2 LCD; Log the values in a text file on an SD card
    e. Interface an electret condenser microphone (or) Turn a pencil drawing into a capacitive sensor
    f. Interface a keypad and LCD screen to design a simple calculator

REFERENCES

1. http://www.engblaze.com/tutorial-using-atmel-studio-6-with-arduino-projects/
2. http://russemotto.com/xloader
3. http://blog.elenika.net/?p=25
4. http://www.asensar.com/howto/step-by-step-guide-to-integrating-atmel-studioavrdude/
5. http://www.asensar.com/howto/step-by-step-guide-to-setting-up-avr-studio-6-forarduino-development/
6. Getting Started with Arduino, Massimo Banzi, 2nd Edition, O'Reilly
7. Beginning C for Arduino, Jack Purdum, e-book (Google Books)

Arduino Cookbook, Michael Margolis, 2nd Edition, O'Reilly

SEMESTER VI

BME304	BIOMEDICAL SIGNAL PROCESSING	L	T	P	C
		3	1	0	4

Prerequisite: MAT202, ECE304

Objective(s): This course introduces various bio-signal representations, various design and processing techniques.

Course Outcome(s):

CO1 To understand the characteristics, basis and utility of a variety of biomedical signals

CO2 To discuss linear and non-linear filtering techniques to extract desired information

CO3 To Apply digital signal processing theory to signal analysis and filtering; analyze and design circuits for signal filtering.

CO4 To understand different noise interference with bio signals. Design of various noise removal filters.

CO5 To understand few bio signal processing applications using microprocessor.

Mapping of COs and POs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	L									
CO2		H			L							
CO3		H										
CO4		M		L								
CO5		H	M		H							

UNIT I SIGNALS AND SYSTEMS

Continuous and 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 IIR FILTER DESIGN

Structures of IIR – Analog filter design – Discrete time IIR filter from analog filter – IIR filter design by Impulse Invariance, Bilinear transformation, Approximation of derivatives – (LPF, HPF, BPF, BRF) filter design using frequency translation.

UNIT IV NOISE FILTERATION FROM BIOSIGNALS

Adaptive filters – Principle noise canceller model – 50 Hz adaptive cancelling using a sine wave model – Maternal ECG cancellation in fetal electrocardiography – ECG cancellation in EMG recording – High frequency noise cancellation in Electro surgery. Signal averaging – Basics and limitations.

UNIT V SIGNAL PROCESSING APPLICATIONS

Data Addressing modes of TMS320C54XX Processors Data Addressing modes, Memory space, program control, instructions and Programming, On-Chip Peripherals, Interrupts, Pipeline Operations.

EEG signal characteristics – EEG analysis - time and frequency domain methods – Parametric model – Phenomenological model – linear prediction theory – Autoregressive method. ECG QRS detection Techniques – Estimation of R-R interval – Estimation of ST segment inclination – Arrhythmia analysis monitoring – Long term ECG recording

TEXT BOOK:

1. John G. Proakis & Dimitris G.Manolakis, “Digital Signal Processing – Principles, Algorithms & Applications”, Fourth Edition, Pearson Education / Prentice Hall, 2007.
2. DC Reddy, Biomedical Signal Processing – Principles and Techniques, Tata McGraw Hill Publishing company Ltd., 2005 (UNITS IV & V)

REFERENCES:

1. Emmanuel C..Ifeachor, & Barrie.W.Jervis, "Digital Signal Processing", Second Edition, Pearson Education / Prentice Hall, 2002.
2. Sanjit K. Mitra, "Digital Signal Processing – A Computer Based Approach", Tata Mc Graw Hill, 2007.
3. A.V.Oppenheim, R.W. Schafer and J.R. Buck, "Discrete-Time Signal Processing", 8th Indian Reprint, Pearson, 2004.
4. Andreas Antoniou, "Digital Signal Processing", Tata Mc Graw Hill, 2006.

BME305	DIAGNOSTIC AND THERAPEUTIC EQUIPMENTS	L	T	P	C
		3	1	0	4

Prerequisite: BME203, BME303

Objective(s): To know the various bio-potential recordings so as to enable students to record various bio-signals.

Course Outcome(s):

CO1 To know the various functional blocks present is cardiac care units so that the students can handle these equipments with care and safety.

CO2 Understand the medical devices applied in measurement of parameters related to cardiology, neurology and the methods of continuous monitoring and transmitting them.

CO3 Apply the knowledge of communication engineering in medical field.

CO4 Learn to measure the signals generated by muscles

CO5 Understand the need and use of some of the extracorporeal devices, thermography and laser equipments.

CO	POs											
	1	2	3	4	5	6	7	8	9	10	11	12
CO1		L	L									

CO2		M		M								
CO3		L										
CO4	L	H	M		M	H	M					L
CO5	M	M	M	M	H		M					L

UNIT I CARDIAC EQUIPMENT

Electrocardiograph, Normal and Abnormal Waves, Heart rate monitor, Holter Monitor, Phonocardiography, Plethysmography. Cardiac Pacemaker- Internal and External Pacemaker– Batteries, AC and DC Defibrillator- Internal and External

UNIT II NEUROLOGICAL EQUIPMENT

Clinical significance of EEG, Multi channel EEG recording system, Epilepsy, Evoked Potential–Visual, Auditory and Somatosensory, MEG (Magneto Encephalo Graph). EEG Bio Feedback Instrumentation.

UNIT III SKELETAL MUSCULAR EQUIPMENT

Generation of EMG, recording and analysis of EMG waveforms, fatigue characteristics, Muscle stimulators, nerve stimulators, Nerve conduction velocity measurement, EMG Bio Feedback Instrumentation.

UNIT IV PATIENT MONITORING AND BIOTELEMETRY

Patient monitoring systems, ICU/CCU Equipments, Infusion pumps, bed side monitors, Central consoling controls. Radio Telemetry (single, multi), Portable and Landline Telemetry unit, Applications in ECG and EEG Transmission.

UNIT V EXTRA CORPOREAL DEVICES AND SPECIAL DIAGNOSTIC TECHNIQUES

Need for heart lung machine, functioning of bubble, disc type and membrane type oxygenerators, finger pump, roller pump, electronic monitoring of functional parameter. Hemo Dialyser unit, Lithotripsy, Principles of Cryogenic

technique and application, Endoscopy, Laproscopy. Thermography – Recording and clinical application, ophthalmic instruments.

TEXT BOOK:

1. Khandpur R.S, "Handbook of Biomedical Instrumentation", Tata McGraw Hill, New Delhi, 2003.

2. REFERENCES:

1. Myer Kutz, "Standard Handbook of Biomedical Engineering & Design", Mc Graw Hill, 2003.
2. L.A Geddes and L.E.Baker, "Principles of Applied Biomedical Instrumentation", 3rd Edition, 2008
3. Leslie Cromwell, "Biomedical Instrumentation and Measurement", Pearson Education, New Delhi, 2007.
4. Antony Y.K.Chan, "Biomedical Device Technology, Principles and design", Charles Thomas
3. Publisher Ltd, Illinois, USA, 2008.
4. Joseph J. Carr and John M. Brown, "Introduction to Biomedical Equipment Technology", Pearson education, 2004.
5. John G.Webster, "Medical Instrumentation Application and Design", third edition, John Wiley and Sons, New York, 2006.

BME383	BIOMEDICAL SIGNAL PROCESSING LABORATORY	L	T	P	C
		0	0	3	2

Prerequisite: BME304

Objective(s): To provide hands on training on Measurement of physiological parameters, biochemical parameters measurement and bio-signal analysis.

Course Outcome(s):

Upon completion of the course, students will be able to

CO1 To understand the handling of discrete/ digital signals using MATLAB.

CO2 To understand and apply the basic operations on bio signals to

process as per the requirements.

CO3 To understand, analyze and estimate various bio signals by implementing the compensatory techniques for extraction of different bio signal distortions.

	POs											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	H	M	M	H	H		M					
CO2			H	H	H	H	M					
CO3		H		H	H		M	M	H	H	M	M

LIST OF EXPERIMENTS

1. Signal Averaging of ECG
2. Noise removal in EEG signal using Chebychev filter.
3. Noise removal in EMG signal using Butterworth filter
4. Designing an FIR filter using window techniques in MATLAB.
5. Estimation of bio-signals using Parametric Method.
6. Estimation of bio-signals using nonparametric estimation
7. Time frequency domain properties of different windows using MATLAB.
8. Implementation of the Double-Precision Complex FFT for ECG signal.
9. Design of Notch filter for elimination of 50Hz from ECG signal.
10. EMG processing using MATLAB –Rectification and Signal Averaging.

BME384	**DIAGNOSTIC AND THERAPEUTIC EQUIPMENT LABORATORY**	**L**	**T**	**P**	**C**
		0	**0**	**3**	**2**

Prerequisite : BME306

Objective(s): To study, stimulate, design, record and analyse various bio-signal parameters.

Course Outcome(s):

Upon completion of the course, students will be able to

CO1 Collect basic knowledge about measurements of parameters related to cardiac and respiratory system.

CO2 Know the importance of patient safety against electrical hazard

CO3 Develop an understanding of the physiotherapy and diathermy equipment so that the student can learn to operate.

CO4 Design and recording of audiogram and medical simulator.

CO	POs											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
CO1	L	M	H	M								
CO2		M	M	L			H	L				H
CO3	M	H	H	H	M							M
CO4	M	H	H	H	M							

LIST OF EXPERIMENTS:

1. Simulation of ECG – detection of QRS complex and heart rate.
2. Study of shortwave and ultrasonic diathermy.
3. Study of biotelemetry.
4. Electrical safety measurements.
5. Measurement of Respiratory parameters using spirometry.
6. Study of medical stimulator.
7. Study of ESU – cutting and coagulation modes.
8. Recording of Audiogram.
9. Design of ECG amplifier, recording and analysis using LabVIEW.

BME399	**COMMUNITY SERVICE PROJECT**	**L**	**T**	**P**	**C**
		0	**0**	**3**	**3**

Prerequisite: BME398

Objective(s): To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same. To train the students in preparing project reports and to face reviews and viva voce examination.

Course Outcome(s):

Upon completion of the course, students will be able to

CO1 Work in a team to design and develop effective engineering solutions with the consideration of the open ended, real time issues of public, safety and welfare for a societal problem considering global, environmental, and economical aspects.

	POs											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	H	M	H	M	H	H	H	M	M	H	L	L

- The students in a group of 3 to 4 works on a topic will be approved by the head of the department under the guidance of a faculty member and prepares a comprehensive project report after completing the work to the satisfaction of the supervisor.
- The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department.
- A project report is required at the end of the semester.
- The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

SEMESTER VII

BME401	MEDICAL IMAGING TECHNIQUES	L	T	P	C
		3	1	0	4

Prerequisite: BME301, BME306

Objective(s): It presents a systematic overview of principles and systems of biomedical imaging and fundamental image processing and visualization methods. equip with knowledge to select proper imaging modalities for specific clinical and research purposes, with the understanding of their strengths and limitations.

Course Outcome(s):

CO1 Understand x-ray, ultrasound, and magnetic resonance interactions with tissue and the various components of imaging systems.

CO2 Use fundamentals of mathematics and physics to analyze image data.

CO3 Understand modern imaging devices and their application in medicine and industry.

CO4 Demonstrate understanding of image data collection, resolution, reconstruction, storage, processing, visualization, fusion, and communication.

CO5 Develop a competence in the Fundamental analytical and computational tools used in medical imaging.

	POs											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H			L							
CO2	H	H										
CO3					H	L	L					
CO4			L	M	H	M						L
CO5	H	L	M	M	H	M						

UNIT I DIGITAL IMAGE FUNDAMENTAL

Elements of digital image processing systems, Elements of Visual perception, Image sampling and quantization, – Some Basic relationships between pixels, Matrix and Singular Value representation of discrete images.

UNIT II IMAGE TRANSFORMS

1D DFT, 2D DFT, Cosine, Sine Hadamard, Haar, Slant, KL transform and their properties.

UNIT III IMAGE ENHANCEMENT

Histogram – Modification and specification techniques, Enhancement by point processing Image smoothening,Image sharpening, generation of spatial masks from frequency domain specification, Homomorphic filtering,and color image processing.

UNIT IV IMAGE RESTORATIONAND RECONSTRUCTION OF MEDICAL IMAGES

Image degradation models, Unconstrained and Constrained restoration, inverse filtering, Least mean square filter, Image reconstruction from projections – Radon transforms, Filter back projection algorithm, 3D tomography, Fourier reconstruction of MRI Images.

UNIT V MEDICAL IMAGE COMPRESSION TECHNIQUES

Run length, Huffman coding, arithmetic coding, Pixel coding, transform coding, JPEG Standard, predictive techniques, Application of image processing techniques in thermography, SPECT, PET images.

TEXT BOOKS

1. Rafael C., Gonzalez and Richard E. Woods, Digital Image Processing, Pearson Education Asia, 2001

2. Anil K. Jain, Fundamentals of Digital Image Processing, Prentice Hall of India, 1997

REFERENCE BOOKS

1. William K. Pratt, Digital Image Processing, John Wiley, NJ, 1987.
2. Albert Macouski, Medical Imaging systems, Prentice Hall, New Jersey.1983.
3. Sid Ahmed M.A., Image Processing Theory, Algorithm and Architectures, McGraw Hill, 1995.

BME402	EMBEDDED SYSTEMS IN MEDICINE	L	T	P	C
		3	1	0	4

Prerequisite: BME204, ECE304

Objective(s): To introduce students to the modern embedded systems and to show how to understand and program such systems using a concrete platform built around.

Course Outcome(s):

CO1 Describe the differences between the general computing system and the embedded system, also recognize the classification of embedded systems.

CO2 To acquire knowledge in various processors employed in embedded systems

CO3 Implementation of concurrent process and data flow models.

CO4 Design real time embedded systems using the concepts of RTOS

CO5 Apply the concept of embedded system in various medical applications.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H										
CO2	H				H		H	H	H	H		
CO3	H	H	L	L	M		M	M	M	M		
CO4	H	H	H	H	M		L	M	M	M		
CO5			H	L	M		L	M	M	M		

UNIT I INTRODUCTION TO EMBEDDED SYSTEM

Introduction, design challenge, processor technology, IC technology, Design technology, Trade-offs, Single purpose processors, RT-level combinational logic, sequential logic (RT-level), custom single purpose processor design (RT-level) and optimization techniques.

UNIT II GENERAL PURPOSE PROCESSORS, STATE MACHINE

Basic architecture, operation, Pipelining, Programmer's view, development environment, Application Specific Instruction-Set Processors (ASIPs) – Micro Controllers and Digital Signal Processors, models Vs. languages, finite state machines with data path model (FSMD), using state machines, program state machine model (PSM),

UNIT III CONCURRENT PROCESS MODELS

Concurrent process model, concurrent processes, communication among processes, synchronization among processes, implementation, data flow model, real-time systems

UNIT IV COMMUNICATION INTERFACES

Need for communication interfaces, RS232 / UART, RS422 / RS485, USB, Infrared, IEEE 1394 Firmwire, Ethernet, IEEE 802.11, Blue tooth.

UNIT V APPLICATIONS

Real-Time Embedded Software Development, Sending a Message over a Serial Link, Simulation of a Process Control System, Controlling an Appliance from the RT Linux System, Embedded Database Applications, Embedded medical applications: Ophthalmology - Glaucoma screening device, Medical Imaging Acquisition User Interface, Drug delivery systems, Patient monitoring Systems.

TEXT BOOKS

1. Frank Vahid, Tony D. Givargis, "Embedded System Design – A Unified Hardware/Software Introduction", John Wiley, 2002.
2. K.V.K.K. Prasad, "Embedded / Real Time Systems", Dreamtech Press, 2005.
3. Sri Ram V Iyer - Pankaj Gupta, "Embedded Real Time Systems Programming", Tata McGraw Hill, 2005.
4. Steve Heath, "Embedded System Design", Elsevier, Second Ed., 2004.

BME481	MEDICAL IMAGE PROCESSING LABORATORY**	L	T	P	C
		0	0	3	2

Prerequisite: BME401

Objective(s): To provide hands on training on various Medical image processing techniques.

Course Outcome(s):

Upon completion of the course, students will be able to

CO1 Understand the various concepts in medical image processing.

CO2 Learn to remove noise in the medical images.

CO3 To compress the image for data storage and long distance transmission.

	medicaPOs											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	H	M	L				L		H			M
CO2				H	H	M					L	M
CO3		M			H	H				L	L	H

LIST OF EXPERIMENTS

1. Digital image Fundamentals – Sampling and quantization.
2. Image Enhancement - Spatial filtering, Filtering in frequency domain
3. Removal of noise in medical images.
4. Image Transformation in spatial domain and frequency domain.
5. Edge detection and boundary tracing techniques.
6. Region based processing
7. Color image processing
8. Basic Morphological operations.
9. Image compressions.
10. Image segmentation by thresholding**.**

MINI PROJECTS:

1. Applications to Biometric and security
2. Applications to Medical Images
3. Texture analysis with statistical properties
4. Boundary detection

BME499	PROJECT WORK	L	T	P	C
		0	0	24	10

Prerequisite: All Biomedical Courses

Objective(s): To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same. To train the students in preparing project reports and to face reviews and viva voce examination.

Course Outcome(s):

Upon completion of the course, students will be able to

CO1 Apply engineering knowledge and skills to identify problems and design solutions with recognition of ethical and professional responsibilities .

CO2 Function as a professional in a team *with leadership qualities* including effective communication

	POs											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	H	H	H	H	H	H	H	H				M
CO2									H	H	H	

- The students in a group of 3 to 4 works on a topic will be approved by the head of the department under the guidance of a faculty member and prepares a comprehensive project report after completing the work to the satisfaction of the supervisor.

- The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department.
- A project report is required at the end of the semester.
- The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

MAJOR ELECTIVES FOR V SEMESTER

BME306	RADIOLOGICAL EQUIPMENTS	L	T	P	C
		3	0	0	3

Prerequisite: BME303, BME306

Objective(s): To understand various types of radiological sources, equipments contruction and working with precaution measures to be taken.

Course Outcome(s):

CO1 Learn different types of radio diagnostic techniques

CO2 Understand generation of x-rays and its uses in imaging.

CO3 Know techniques used for visualizing different sections of the body

CO4 Acquire knowledge in various nuclear source and measuring devices

CO5 Learn radiation therapy methodologies and the radiation safety

UNIT I MEDICAL X-RAY EQUIPMENT

Nature of X-rays- X-Ray absorption – Tissue contrast. X- Ray Equipment (Block Diagram) – X-Ray Tube, the collimator, Bucky Grid, power supply, Digital Radiography- discrete digital detectors, storage phosphor and film scanning, X-ray Image Intensifier tubes – Fluoroscopy – Digital Fluoroscopy. Angiography, cine Angiography. Digital subtraction Angiography. Mammography.

UNIT II COMPUTED TOMOGRAPHY

Principles of tomography, CT Generations, X- Ray sources- collimation- X-Ray detectors-Viewingsystems- spiral CT scanning – Ultra fast CT scanners. Image reconstruction techniques- backprojection and iterative method.

UNIT III MAGNETIC RESONANCE IMAGING

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), shim coils, Electronic components, Fmri.

UNIT IV NUCLEAR MEDICINE SYSTEM

Radio Isotopes- alpha, beta, and gamma radiations. Radio Pharmaceuticals. Radiation detectors –gas filled, ionization chambers, proportional counter, GM counter and scintillation Detectors, Gammacamera- Principle of operation, collimator, photo multiplier tube, X-Y positioning circuit, pulse heightanalyzer. Principles of SPECT and PET.

UNIT V RADIATION THERAPY AND RADIATION SAFETY

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

TEXT BOOKS:

1. Steve Webb, The Physics of Medical Imaging, Adam Hilger, Philadelpia, 1988 (Units I, II, III & IV).
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 and biomedical Engineering", - CRC Press, 1999.
3. Myer Kutz, "Standard handbook of Biomedical Engineering and design", McGraw Hill, 2003.
4. P.Ragunathan, "Magnetic Resonance Imaging and Spectroscopy in Medicine.

BME307	FIBER OPTICS AND LASERS IN MEDICINE	L	T	P	C
		3	0	0	3

Prerequisite: BME101, BME201

Objective(s): To acquire adequate knowledge in physics of light in biological tissues and its application in diagnostic and therapeutic applications.

Course Outcome(s):

Upon completion of the course, the students should be able to

CO1 Be familiar with property of light in tissues

CO2 Acquire knowledge in source and detectors of light.

CO3 Application of light in diagnostic practices.

CO4 Understand the concept of LASER in therapeutic applications.

CO5 Be exposed to Optical Holography

Mapping of COs and POs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M				M							
CO2			L									
CO3		H			L							
CO4												
CO5				H								

UNIT I

Refraction, scattering, absorption, light transport inside the tissue, tissue properties, Light interaction with tissues, optothermal interaction, fluorescence, speckles.

UNIT II INSTRUMENTATION IN PHOTONICS

Instrumentation for absorption, scattering and emission measurements, excitation light sources – high pressure arc lamp, solid state LEDs, optical filters, polarisers, time resolved and phase resolved detectors.

UNIT III APPLICATIONS OF LASERS

Laser in tissue welding, lasers in dermatology, lasers in ophthalmology, otolaryngology, urology.

UNIT IV OPTICAL HOLOGRAPHY

Wave fronts, interference patterns, principle of hologram, optical hologram, applications.

UNIT V SPECIAL TECHNIQUES

Near field imaging of biological structures, in-vitro clinical diagnostic, fluorescent spectroscopy, photodynamic therapy.

TEXT BOOKS

1. Leon Goldman, M.D., & R.James Rockwell, Jr., "Lasers in Medicine", Gordon and Breach, Science Publishers Inc., 1975.
2. Abraham Katzir, "Lasers and Optical Fibers in Medicine", Academic Press Edition,1998.

REFERENCES:

1. Tuan Vo Dirh, "Biomedical Photonics – Handbook", CRC Press, Bocaraton,2003 (Unit I – III, V)
2. Glasser, O., "Medical Physics -- Vol 1, 2, 3 "Adam Hilgar Brustol Inc, 1987.
3. G.David Baxter "Therapeutic Lasers – Theory and practice", Churchill Livingstone Publications Edition- 2001.

BME308	BIOFLUIDS AND DYNAMICS	L	T	P	C
		3	0	0	3

Prerequisite: BME202, MEC101

Objective(s): •An understanding on the physiology and anatomy of studied

systems.

•A capability to analyse cardiac, respiratory, soft tissue and orthopedic mechanics.

Course Outcome(s):

CO1 To understand the concept of mechanics of bio-fluids.

CO2 To study the nature of blood flow in different vessels.

CO3 To understand mechanical activity of heart.

CO4 To understand mechanical activity of soft tissues.

CO5 To understand mechanical activity of bones and joints.

Mapping of COs and POs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		L				H						
CO2	M	M				H						
CO3	M	M				H						
CO4	M	M				H						
CO5	M	M				H						

UNIT I INTRODUCTION TO BIOFLUsIDICS

Newton's laws, Stress, Strain, Elasticity, Hooks-law, viscosity, Newtonian fluid, Non-Newtonian fluid, Viscoelastic fluids, vascular tree, Relationship between diameter, velocity and pressure of blood flow, Resistance against flow. Bioviscoelastic fluid: Viscoelasticity - Viscoelastic models, Maxwell, Voigt and Kelvin Models, Response to Harmonic variation, Use of viscoelastic models, Bio- Viscoelastic fluids: Protoplasm, Mucus, Saliva, Synovial fluids.

UNIT II FLOW PROPERTIES OF BLOOD

Physical, Chemical and Rheological properties of blood. Apparent and relative viscosity, Blood viscosity variation: Effect of shear rate, hematocrit, temperature, protein contents of blood. Casson's equation, Problems associated with extracorporeal blood flow. Rheology of Blood In Microvessels: Fahraeus - Lindquist effect and inverse effect, distribution of suspended particles in a narrow rigid tube. Nature of red blood cells in tightly fitting tubes, hematocrit in very narrow tube

UNIT III CARDIAC MECHANICS

Cardiovascular system. Mechanical properties of blood vessels: arteries, arterioles, capillaries and veins. Blood flow: Laminar and Turbulent, Physics of cardiovascular diseases, Prosthetic heart valves and replacements. Respiratory Mechanics: Alveoli mechanics, Interaction of Blood and Lung P-V curve of Lung: Breathing mechanism, Airway resistance, Physics of Lung diseases.

UNIT IV SOFT TISSUE MECHANICS

Pseudo elasticity, non-linear stress-strain relationship, Viscoelasticity, Structure, function and mechanical properties of skin, ligaments and tendons.

UNIT V ORTHOPEDIC MECHANICS 8 Mechanical properties of cartilage, diffusion properties of Articular cartilage, mechanical properties of bone, kinetics and kinematics of joints, lubrication of joints.

TEXT BOOK:

1. Y.C Fung, "Biomechanics- Mechanical properties of living tissues", 2nd Edition, Springer-Verlag,
1993.

REFERENCES:

2. David A. Rubenstein, Weiyin, Mary D. Frame, "Biofluid Mechanics- An Introduction to fluid
1. Mechanics, Macrocirculation and Microcirculation", Springer, 2013.
2. Silver Frederick H. Biomaterials, Medical Devices & Tissue Engineering: Chapman & Hall,London, 1994
3. Nihanth ozkai, D.A Mc Donald ,"Biomechanics, Blood flow in arteries", Edward Arnold ltd, 1998.
4. D.O Cooney, Biomedical Engineering Principles. Marcel Dekker, INC New York.1976.

BME309	BIOINFORMATICS	L	T	P	C
		3	1	0	4

Prerequisite: BME101

Objective(s): To introduce various formats, tools for processing, analyzing, interpretation of bioinformatics.

Course Outcome(s)

CO1 To expose the outline of bioinformatics.
CO2 To infer the need for Bioinformatics tools
CO3 To be familiar with the modeling techniques
CO4 To learn the microarray analysis
CO5 Expose to Pattern Matching and Visualization

Mapping of COs and POs												
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1					L							
CO2	M		H									
CO3		M				M						
CO4	M											
CO5				H								

UNIT I INTRODUCTION

Need for Bioinformatics technologies – Overview of Bioinformatics technologies Structural
bioinformatics – Data format and processing – Secondary resources and applications – Role of Structural bioinformatics - Biological Data Integration System.

UNIT II DATAWAREHOUSING AND DATAMINING IN BIOINFORMATICS

Bioinformatics data – Data warehousing architecture – data quality – Biomedical data analysis – DNA data analysis – Protein data analysis – Machine learning – Neural network architecture and applications in bioinformatics

UNIT III MODELING FOR BIOINFORMATICS

Hidden markov modeling for biological data analysis – Sequence identification –Sequence
classification – multiple alignment generation – Comparative modeling – Protein modeling – genomic modeling – Probabilistic modeling – Bayesian networks – Boolean networks - Molecular modeling – Computer programs for molecular modeling.

UNIT IV PATTERN MATCHING AND VISUALIZATION 9

Gene regulation – motif recognition – motif detection – strategies for motif detection – Visualization – Fractal analysis – DNA walk models – one dimension – two dimension – higher dimension – Game representation of Biological sequences – DNA, Protein, Amino acid sequences.

UNIT V MICROARRAY ANALYSIS 9

Microarray technology for genome expression study – image analysis for data extraction –

Pre-processing – segmentation – gridding – spot extraction – normalization, filtering – cluster analysis – gene network analysis – Compared Evaluation of Scientific Data Management Systems – Cost Matrix – Evaluation model - Benchmark – Tradeoffs

TEXT BOOK:

1. Yi-Ping Phoebe Chen Edition, "BioInformatics Technologies", First Indian Reprint, Springer Verlag, 2007.

REFERENCES:

1. Bryan Bergeron, "Bio Informatics Computing", Second Edition, Pearson Education, 2003.
2. Arthur M Lesk, "Introduction to Bioinformatics", Second Edition, Oxford University Press, 2005

BME310	COMPUTERS IN MEDICINE	L	T	P	C
		3	1	0	4

Prerequisite: BME304

Objective(s): To discuss the various aspects of informatics applied in health industry so that quality of health care is improved.

Course Outcome(s):

CO1 To understand the system of information managed in the hospital.

CO2 To demonstrate the application of softwares employed in medical data management.

CO3 To examine medical imaging data with an assist of computers.

CO4 To understand the concept of maintaining digital patient records.

CO5 To acquire knowledge in delivering instructions in medicine using computers.

Mapping of COs and POs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	3	4	5	6	7	8	9	10	11	12
CO2	M				M							
CO3	L				M							
CO4	L	L			M							
CO5	M	L			M							

UNIT I HOSPITAL INFORMATION SYSTEM

Introduction –Historical review of the development of computers and informatics –Foundation ontology – use of internet in medicine –Internet vs online services-computer based medical information retrieval.

UNIT II COMPUTERISED PATIENT DATABASE MANAGEMENT

Data base approach -Automated clinical laboratories – automated method in hematology – chromosome analysis by computer –computerised cytology and histology- Automatic scanning for cervical cancer –computer assisted semen analysis-Radio immuno assays-Intelligent laboratory information system-computerized ECG-computer aided analysis of ECG-computerised EEG and EMG. Computer assisted medical imaging-ultrasound –CT Radiation therapy planning-NMR.

UNIT III COMPUTER ASSISTED MEDICAL IMAGING AND DECISION MAKING

Computer Assisted Medical Decision Making-Model of CMD-Approaches-Decision Support Systems Algorithms –Analysis –CBR-Production Rule Systems-Cognitive Models-Somantic Networks –Decision Analysis in Clinical Medicine –Hospital Information System-Functional Capabilities –Need-Security-Cost Effectiveness. Clinical Information System –Benefits –Sources Of Data-Modes Of Decision –CIS in Obestrics and Gynecology-Clinical Decision Support.

UNIT IV COMPUTERISED PATIENT RECORD

Computerised Patient Record –Introduction-History Taking By Computer-Dialogue With The Computer - Computerised Prescriptions For Patients-Introduction-Adverse Drug Reactions-Computer Assisted Patient Education And Health Care Information –Introduction –Health Online –Electronic Communication With Patients-Importance Of Behaviour Modification –Patient Self Management Education-Computers In Case Of Critically Ill Patients-Introduction –Cognitive System, Engineering –Automated Computer Assisted Fluid And Metabolic Balance –Pulmonary Function Evaluation-Computer Aids For The Handicapped-Computer Assisted Surgery.

UNIT V COMPUTER ASSISTED INSTRUCTION IN MEDICINE

Computer Assisted Drug Discovery And Development ,Molecular Modelling By Computer-Computational Representation Of Molecules-Modelling GPCRS-Pharmacophores-New Drugs For Cancer-0 from Gene To Screen –Combinational Chemistry-Metabolomics-Knowledge Based Drug Discovery-Pharmaco Metabolomics Role Of PET And SPECT In Drug Discovery. Computer Assisted Instruction In Medicine.

TEXT BOOK

1. R. D. Lee, Computers in Medicine, Tata McGraw Hill Publishing Company Limited, New Delhi, 1993.

REFERENCE BOOKS

1. Harold Sackamn, Biomedical Information Technology, Academic Press, New York.
2. S.K.Chachan, PC Organisation, S.K. Kataria and Sons, Delhi 2000.

MAJOR ELECTIVES FOR VI SEMESTER

BME311	REHABILITATION ENGINEERING	L	T	P	C
		3	0	0	3

Prerequisite: BME202, BME205, BME207

Objective(s): Discuss the broad area of rehabilitation engineering and its application to assist people with impairments in sensing, communication, seating, manipulation, and mobility

Course Outcome(s):

CO1 Study the principles of rehabilitation.

CO2 Describe the features of human movement in health and disability and discuss the application of these properties in rehabilitation engineering design.

CO3 Learn therapeutic Exercise Techniques.

CO4 Discuss the various rehabilitation communication techniques.

CO5 Understand orthopedic prosthetics and orthotics in rehabilitation

Mapping of COs and POs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	L							H				
CO2	M	M	M					M				
CO3		M	H			H						
CO4		H						M				
CO5	M	M				H		H				

UNIT I INTRODUCTION TO REHABILITATION & REHABILITATION TEAM

What is Rehabilitation, 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 PRINCIPLES OF REHABILITATION

Introduction, The Human Component, Principles of Assistive Technology Assessment, Principles of Rehabilitation Engineering- Key Engineering Principles, Key Ergonomic Principles - Practice of Rehabilitation and Assistive Technology.

UNIT III THERAPEUTIC EXERCISE TECHNIQUE

Co-ordination exercises, Frenkels exercises, Gait analyses-Pathological Gaits, Gait Training, Relaxation exercises-Methods for training Relaxation, Strengthening exercises-Strength training, Types of Contraction, Mobilization exercises, Endurance exercises.

UNIT IV PRINCIPLES IN MANAGEMENT OF COMMUNICATION

Impairment-introduction to communication, Aphasia, Types of aphasia, Treatment of aphasic patient, Augmentative communication-general form of communication, types of visual aids, Hearing aids, Types of conventional hearing aid, Writing aids.

UNIT V ORTHOTIC & PROSTHETIC DEVICES:

General orthotics, Classification of orthotics-functional & regional, General principles of Orthosis, Calipers- FO, AFO, KAFO, HKAFO.

Prosthetic devices: Hand and arm replacement, Body powered prosthetics, Myoelectric controlled prosthetics and Externally powered limb prosthetics.

TEXT BOOKS:

1. Dr. S. Sunder, Rehabilitation Medicine-, 3rd Edition, Jaypee Medical Publications, New Delhi. 2010 (Units I, III, IV & V)

2. Joseph D.Bronzino, The Biomedical Engineering Handbook, Third Edition: Three Volume Set, CRC Press, 2006 (Units II & V).

REFERENCES :

1. Rory A Cooper, An Introduction to Rehabilitation Engineering, Taylor & Francis, CRC press, 2006.
2. Susan B O'Sullivan, Thomas J Schmitz, Physical Rehabilitation. 5th Edition, Davis publications, 2007.

BME312	VIRTUAL REALITY	L	T	P	C
		3	0	0	3

Prerequisite: BME205

Objective(s): Design a system or process to meet given specifications with realistic engineering constraints.

Course Outcome(s):

CO1 Explore the potential of a virtual world for delivering application.

CO2 Determine possible instructional designs.

CO3 Understand the limitations.

CO4 Applying software in virtual reality.

CO5 Understand the barriers, solutions, and costs associated, including required training.

Mapping of COs and POs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		M										
CO2		H										
CO3	M	M										
CO4		M			M							
CO5		M										

UNIT I INTRODUCTION

The three I's of virtual reality-commercial VR technology and the five classic components of a VR system - Input Devices : (Trackers, Navigation, and

Gesture Interfaces): Three-dimensional position trackers, navigation and manipulation-interfaces and gesture interfaces-Output Devices: Graphics displays-sound displays & haptic feedback.

UNIT II MODELING

Geometric modeling - kinematics modeling- physical modeling - behaviour modeling - model management.

UNIT III HUMAN FACTORS

Methodology and terminology-user performance studies-VR health and safety issues-Usability of virtual reality system- cyber sickness -side effects of exposures to virtual reality environment

UNIT IV VR PROGRAMMING

Introducing Java 3D-loading and manipulating external models-using a lathe to make shapes. 3D Sprites- animated 3D sprites-particle systems.

UNIT V APPLICATIONS

Medical applications-military applications-robotics applications- Advanced Real time Tracking-other applications- games, movies, simulations, therapy.

TEXT BOOKS:

1. C. Burdea & Philippe Coiffet, "Virtual Reality Technology", Second Edition, Gregory, John Wiley & Sons, Inc.,2008.
2. Andrew Davison, "Killer Game Programming in Java", Oreilly SPD, 2005.

REFERENCES:

1. William R.Sherman, Alan Craig, "Understanding Virtual Reality, interface, Application and Design", Elsevier, Morgan Kaufmann, 2002.

2. Bill Fleming ,"3D Modeling and surfacing", Elsevier, Morgan Kauffman, 1999
3. David H.Eberly, "3D Game Engine Design Practical Approach to Real-Time Computer Graphics", Elsevier, 2007.
4. John Vince, "Virtual Reality Systems", Pearson Education, 2007.

BME313	MODELING OF PHYSIOLOGICAL SYSTEM	L	T	P	C
		3	0	0	3

Prerequisite: BME202, BME302

Objective(s): Demonstrates the application of Physiological models.

Course Outcome(s):

CO1 Understand and appreciate the value and application of Physiological models and Vital organs.

CO2 Implement the transfer function for various physiological organs.

CO3 Model dynamically varying physiological system.

CO4 Understand methods and techniques for analysis and synthesis of dynamic models.

CO5 Develop differential equations to describe the dynamic models, simulate and visualize, dynamic responses of physiological models using software.

Mapping of COs and POs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	M				M						
CO2	M	M	H			M						
CO3	M	M	H			M						
CO4	M	H	M			M						
CO5	M	M	H			M						

UNIT I SYSTEM CONCEPT

Review of physiological system modeling- system properties- different configurations of tracheal network, static and dynamic resistance, Thermal resistance in human systems, System with volume storage capacity and its electrical analog, Simplified model of respiratory system , Simulation of aortic segments ,Comparison of muscle model isotonic response, Step response of

resistant / compliant systems –Dye dilution study of circulation, pulse response of first order system.

UNIT II TRANSFER FUNCTION

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, Measurement of airway resistance .

UNIT III PERIODIC SIGNALS

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, Relationship between Phase lag and Time Delay-closed loop aspects of pupillary control system , 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

Characterization of Physiological Feedback systems- Hypophysis adrenal systems, pupillary hippus, Uses and Testing of System Stability, Simulation-Hodgkin-Huxley model, Model of cardiovascular variability.

UNIT V SIMULATION OF BIOLOGICAL SYSTEMS

Simulation of thermal regulation, pressure and flow control in circulation, occulo motor system, Endocrinal system, functioning of receptors, introduction to digital control system.

TEXT BOOKS

1. 1.Willian B. Blesser, "A System Approach to Biomedicine", Mc Graw Hill Book Co., New York, 1969 (Units I, II, III, IV).
2. 2.Manfreo Clynes and John H.Milsum, "Biomedical Engineering System", McGraw Hill and Co., New York , 1970 (Unit V).
3. 3.Micheal C.K.Khoo, "Physiological Control System" Analysis, Simulation and Estimation".- Prentice Hall of India , New Delhi , 2001(Unit V).

REFERENCES:

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

BME314	TELEMEDICINE	L	T	P	C
		3	0	0	3

Prerequisite: EIE207, BME303, BME306

Objective(s): Apply telemetry in healthcare

Course Outcome(s):

CO1 Apply multimedia technologies in telemedicine

CO2 Understand telemedical technology.

CO3 Learn the key principles for telemedicine and health.

CO4 Explain Protocols behind encryption techniques for secure transmission of data.

CO5 Know telemedical standards, mobile telemedicine and it applications

	POs											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	L	L										
CO2	M											

CO3		H										
CO4						M						
CO5					L							

UNIT I TELEMEDICINE AND HEALTH

History and Evolution of telemedicine, Functional diagram of telemedicine system, Telemedicine, Telehealth, Tele care, Organs of telemedicine, Global and Indian scenario, Ethical and legal aspects of Telemedicine - Confidentiality, Social and legal issues, Safety and regulatory issues, Advances in Telemedicine.

UNIT IITELEMEDICAL TECHNOLOGY

Principles of Multimedia - Text, Audio, Video, data, Data communications and networks, PSTN,POTS, ANT, ISDN, Internet, Air/ wireless communications: GSM satellite, and Micro wave, Modulation techniques, Types of Antenna, Integration and operational issues, Communication infrastructure for telemedicine – LAN and WAN technology. Satellite communication. Mobile hand held devices and mobile communication. Internet technology and telemedicine using world wide web (www). Video and audio conferencing. Clinical data – local and centralized.

UNIT III TELEMEDICAL STANDARDS

Data Security and Standards: Encryption, Cryptography, Mechanisms of encryption, phases of Encryption. Protocols: TCP/IP, ISO-OSI, Standards to followed DICOM, HL7, H. 320 series (Video phone based ISBN) T. 120, H.324 (Video phone based PSTN), Video Conferencing, Real-time Telemedicine integrating doctors / Hospitals, Clinical laboratory data, Radiological data, and other clinically significant biomedical data, Administration of centralized medical data, security and confidentially of medical records and access control, Cyber laws related to telemedicine.

UNIT IV MOBILE TELEMEDICINE

Tele radiology: Definition, Basic parts of teleradiology system: Image Acquisition system Display system, Tele pathology, multimedia databases, color images of sufficient resolution, Dynamic range, spatial resolution, compression methods, Interactive control of color, Medical information storage and management for telemedicine- patient information medical history, test reports, medical images diagnosis and treatment. Hospital information system - Doctors, paramedics, facilities available. Pharmaceutical information system.

UNIT V TELEMEDICAL APPLICATIONS

Telemedicine access to health care services – health education and self care. Introduction to robotics surgery, telesurgery. Telecardiology, Teleoncology, Telemedicine in neurosciences, Electronic Documentation, e-health services security and interoperability., Telemedicine access to health care services – health education and self care, Business aspects - Project planning and costing, Usage of telemedicine.

TEXT BOOK:

1. Norris, A.C. “Essentials of Telemedicine and Telecare”, Wiley, 2002

REFERENCES:

1. Wootton, R., Craig, J., Patterson, V. (Eds.), “Introduction to Telemedicine. Royal Society of Medicine” Press Ltd, Taylor & Francis 2006
2. O'Carroll, P.W., Yasnoff, W.A., Ward, E., Ripp, L.H., Martin, E.L. (Eds), “Public Health Informatics and Information Systems”, Springer, 2003.
3. Ferrer-Roca, O., Sosa - Iudicissa, M. (Eds.), Handbook of Telemedicine. IOS Press (Studies in Health Technology and Informatics, Volume 54, 2002.

4. Simpson, W. Video over IP. A practical guide to technology and applications. Focal Press Elsevier, 2006.
5. Bemmel, J.H. van, Musen, M.A. (Eds.) Handbook of Medical Informatics. Heidelberg, Germany: Springer, 1997.
6. Mohan Bansal, "Medical Informatics", Tata McGraw-Hill, 2004.

BME315	INTERNET OF THINGS	L	T	P	C
		3	0	0	3

Prerequisite: CSE102, ECE304

Objective(s): Explain the current status and expected future directions of the internet of things.

Course Outcome(s):

CO1 Explain in a concise manner how the general Internet as well as Internet of Things work.

CO2 Understand constraints and opportunities of wireless and mobile networks for Internet of Things.

CO3 Use basic measurement tools to determine the real-time performance of packet based networks.

CO4 Analyze trade-offs in interconnected wireless embedded sensor networks

CO5 Develop the business model for Internet of Things.

Mapping of COs and POs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1					M							L
CO2	L					L				L		
CO3		L			M						M	
CO4			H	L								M
CO5	M								L			

UNIT I INTRODUCTION

Definition – phases – Foundations – Policy– Challenges and Issues - identification - security – privacy. Components in internet of things: Control

Units – Sensors – Communication modules – Power Sources – Communication Technologies – RFID – Bluetooth – Zigbee – Wifi – Rflinks – Mobile Internet – Wired Communication

UNIT II PROGRAMMING THE MICROCONTROLLER FOR IoT

Basics of Sensors and actuators – examples and working principles of sensors and actuators – Cloud computing and IOT – Arduino/Equivalent Microcontroller platform – Setting up the board - Programming for IOT – Reading from Sensors Communication: Connecting microcontroller with mobile devices – communication through bluetooth and USB – connection with the internet using wifi / ethernet

UNIT III RESOURCE MANAGEMENT IN THE INTERNET OF THINGS

Clustering - Software Agents - Data Synchronization - Clustering Principles in an Internet of Things Architecture - The Role of Context - Design Guidelines - Software Agents for Object - Data Synchronization- Types of Network Architectures - Fundamental Concepts of Agility and Autonomy-Enabling Autonomy and Agility by the Internet of Things-Technical Requirements for Satisfying the New Demands in Production - The Evolution from the RFID-based EPC Network to an Agent based Internet of Things- Agents for the Behaviour of Objects

UNIT IV BUSINESS MODELS FOR THE INTERNET OF THINGS

The Meaning of DiY in the Network Society- Sensor-actuator Technologies and Middleware as a Basis for a DiY Service Creation Framework - Device Integration - Middleware Technologies Needed for a DiY Internet of Things Semantic Interoperability as a Requirement for DiY Creation -Ontology- Value Creation in the Internet of Things-Application of Ontology Engineering in the Internet of Things-Semantic Web-Ontology - The Internet of Things in Context of EURIDICE - Business Impact

UNIT V FROM THE INTERNET OF THINGS TO THE WEB OF THINGS:

Resource-oriented Architecture and Best Practices- Designing REST ful Smart Things - Web- enabling Constrained Devices - The Future Web of Things - Set up cloud environment – send data from microcontroller to cloud – Case studies – Open Source e-Health sensor platform – Be Close Elderly monitoring – Other recent projects.

REFERENCES:

1. Charalampos Doukas , Building Internet of Things with the Arduino, Create space, April 2002
2. Dieter Uckelmann et.al, "Architecting the Internet of Things", Springer, 2011
3. Luigi Atzor et.al, "The Internet of Things: A survey, ", Journal on Networks, Elsevier Publications, October, 2010
4. http://postscapes.com/
5. http://www.theinternetofthings.eu/what-is-the-internet-of-things.

MAJOR ELECTIVES FOR VII SEMESTER

BME403	DRUG DELIVERY SYSTEM	L	T	P	C
		3	0	0	3

Prerequisite: BME101, BIT211, BME206

Objective(s): To understand the concepts of drugs and to deliver it in time to the particular site by designing novel delivery drug carriers

Course Outcome(s):

Upon completion of the course, the student will be able to

CO1 Gain knowledge about the properties of drugs

CO2 Understand the factors affecting drug solubility

CO3 Acquire knowledge and design novel drug disperse systems

CO4 Analyze the various formulation methods

CO5 Understand the properties of a drug through chemical transformation

Mapping of COs and POs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1					H							
CO2		H										
CO3				H								H
CO4				H	H							
CO5								H				H

UNIT-I PHYSICOCHEMICAL PROPERTIES OF DRUGS

Activity of drug solutions; Osmotic properties of drug solutions; ionization of drugs in solution.

DRUG STABILITY: Chemical decomposition of drug; kinetics of decomposition in solution; decomposition in the solid phase; factors affecting drug stability.

UNIT-II DRUG SOLUBILITY

Factors affecting drug solubility; solubility products; partitioning.

SURFACE AND INTERFACIAL BEHAVIOR: Surfaces and surfactant; surface activity of drug; insoluble mono layer; adsorption isotherms; applications of adsorption in pharmaceutical science; micellisation; solubilisation using micelles.

UNIT-III DRUG DISPERSE SYSTEMS

Drug emulsions; drug suspensions; applications of disperse systems in delivery of pharmaceuticals; pharmaceutical gels.

POLYMERS FOR DRUG DELIVERY

Types of polymer, pharmaceutical polymers, physicochemical properties of polymers and relationship with structure, properties, kinetics, mechanisms and applications, delivery systems for macromolecules.

UNIT-IV FORMULATION METHODS

Principles, technology and manufacture of sustained drug delivery systems and applications to therapeutic delivery systems designed to release a specific quantity of drug at controlled rates; Diffusional system, Fick's law of diffusion, transdermal delivery, ocular delivery and intra-uterine system; modified-release by coating: enteric and other coated tablets, particles and other systems.

UNIT-V CHEMICAL METHODS

Prodrugs - definition of the prodrug; concept; prodrugs of various functional groups; design strategies for modification of drug properties; modification of the physicochemical, Pharmacokinetics and pharmacodynamic properties of a drug through chemical transformation. Applications of the prodrug approach: transport theory, oral absorption, reduction of side effects, Bioavailability.

TEXT BOOKS

1. Pharmaceutical Biotechnology – S.P. Vyas, V.K. Dixit, CBS publication and Distributors.

REFERENCE BOOKS

1. Industrial microbiology – L.E. Casida JR, New age International (P) Limited Publication
2. Introduction to Biopharmaceutics and Pharmacokinetics, Dr. H.P.Tipnis, Dr. M.S.Nagarsenker, NiraliPrakasan Publications.

BME404	NANOTECHNOLOGY IN MEDICINE	L	T	P	C
		3	0	0	3

Prerequisite: PHY101, PHY132, CHY105

Objective(s): To gain knowledge on nanosystems and to apply the techniques for health care industry.

Course Outcome(s):

Upon completion of the course, the student will be able to

CO1 Improvise the knowledge in physics of solid state

CO2 Understand the fundamentals of nanoscience

CO3 Demonstrate the preparation of nanosystems

CO4 Characterize different nanosystems

CO5 Apply the knowledge acquired in medicine

Mapping of COs and POs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	M										
CO2	M	L										
CO3		M	M									
CO4		M										
CO5	M	M										

UNIT I INTRODUCTION TO PHYSICS OF SOLID STATE

Intermolecular forces: thermodynamic aspects - Quantum Mechanical Treatment of the Many-Particle Problem - Potential Energy Surface - Pair Potential Approximation - Advantages and Limitations of the Pair Potential Approximation - Phenomenological Potentials - Pseudo-Potentials - Many-Body Potentials.

UNIT II FUNDAMENTALS OF NANOSCIENCE

Size dependence of properties - Particle size determination - Bulk to nano transition - Semiconducting nanoparticles - Carbon nanostructures - Mechanical properties (hardness, ductility, elasticity) - Optical properties of nanotubes - Electrical properties of nanotubes.

UNIT III PREPARATION OF NANOSYSTEMS

Introduction to nanolithography - Carbon nanotubes: preparation - Synthesis and preparation of nanomaterials (crystalline and thinfilm) - Physical and chemical methods - Control and stability (size, shape, composition).

UNIT IV CHARACTERIZATION OF NANOSYSTEMS

Thermal Stability - Basic Material Properties - Mean Values and Correlation Functions - X-ray diffraction - Scanning Electron Microscopy - Scanning Tunneling Microscopy - Electron Microscopy - X-ray absorption spectroscopy – Photoelectron emission spectroscopy.

UNIT V APPLICATIONS: POTENTIAL OF NANOTECHNOLOGY IN MEDICINE

Nanotubes, nanowires, and nanodevices-introduction - Functional Nanostructures – Introduction to molecular electronics - Field emission and Shielding - Microelectromechanical systems (MEMs) - Nanoelectromechanical systems (NEMs) - Molecular and Supramolecular Switches – Biosensors – Qdots – Nanoshells – Nanobiotix – Cancer detection – Drug Delivery using Nanoparticles and Molecular Carriers.

TEXT BOOKS

1. Di Ventra, Massimiliano; Evoy, Stephane; Heflin, James R., Introduction to Nanoscale Science and Technology, Springer publications, 2004 (UNITS I, II, III & IV)

2. Vinod Labhasetwar, Diandra L. Leslie-Pelecky, Biomedical Applications Of Nanotechnology, Wiley-Interscience A John Wiley & Son, Inc., Publication, 2007 (UNIT V) .

REFERENCE BOOKS

1. Chattopadhyay, Introduction to Nanoscience and Naotechnology, PHI, 2009
2. B.k. Parthasarathy, Nanoscience and Nanotechnology, Gyan Books, 2007 82
3. Vicki H. Grassian, Nanoscience and Nanotechnology: Environmental and Health Impacts (Hardcover - 2008), John Wiley & Sons
4. T. Pradeep, Nano – The essentials, McGraw-Hill publishers, 2008
5. Bhushan, Bharat (Ed.), Springer Handbook of Nanotechnology, Springer publications, 2nd rev. and extended ed., 2007
6. Tuan Vo-Dinh, Nanotechnology in Biology and Medicine: Methods, Devices, and Applications, CRC Press, Jan 2007

BME405	Bio MEMs	L	T	P	C
		3	0	0	3

Prerequisite: BME203, BME204, EIE207

Objective(s): To understand the principles of MEMS and to design medical devices utilizing the principles

Course Outcome(s):

Upon completion of the course, the student will be able to

CO1 Understand about the materials of MEMs and Microsystems

CO2 Gain knowledge about microsensors and actuators

CO3 Understand the fundamentals of MEMs technology

CO4 Analyze the microfluidic systems

CO5 Apply the MEMs technology in biological applications

CO	POs											
	1	2	3	4	5	6	7	8	9	10	11	12
CO1			M			M	M					L

CO2	M				M							
CO3	M					L	L	L				
CO4	M	L	M		H	M	M	M				M
CO5	M		H	M	M	M	H	M				M

UNIT I MEMS AND MICROSYSTEMS

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 MICROSENSORS AND ACTUATORS

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, gyroscope, piezo actuator. Thermal sensors and actuators- micro machined thermocouple probe, Peltier effect hat pumps, thermal flow sensors

UNIT III MICRO OPTO ELECTRO MECHANICAL SYSTEMS

Fundamental principle of MOEMS technology, light modulators, beam splitter, micro lens, digital micro mirror devices, light detectors, grating light valve, optical switch.

UNIT IV MICROFLUIDIC SYSTEMS

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

UNIT V BIOMEMS

CAD for MEMs, Drug delivery, micro total analysis systems (MicroTAS) detection and measurement methods, microsystem approaches to polymerase chain reaction (PCR), DNA hybridization**.**

TEXT BOOKS:

1. NitaigourPremchandMahalik, " MEMS", Tata McGraw Hill Publishing Company, New Delhi, 2007
2. Tai Ran Hsu , "MEMS and Microsystems design and manufacture", Tata McGraw Hill Publishing Company, New Delhi, 2002
3. Wanjun Wang, Stephen A.Soper, "BioMEMs: Technologies and applications", CRC Press, New York, 2007

BME406	TISSUE ENGINEERING	L	T	P	C
		3	0	0	3

Prerequisite: BME101, BIT211, BME206

Objective(s): To understand the concepts of molecular biology and to aid in new tissue generation and organ transplantation

Course Outcome(s):

Upon completion of the course, the student will be able to

CO1 Have a basic knowledge in tissue engineering

CO2 Culture cells

CO3 Analyze the molecular biology in tissue engineering

CO4 Understand the transplantation

CO5 Get a clear idea on how the tissue engineering applicable for real life

UNIT I INTRODUCTION

Basic definition, Structural and organization of tissues: Epithelial, connective; vascularity and angiogenesis, basic wound healing, cell migration, current scope of development and use in therapeutic and in-vitro testing.

UNIT II CELL CULTURE

Different cell types, progenitor cells and cell differentiations, different kind of matrix, cell-cell interaction. Aspect of cell culture: cell expansion, cell transfer, cell storage and cell characterization, Bioreactors.

UNIT III MOLECULAR BIOLOGY ASPECTS

Cell signaling molecules, growth factors, hormone and growth factor signaling, growth factor delivery in tissue engineering, cell attachment: differential cell adhesion, receptor-ligand binding, and Cell surface markers.

UNIT IV SCAFFOLD AND TRANSPLANT

Engineering biomaterials for tissue engineering, Degradable materials (collagen, silk and polylactic acid), porosity, mechanical strength, 3-D architecture and cell incorporation. Engineering tissues for replacing bone, cartilage, tendons, ligaments, skin and liver. Basic transplant immunology stems cells: introduction, hepatopoiesis.

UNIT V CASE STUDY AND REGULATORY ISSUES

Case study of multiple approaches: cell transplantation for liver, musculoskeletal, cardiovascular, neural, visceral tissue engineering. Ethical, FDA and regulatory issues of tissue engineering.

TEXT BOOK

1. Clemens van Blitterswijk, Tissue Engineering, Academic Press, 2008

REFERENCE:

1. Principles of tissue engineering, Robert. P.Lanza, Robert Langer & William L. Chick, Academic press.
2. The Biomedical Engineering –Handbook, Joseph D. Bronzino, CRC press.
3. Introduction to Biomedical Engg. , Endarle, Blanchard &Bronzino, Academic press.
4. Tissue Engineering, B. Palsson, J.A. Hubbell, R.Plonsey& J.D.

Bronzino, CRC- Taylor & Francis.

BME407	BIOETHICS, IPR AND STANDARDS	L	T	P	C
		3	0	0	3

Prerequisite: BME304

Objective(s): To understand the standards to be maintained while designing biomedical devices considering bioethics

Course Outcome(s):

Upon completion of the course, the student will be able to

CO1 Understand the biomedical ethics

CO2 Analyze the issues arise in biomedical devices

CO3 Know about the basic principles of IPR law

CO4 Describe about the safety measures in order to use a biomedical device

CO5 Understand the biomedical standards

Mapping of COs and POs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1								H				
CO2			H					H				
CO3								H				
CO4								H				
CO5								H				

UNIT I BIOMEDICAL ETHICS

Principles, rules and moral decisions of biomedical ethics, respect for autonomy, voluntariness information and informed consent, competency, non-maleficence, the rule of the double effect, beneficence, paternalism, justice.

UNIT II ETHICAL ISSUES IN DESIGN AND MANUFACTURE OF MEDICAL DEVICES

Cost benefit analysis, professional restrictions and responsibility, rights of engineers, conflict of interest, codes of ethics for biomedical engineers, ethics of implant use and marketing.

UNIT III BASIC PRINCIPLES OF IPR LAWS

History of IPR-GATT,WTO,WIPO & TRIPs, Role of IPR in Research & Development, Concept of property, Different forms of IPR – copyright, trade mark, Industrial Designs, Layout designs of Integrated circuits, Patents, Geographical Indications, Traditional Knowledge, Plant varieties, Trade secrets

UNIT IV SAFETY

Regulatory Authorities for medical device regulation in India (CDSCO), Global Harmonization Task Force for device regulation abroad, Quality management system for medical devices (ISO 9001 and ISO13485)

UNIT V STANDARDS

Safety and standardization for risk management (ISO 14971), European standard conformity (CE marking), FDA guidelines for medical devices approval and classification based on risk assessment.

REFERENCE BOOKS:

1. Daniel A Vallero, “Biomedical ethics for Engineers”, Academic Press, New York, 2007.
2. Ronald Munson, “Intervention and Reflection: Basic Issues in Medical Ethics”, Wadsworth Pub. Co., 1992.
3. PrabuddghaGanguli, “Intellectual Property Rights”, TMH Publishing Co. Ltd., 2001.
4. Patents by N.R. Subbaram, Pharma Book Syndicate, Hyderabad, India, 2006.
5. World Intellectual Property Organizations (WIPO) Handbook/ Notes, WIPO Copyright treaty, 1996.

BME408	CLINICAL ENGINEERING	L	T	P	C
		3	0	0	3

Prerequisite: BME304

Objective(s): To perform the role as a Biomedical engineer in the hospital understanding all the modules involved in hospitals

Course Outcome(s):

Upon completion of the course, the student will be able to

CO1 Classify the architecture and types of hospitals

CO2 Understand how an electrical system should be in a hospital

CO3 Understand the air conditioning and gas systems

CO4 Know about the importance of Biomedical Engineer

CO5 Attain knowledge about the hospital information

	POs											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1							M	L				L
CO2			M			H	H	H		L		L
CO3						H	H	H		L		L
CO4						M	H	H	M	H	H	
CO5						M	H	H		H		L

UNIT I CLASSIFICATION OF HOSPITAL & ARCHITECTURE

General hospital, specialized hospital, primary health care – their role and functions. Aspects of hospital services – inpatient, outpatient and emergency. Location and environment of hospital, Hierarchy of medical and paramedical staff & their functions and responsibilities. Modern Hospital Architecture-space in a hospital building, design of ward, intensive care units, air conditioning, plumbing & sanitation, gas supply, waste disposal, cleaning, dietary, sterilizing, laundry, storage and operation theatre systems, Radiology, Central labs, Blood banks, OPD, Causality, etc.

UNIT II ELECTRICAL POWER SYSTEMS IN HOSPITALS

Safety of electrical systems, Protective systems - interference of patient's protection grounding. Design of sub stations, breakers, Surge protectors, EMI filters, voltage stabilizers, generator sets and UPS. Uninterrupted power supply for ICU and computerized monitoring units. Specification & estimation for hospital wiring - small case study.

UNIT III AIR CONDITIONING & GAS SUPPLY SYSTEMS

Air conditioning and refrigeration systems for small and large areas. Air changes, filtering and sterility. Deodorization, disinfection, dehumidification and cryogenic systems. Centralized supply of air, oxygen, nitrous oxide & vacuum - Principle of production of liquid oxygen. Management lifts fire fighting equipments.

UNIT IV HOSPITAL ENGINEERING & MANAGEMENT

Definition of biomedical Engineering, clinical engineering & hospital engineering. Importance of BME department – servicing and maintenance, testing, acceptance & maintenance protocols, Computerized preventive maintenance planning, MROs. Training of men for medical equipments preventive and periodical maintenance procedures. Preparation of estimates, specifications, tender details etc. Importance of ISO 9000 Certificates - Obtaining ISO certificates in hospitals. Proposed protocols.

UNIT V HOSPITAL INFORMATION SYSTEM

Role of database in HIS. Need of Networking in HIS. Overview of Networking, topologies and its configuration. Structuring medical records to carry out functions like admissions, discharges, treatment history etc. Computerization in pharmacy & billing. Automated clinical laboratory systems & radiology information system.

TEXT BOOK

1. Harold E. Smalley, “Hospital Management Engineering – A guide to the improvement of hospital management system”, PHI.

REFERENCES

1. Sharma, Essentials for Hospital Support Services and Physical Infrastructure, 1/e, Jaypee Medical Publishers 2003
2. Hospital Engineering And Facilities Management 2007 - Report, Fifth official report of the International Federation of Hospital Engineering (IFHE), January 2007
3. Gupta, Kant, Chandrashekhar, Satpathy, Modern Trends in Planning and Designing of Hospitals Principles and Practice with CD-ROM, Jaypee Medical publishers, 1/e, 2007
4. Sakharkar, Principles of Hospital Administration and Planning, Jaypee Medical publishers 1/e, Reprint 2004

SELF- STUDY ELECTIVES FOR SEMESTER VIII

BME409	WEARABLE SYSTEMS	L	T	P	C
		3	0	0	3

Prerequisite: BME203, EIE207, BME301

Objective(s): To design new medical devices based on wearable sensors

Course Outcome(s):

Upon completion of the course, the student will be able to

CO1 Differentiate the sensors that can be used for wearable systems

CO2 Process the signals picked by the wearable sensors

CO3 Utilize different sources of energy to be used for wearable systems

CO4 Analyze the technical aspects of wireless health systems

CO5 Apply the wearable sensors into novel medical applications

Mapping of COs and POs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	L											
CO2		M	M									
CO3		H	M									
CO4		H	H			M		M				
CO5		H	M			H		H				

UNIT I SENSORS

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, E-Textiles, Bio compatibility.

UNIT II SIGNAL PROCESSING

Wearability issues -physical shape and placement of sensor, Technical challenges - sensor design, signal acquisition, Constraint on sampling frequency for reduced energy consumption, light weight signal processing, Rejection of irrelevant information, Data mining

UNIT III ENERGY HARVESTING FOR WEARABLE DEVICES

Solar cell, Vibration based, Thermal based human body as a heat source for power generation, Hybrid thermoelectric photovoltaic energy harvests, Thermopiles.

UNIT IV WIRELESS HEALTH SYSTEMS

Need for wireless monitoring, Definition of Body area network, BAN and Healthcare, Technical Challenges- System security and reliability, BAN Architecture – Introduction, Wireless communication techniques.

UNIT V APPLICATIONS OF WEARABLE SYSTEMS

Medical Diagnostics, Medical Monitoring-Patients with chronic disease, Hospital patients, Elderly patients, Multi parameter monitoring, Neural recording, Gait analysis, Sports Medicine, Smart Fabrics.

TEXT BOOKS:

1. 1.Annalisa Bonfiglio,Danilo De Rossi ,"Wearable Monitoring Systems", Springer, 2011.
2. Sandeep K.S. Gupta,Tridib Mukherjee,Krishna Kumar Venkatasubramanian, "Body Area Networks 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, Implementation and Applications",Pan Stanford Publishing Pvt.Ltd, Singapore, 2012
3. Guang-Zhong Yang(Ed.), "Body Sensor Networks, "Springer, 2006
4. Andreas Lymberis, Danilo de Rossi ,'Wearable eHealth systems for Personalised Health Management - State of the art and future challenges ' IOS press, The Netherlands, 2004

BME410	SPORTS AND BIOMEDICAL ENGINEERING	L	T	P	C
		3	0	0	3

Prerequisite: BME205, BME206

Objective(s): To understand about the needs of a sports person met by a Biomedical Engineer

Course Outcome(s):

Upon completion of the course, the student will be able to

CO1 Illustrate the basics of soft tissue mechanics

CO2 Analyze the mechanics of head and neck after having an injury

CO3 Distinguish the mechanics of different joints of the body

CO4 Interpret the gait analysis

CO5 Discuss the functions of organs during sports and exercise

	POs											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**H**	**L**		**L**	**L**							L
CO2	**M**	**H**	**L**	**M**	**M**	M	L	M	M	M		L
CO3	M	L		L				L	M			
CO4	**M**	**M**	**M**	**H**	**H**	M		M	H	M	M	M
CO5	**M**			**M**		L			M	L		

Unit I soft tissue Biomechanics:

Fundamentals of Soft Tissue Mechanics: Muscle Architecture, Max Muscle Stress, Max Muscle Contraction Velocity, Muscle Force-Length Relationship, Muscle Force-Velocity Relationship, Tendon Biomechanics

Unit II Mechanics of Head and Neck

Injury Mechanisms, Mechanical Response, Regional Tolerance, Biomechanics of Chest and Abdominal Impact, Biomechanical Responses During Impact, Injury Risk Assessment.

UNIT III Biomechanics of Different Joints of Human Body:

Geometry of Articulating Surfaces, Joint Contact, Axes of Rotation of (Ankle, Knee, Hip, Shoulder, Elbow, Wrist, Hand), Tribology (Friction, Wear and Surface Damage), Hydrodynamic Lubrication Theories, Boundary Lubrication, Synovial Joints,

UNIT IV Gait Analysis:

Clinical Gait Analysis Information, Data Collection Protocol, Measurement Approaches and Systems (Stride and Temporal Parameters, Motion Measurement, Ground Reaction Measurement, Dynamic Electromyography)

UNIT V

Physiology in Sports and Exercise: Muscle Energetic, Cardiovascular Adjustments, Maximum Oxygen Uptake, Respiratory Responses, Optimization Techniques, Thermal Response, Applications.

Text Books :

1. J. D. Bronzino, "Biomedical Engineering Handbook", 3rd ed,CRC Press, 2006.
2. Nordine-Frankel, "Basic Biomechanics of the Musculoskeletal System", Lea & Febiger, 2012.
3. Arthur T. Johnson, "Biomechanics and Exercise Physiology", 2nd edition, John Wiley and Sons, 2007.
4. Cappozzo-Berne, "Biomechanics of Human Movement: Applications in Rehabilitation, Sports and Ergonomics", Bertec Corporation, 1990

BME411	BIOMETRIC SYSTEMS	L	T	P	C
		3	0	0	3

Prerequisite: BME301, BME401

Objective(s): To understand the existing biometric systems and to develop novel Biometric systems utilizing unique features of the human body

Course Outcome(s):

Upon completion of the course, the student will be able to

CO1 Understand the concept of Biometrics and its applications

CO2 Illustrate the various methodologies involved in fingerprint technology

CO3 Develop techniques for face recognition and hand geometry biometrics

CO4 Demonstrate the multimodal biometrics and the methods for evaluating the performance

CO5 Distinguish the authentication mechanism of the biometric systems

	POs											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H										
CO2				M								

UNIT I INTRODUCTION TO BIOMETRICS

Introduction and back ground – biometric technologies – passive biometrics – active biometrics -Biometric systems – Enrollment – templates – algorithm – verification – Biometric applications –biometric characteristics- Authentication technologies –Need for strong authentication – Protecting privacy and biometrics and policy – Biometric applications – biometric characteristics

UNIT II FINGERPRINT TECHNOLOGY

History of fingerprint pattern recognition - General description of fingerprints - Finger print feature processing techniques - fingerprint sensors using RF imaging techniques – fingerprint quality assessment – computer enhancement

and modeling of fingerprint images – fingerprint enhancement – Feature extraction – fingerprint classification – fingerprint matching

UNIT III FACE RECOGNITION AND HAND GEOMETRY

Introduction to face recognition, Neural networks for face recognition – face recognition from correspondence maps – Hand geometry – scanning – Feature Extraction - Adaptive Classifiers -Visual-Based Feature Extraction and Pattern Classification - feature extraction – types of algorithm –Biometric fusion.

UNIT IV MULTIMODAL BIOMETRICS AND PERFORMANCE EVALUATION

Voice Scan – physiological biometrics –Behavioral Biometrics - Introduction to multimodal biometric system – Integration strategies – Architecture – level of fusion – combination strategy –training and adaptability – examples of multimodal biometric systems – Performance evaluation- Statistical Measures of Biometrics – FAR – FRR – FTE – EER – Memory requirement and allocation.

UNIT V BIOMETRIC AUTHENTICATION

Introduction - Biometric Authentication Methods - Biometric Authentication Systems – Biometric authentication by fingerprint -Biometric Authentication by Face Recognition. -. Expectation- Maximization theory - Support Vector Machines. Biometric authentication by fingerprint –biometric authentication by hand geometry- Securing and trusting a biometric transaction – matching location – local host - authentication server – match on card (MOC) – Multibiometrics and Two-Factor Authentication

TEXT BOOKS:

1. James Wayman, Anil Jain, Davide Maltoni, Dario Maio, “Biometric Systems, Technology Design and Performance Evaluation”, Springer, 2005 (Units I, II, III & IV)

2. S.Y. Kung, S.H. Lin, M.W.Mak, “Biometric Authentication: A Machine Learning Approach”Prentice Hall, 2005(Unit V)

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.

BME412	SPEECH PROCESSING	L	T	P	C
		3	0	0	3

Prerequisite: BME301, BME202, BME201

Objective(s): To gain knowledge on speech recognition, processing and synthesis techniques

Course Outcome(s):

Upon completion of the course, the student will be able to

CO1 Demonstrate the basic concepts of acoustics and speech processing

CO2 Design and develop techniques for speech analysis

CO3 Develop new models for speech processing

CO4 Describe different methodologies of speech recognition

CO5 Create text to speech synthesis methodologies

Mapping of COs and POs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	L											
CO2		M										
CO3				L								
CO4			M									
CO5					M							

UNIT I BASIC CONCEPTS

Speech Fundamentals: Articulatory Phonetics – Production and Classification of Speech Sounds; Acoustic Phonetics – Acoustics of speech production; Review of Digital Signal Processing concepts; Short-Time Fourier Transform, Filter-Bank and LPC Methods.

UNIT II SPEECH ANALYSIS

Features, Feature Extraction and Pattern Comparison Techniques: Speech distortion measures–mathematical and perceptual – Log–Spectral Distance, Cepstral Distances, Weighted Cepstral Distances and Filtering, Likelihood Distortions, Spectral Distortion using a Warped Frequency Scale, LPC, PLP and MFCC Coefficients, Time Alignment and Normalization – Dynamic Time Warping, Multiple Time – Alignment Paths.

UNIT III SPEECH MODELING

Hidden Markov Models: Markov Processes, HMMs – Evaluation, Optimal State Sequence – Viterbi Search, Baum-Welch Parameter Re-estimation, Implementation issues.

UNIT IV SPEECH RECOGNITION

Large Vocabulary Continuous Speech Recognition: Architecture of a large vocabulary continuous speech recognition system – acoustics and language models – n-gram, context dependent sub-word units; Applications and present status.

UNIT V SPEECH SYNTHESIS

Text-to-Speech Synthesis: Concatenative and waveform synthesis methods, sub-word units for TTS, intelligibility and naturalness – role of prosody, Applications and present status.

TEXT BOOKS:

1. Lawrence Rabiner and Biing-Hwang Juang, "Fundamentals of Speech Recognition", Pearson Education, 2003.
2. Daniel Jurafsky and James H Martin, "Speech and Language Processing – An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition", Pearson Education, 2002.
3. Frederick Jelinek, "Statistical Methods of Speech Recognition", MIT Press, 1997.

REFERENCES:

1. Steven W. Smith, "The Scientist and Engineer's Guide to Digital Signal Processing", California Technical Publishing, 1997.
2. Thomas F Quatieri, "Discrete-Time Speech Signal Processing – Principles and Practice", Pearson Education, 2004.
3. Claudio Becchetti and Lucio Prina Ricotti, "Speech Recognition", John Wiley and Sons, 1999.
4. Ben Gold and Nelson Morgan, "Speech and audio signal processing, Processing and Perception of Speech and Music", Wiley- India Edition, 2006.

BME413	BIOMEDICAL WASTE MANAGEMENT	L	T	P	C
		3	0	0	3

Prerequisite: BME304, CHY102, CHY101

Objective(s): To understand the hazards of biomedical waste and to dispose it in a right way as per the guidelines

Course Outcome(s):

Upon completion of the course, the student will be able to

CO1 Distinguish the different types of hazardous biomedical waste, its handling and disposal methodologies

CO2 Enumerate the hazards caused by non disposal of medical waste

CO3 Analyze the various treatment techniques of processing biomedical waste

CO4 Illustrate the laws for handling the biomedical waste

CO5 Demonstrate the guidelines provided by WHO for management of hospital waste

	POs											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**L**		**H**		**L**	H	M		L	M	L	L
CO2		**L**	**L**	**M**		H	M	M	M	M		
CO3	M	M	H	H	H	H	M	M	M	M	M	L
CO4	**L**			**L**		M	L	M	H	M		L
CO5		**L**		**M**		L	L	M	H	M		L

UNIT I INTRODUCTION

Definition of general and hazardous health care waste, Infectious waste, geno-toxic waste, waste sharps, categorization and composition of Biomedical waste, major and minor sources of biomedical waste, Segregation of waste, Color coding, waste handling and disposal

UNIT II HAZARD OF BIOMEDICAL WASTE

Need for disposal of biomedical waste, Specifically Communicable diseases, Diseases epidemiology and mode of transmission of disease, Environmental pollution by biomedical waste - causes, consequences, mitigation and remedies.

UNIT III TREATMENT TECHNOLOGIES FOR WASTES

Mechanical Treatment & Chemical Disinfections, Conventional Treatment Technologies: Wet thermal technology, Incineration, Microwave Technology, Autoclave system, Hydro clave system, Electro Thermal Reactivation(ETP), Treatment Process Electron beam Technology, Plasma Pyrolysis/Gasificaton systems

UNIT IV LAWS OF BIOMEDICAL WASTE HANDLING

Legislation, policies and law regarding environment on Health care waste management, Biomedical waste management and handling rules 1998 and its amendment.

UNIT V GUIDELINES

CPCB guidelines. World Health Organization guidelines on Management of wastes from Hospital wastes

REFERENCES:

1. Anantpreet Singh, Sukhjit Kaur, “Biomedical Waste Disposal”, 1st ed., Jaypee Publishers (P) Ltd, India, 2012.
2. Sushma Sahai, “Bio-Medical Waste Management”, APH Publishing Corporation, India, 2009.
3. Sanskriti Sharma, “Hospital Waste Management and Its Monitoring”, Jaypee Publishers (P) Ltd, India, 2002.

MINOR ELECTIVES

ECE309	VLSI DESIGN	L	T	P	C
		3	0	0	3

Prerequisite: EIE207

Objective(s): To familiarize the students on design in integrated circuits using CMOS.

Course Outcome(s):

Upon completion of the course, the student will be able to

CO1 Explain the characteristics of CMOS transistors and their circuit level of models.

CO2 Explain the chip technology scaling process.

CO3 Identify the interactions between process parameters device structures, circuit performance and system design.

CO4 Create models of CMOS circuit that realize specified function as mini-project.

CO5 Describe digital system testing and verification strategies.

CO6 Survey literature on new developments in integrated circuit design and communicate the information analyzed from it through reports

Mapping of COs and POs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	L											
CO2		M										
CO3			M	H								
CO4			M		H							
CO5						H						
CO6												

UNIT I INTRODUCTION TO CMOS CIRCUITS

MOS transistors, CMOS Logic, VLSI design flow, Introduction Fabrication, Packaging and Testing, Circuit and System Representations, Introduction MOS transistor theory, MOS Device design equations – Ideal I-V Characteristics, C-V Characteristics, Non-Ideal I-V effects; Complementary CMOS inverter – DC characteristics.

UNIT II CMOS PROCESSING TECHNOLOGY

CMOS Fabrication, Silicon semiconductor technology overview wafer formation, photo lithography, well and channel formation, oxidation, isolation, n-tub, p-tub and twin-tub CMOS process. gate oxide, gate and source/drain formation, contacts and metallization, passivation, metrology; Basic CMOS technology, Stick Diagrams, Design rules and Layouts Layer representation, n-well rules, design rule background, layer assignments.

UNIT III CIRCUIT CHARACTERISATION AND PERFORMANCE ESTIMATION

Introduction, Resistance estimation, Capacitance estimation, Inductance estimation , Switching characteristics Delay estimation-introduction, Transient response, RC delay model, Linear delay model, CMOS gate transistor sizing, Logical effort and transistor sizing, Timing analysis delay models, Power Dissipation Dynamic power, Static power, Energy-delay optimization, Low power architectures

UNIT IV CMOS CIRCUIT DESIGN AND DESIGN METHOD

Combinational Circuit Design , Circuit Families, Circuit Pitfalls, Sequential Circuit Design, Sequencing Static Circuits, Circuit Design of Latches and Flip-Flops, Sequencing Dynamic Circuits, Datapath Subsystems, Addition/Subtraction, One/Zero Detectors, Comparators, Counters, Boolean Logical Operations, Coding.

UNIT V DESIGN METHODOLOGY, TESTING, DEBUGGING, AND VERIFICATION

Introduction, Structured Design Strategies, Design Methods, Design Flows, DC Specifications, AC Specifications, CMOS Physical Design Styles, Pitfalls and Fallacies, Logic Verification, Testers, Test Fixtures, and Test Programs, Logic Verification Principles, Silicon Debug Principles, Manufacturing Test Principles, Design for Testability

TEXT BOOK

1. Neil H. E. Weste, David Harris, CMOS VLSI Design, Pearson India, 4th Edition, 2011.

REFERENCES

1. Neil H. E. Weste, Eshraghian Kamran, Principles of CMOS VLSI Design A System Perspective, Pearson India, 2nd Edition, 2010
2. Neil H. E. Weste, David Harris, Banerjee, CMOS VLSI Design A Circuits and System Perspective, Pearson India, 3rd Edition, 2011
3. Douglas A Pucknell and Eshraghian Kamran, Basic VLSI Design - System and Circuits. PHI, 2003
4. Wayne Wolf, Modern VLSI Design, Pearson India, 2009
5. John .P. Uyemura, Introduction to VLSI Circuits and Systems , Wiley India, 2006

CSE326	CLOUD COMPUTING	L	T	P	C
		3	0	0	3

Objective(s): To familiarize the students with cloud computing principles.

Course Outcome(s):

Upon completion of the course, the student will be able to

CO1 Understand the layers and types of Cloud Computing

CO2 Understand the IaaS, PaaS and SaaS

CO3 Analyze various scheduling techniques for virtual machines in cloud infrastructure

CO4 Implement private/public/hybrid Cloud infrastructure

CO5 Implement policy management system for Cloud Computing

CO6 Design of data security techniques in the Cloud Computing

Mapping of COs and POs												
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	L											
CO2		L										
CO3				L								
CO4			M									
CO5					M							M
CO6												

UNIT I FOUNDATIONS

Introduction to Cloud Computing, Definition, Characteristics, Components, Cloud provider, SAAS, PAAS, IAAS and Others, Organizational scenarios of clouds, Administering & Monitoring cloud services, benefits and limitations, Deploy application over cloud, Comparison

among SAAS, PAAS, IAAS Cloud computing platforms: Infrastructure as service: Amazon EC2,Platform as Service: Google App Engine, Microsoft Azure, Utility Computing, Elastic Computing

UNIT II INFRASTRUCTURE AS A SERVICE (IaaS)

Introduction to Cloud Technologies, Study of Hypervisors, Compare SOAP and REST Webservices, AJAX and mashups-Web services: SOAP and REST, SOAP versus ,REST, AJAX: asynchronous 'rich' interfaces, Mashups: user interface services Virtualization Technology: Virtual machine technology, virtualization applications in enterprises, Pitfalls of virtualization Multitenant software: Multi-entity support, Multi-schema approach, Multi-tenance using cloud data stores, Data access control for enterprise applications,

UNIT III PLATFORM AND SOFTWARE AS A SERVICE

Data in the cloud: Relational databases, Cloud file systems: GFS and HDFS, BigTable, HBase and Dynamo. Map-Reduce and extensions: Parallel computing, The map-Reduce model, Parallel efficiency of Map-Reduce, Relational operations using Map-Reduce, Enterprise batch processing using Map-Reduce, Introduction to cloud development, Example/Application of Mapreduce, Features and comparisons among GFS,HDFS etc, Map-Reduce model

UNIT IV MONITORING AND MANAGEMENT

Cloud security fundamentals, Vulnerability assessment tool for cloud, Privacy and Security in cloud Cloud computing security architecture: Architectural Considerations- General Issues, Trusted Cloud computing, Secure Execution Environments and Communications, Micro-architectures; Identity

Management and Access control-Identity management, Access control, Autonomic Security Cloud computing security challenges: Virtualization security management- virtual threats, VM Security Recommendations, VM-Specific Security techniques, Secure Execution Environments and Communications in cloud.

UNIT V GOVERNANCE AND SECURITY

Issues in cloud computing, Implementing real time application over cloud platform Issues in Intercloud environments, QOS Issues in Cloud, Dependability, data migration, streaming in Cloud. Quality of Service (QoS) monitoring in a Cloud computing environment. Cloud Middleware. Mobile Cloud Computing. Inter Cloud issues. A grid of clouds, Sky computing, load balancing, resource optimization, resource dynamic reconfiguration, Monitoring in Cloud

TEXT BOOKS

1. Cloud Computing for Dummies by Judith Hurwitz, R.Bloor, M.Kanfman, F.Halper (Wiley India Edition)
2. Enterprise Cloud Computing by Gautam Shroff,Cambridge
3. Cloud Security by Ronald Krutz and Russell Dean Vines, Wiley-India

REFERENCE BOOKS

1. Google Apps by Scott Granneman,Pearson
2. Cloud Security & Privacy by Tim Malhar, S.Kumaraswammy, S.Latif (SPD,O'REILLY)
3. Cloud Computing : A Practical Approach, Antohy T Velte, et.al McGraw Hill,
4. Cloud Computing Bible by Barrie Sosinsky, Wiley India

WEB RESOURCES

1. https://www.priv.gc.ca/resource/fs-fi/02_05_d_51_cc_e.pdf
2. http://www.secc.org.eg/recocape/SECC_Tutorials_An%20Introducti on%20to%2 0Cloud%20Computing%20Concepts.pdf
3. http://c.ymcdn.com/sites/www.aitp.org/resource/resmgr/2013-ie-files/cloudrevolution. Pdf
4. https://java.net/jira/secure/attachment/29265/CloudComputing.pdf
5. http://bigdatawg.nist.gov/_uploadfiles/M0008_v1_7256814129.pdf
6. http://csrc.nist.gov/publications/nistbul/june-2012_itl-bulletin.pdf
7. http://www.oracle.com/technetwork/articles/cloudcomp/migrating-to-the-cloudchap- 3-495856.pdf
8. http://www.cisco.com/en/US/services/ps2961/ps10364/ps10370/ps1 1104/Migrat ion_of_Enterprise_Apps_to_Cloud_White_Paper.pdf
9. http://www.oracle.com/us/products/middleware/data-integration/dataintegration- for-cloud-1870536.pdf
10. http://www.cloudbus.org/papers/Aneka-AzurePlatform.pdf
11. http://www.vmware.com/files/pdf/VMware-Hybrid-Cloud-Brochure.pdf
12. http://www.citrix.com/content/dam/citrix/en_us/documents/product ssolutions/
13. hybrid-cloud-provisioning-with-citrix-xendesktop-and-xenapp.pdf
14. https://www.vmware.com/files/pdf/idc-hybrid-cloud-defined-white-paper.pdf
15. http://research.iaun.ac.ir/pd/faramarz_safiold/pdfs/HomeWork_159 1.pdf
16. http://www.vmware.com/files/pdf/operational_readiness_for_cloud_ computing. Pdf
17. http://assets1.csc.com/cloud/downloads/IDC_WP_for_CSC_Cloud_ Adoption.pdf
18. http://www.centerbeam.com/uploads/pdf/CB_Cloud_Assessment.p

df

19. http://www.cognizant.com/InsightsWhitepapers/cgReadinessBrochureWeb.pdf
20. http://www.cloudwatchhub.eu/sites/default/files/CloudComputingSLs ExploitationofResearchResults.pdf
21. http://www.cloudstandardscustomercouncil.org/2012_Practical_Guide_to_Cloud_SLAs.pdf
22. http://www.infosys.tuwien.ac.at/staff/vincent/pub/Emeakaroha_CloudComp2010.pdf

CSE457	NETWORKS AND PROTOCOLS FOR INSTRUMENTATION	L	T	P	C
		3	0	0	3

Objective(s): To familiarize the students on design in integrated circuits using CMOS.

Course Outcome(s):

Upon completion of the course, the student will be able to

CO1 know the basic principle of communication and the modes of data transmission

CO2 Understand the various types of bus devices used for data communication in industry.

CO3 Describe protocols used for data communication

CO4 Distinguish industrial protocols used for data analysis.

CO5 Interpret the concept of network architecture and LAN standards.

Mapping of COs and POs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		L										
CO2			L									
CO3			M									
CO4					M							
CO5						M						

UNIT I INTRODUCTION AND BASIC PRINCIPLES

Protocols - physical standards - modern instrumentation - bits, bytes – characters - communication principles - communication modes - synchronous -

asynchronous systems - transmission characteristics data coding - UART

UNII II SERIAL COMMUNICATION STANDARDS

Standards organizations - serial data communications interface standards - balanced - unbalanced transmission lines - RS232 – 422 – 423 – 449 - 485 interface standard – troubleshooting - 20mA current loop - serial interface converters - interface to printers - IEEE 488 – USB

UNIT III INTRODUCTION TO PROTOCOLS

Flow control protocols - BSC Protocols – HDLC – SDL C - data communication for instrumentation - control, individual OSI layers - OSI Analogy-example

UNIT IV INDUSTRIAL PROTOCOLS

ASCII based protocols - modbus protocols - allen bradley protocol - HART, field bus

UNIT V LOCAL AREA NETWORKS

Circuit - packet switching - network topologies - LAN standards – Ethernet - MAC - token bus - internet work connections – NOS - network architecture - protocols

TEXT BOOK

1. John Park, et al., Wright Practical Data Communications for Instrumentation and Control, Elseiver Publications, 1st edition, ISBN 0750657979

REFERENCES

1. Stallings, W., High speed Networks TCP/IP and ATM Design Principles, PHI , 1998
2. Behrouz A. Forouzan., Data Communication and Networking, 2nd Edition TMH, 2000

BIT411	BIORESOURCE TECHNOLOGY	L	T	P	C
		3	0	0	3

Objective(s): To familiarize the students on understanding the various bioresources and its utilization

Course Outcome(s):

Upon completion of the course, the student will be able to

CO1 Identify various renewable energy sources

CO2 Describe large- scale fuel technologies and bioconversions

CO3 Demonstrate how biogas is produced from various bio-resources

CO4 Distinguish between the processes involved in bioethanol and butanol

CO5 Evaluate the mechanisms involved in biodiesel production

Mapping of COs and POs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1								H				
CO2			L				M					
CO3				M								
CO4						M						
CO5												L

UNIT I RENEWABLE ENERGY SOURCE

Hydropower, geothermal power, solar power, wind power , Biofuel -Biomass - Feed stocks (agricultural crops, bioenergy crops, agricultural waste residues, wood residues, waste stream)

UNIT II FUEL TECHNOLOGY AND BIOCONVERSION

History - Definition of biofuel, applications of biofuel (transport, direct electricity generation, home use and energy content of biofuel) - Bioconversion of lignocellulosics, cellulose saccharification, pretreatment technologies (air separation process, mechanical size reduction, autohydrolysis) - Pulping and bleaching , Enzymatic deinking.

UNIT III BIOGAS

Biogas plant, feed stock materials, biogas production, factors affecting methane formation - Role of methanogens, Biohydrogen production - Oxygen sensitivity problems in hydrogenenases

UNIT IV BIO ETHANOL AND BUTANOL

Advantages of ethanol over fossil fuels, production of ethanol from cellulosic materials, ethanol recovery - Biobutanol production, energy content and effects on fuel economy - Octane rating, air fuel ratio, specific energy, viscosity, heat of vaporization -Butanol fuel mixtures

UNIT V BIODIESEL

Production of biodiesel, oil extraction from algae by chemical solvents, enzymatic, expeller press - Osmotic shock and ultrasonic assisted extraction - Applications of biodiesel, environmental benefits and concerns

TEXT BOOKS

1. Alain A.V., Biomass to biofuels strategies for global Industries, John Wiley & sons ltd, 1st Edition, 2010.
2. Twidell., J & Weir., T., Renewable energy resources, Taylor & Francis 2nd Edition, 2006.

REFERENCE

1. Luque, R., Camp, J., Hand book of biofuel production processes and technologies, Woodhead publishing ltd., 1st Edition, 2011.
2.

BIT419	MOLECULAR DIAGNOSTICS AND THERAPEUTICS	L	T	P	C
		3	0	0	3

Objective(s): To familiarize the students on understanding the diseases in the molecular level and to gain knowledge on therapeutic agents

Course Outcome(s):

Upon completion of the course, the student will be able to

CO1 Explain the molecular techniques for the analysis of Genetic and Neurological disorders

CO2 Discuss current methods of diagnosis for specific diseases, like tuberculosis

CO3 Recognize the importance of monoclonal and polyclonal antibodies in diagnosis

CO4 Apply genetic engineering tools in disease diagnosis.

CO5 Discuss current methods used for production of recombinant protein

Mapping of COs and POs												
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	H		H		H							
CO2		H			H							
CO3		L			H							
CO4			H	H	H							
CO5				H	H							

UNIT I MOLECULAR DIAGNOSIS OF DISORDERS

Biochemical disorders; Immune, Genetic and Neurological disorders; Molecular techniques for analysis of these disorders; Assays for the Diagnosis of inherited diseases; Bioinformatic tools for molecular diagnosis

UNIT II PROTEINS IN DIAGNOSTIC TECHNIQUES

Isolation of proteins and other molecules associated with disease; Process and their profiling for diagnosis; 2D analysis of such proteins by sequencing individual spots by Mass Spectrometry; Protein Micro array; Present methods for diagnosis of Specific diseases like Tuberculosis, Malaria and AIDS; Ethics in Molecular Diagnosis

UNIT III ANTIBODY BASED DIAGNOSIS

Monoclonal antibodies as diagnostic reagents; Production of monoclonal antibodies with potential for diagnosis; Diagnosis of bacterial, viral and

parasitic diseases by using; ELISA and Western blot.

UNIT IV THERAPEUTIC AGENTS

Proteins as therapeutic agents - Choice of expression systems and optimizing gene expression - Applications, delivery and targeting of therapeutic proteins - Engineering human interferons and human growth hormones - Regulatory aspects of therapeutic proteins - Enzymes as therapeutic agents - Use of genetically engineered DNase I and alginate lyase for treatment of Cystic Fibrosis

UNIT V VACCINES

Bacterial polysaccharides, proteins and toxins as vaccines - Recombinant vaccines- subunit, attenuated and vector vaccines - Multivalent vaccine development against AIDS - Commercial and regulatory aspects of vaccine production and its distribution-Production of Recombinant Proteins having therapeutic and diagnostic applications, recombinant vaccine

TEXT BOOKS

1. Campbell, M.A and Heyer L.J., Discovering Genomics, Proteomics and Bioinformatics, CSHL Press, Pearson/Benzamin Cummings San Francisco, USA, 2nd Edition, 2007.

REFERENCES

1. Andrew Read and Dian Donnai, New Clinical Genetics, Scion Publishing Ltd, Oxfordshire, UK, 2007.
2. James W Goding., Monoclonal antibodies: Principles and Practice, Academic Press, 3rd Edition , 1996.

BIT409	CANCER BIOLOGY	L	T	P	C
		3	0	0	3

Objective(s): To familiarize the students on understanding the carcinogens and treating methodologies of cancer

Course Outcome(s):

Upon completion of the course, the student will be able to

CO1 Understand the regulation and modulation of cell cycle in cancer by various signal switches

CO2 Explain and compare various types of carcinogenesis and its Metabolism

CO3 Describe the role of activation of kinases, identification of oncogenes, and how telomerase induced cancer

CO4 Explain metastasis and its significant clinical markers for invasion and metastasis

CO5 Describe molecular tool for early diagnosis of cancer, different forms of cancer chemotherapy and radiation therapy

Mapping of COs and POs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H		H		H							
CO2		H			H							L
CO3		L			H							
CO4			H	H	H							
CO5	L			H	H							H

UNIT I FUNDAMENTALS OF CANCER BIOLOGY

Regulation of cell cycle, mutations that cause changes in signal molecules - Effects on receptor, signal switches, tumour suppressor genes - Modulation of cell cycle in cancer, different forms of cancers, diet and cancer

UNIT II PRINCIPLES OF CARCINOGENESIS

Theory of carcinogenesis -Chemical carcinogenesis, metabolism of

carcinogenesis, principles of physical carcinogenesis, x-ray radiation - Mechanisms of radiation carcinogenesis

UNIT III PRINCIPLES OF MOLECULAR CELL BIOLOGY OF CANCER

Signal targets and cancer, activation of kinases - Oncogenes, identification of oncogenes, retroviruses and oncogenes - Detection of oncogenes, oncogenes and proto oncogene activity - Growth factors related to transformation - Telomerases

UNIT IV PRINCIPLES OF CANCER METASTASIS

Clinical significances of invasion, heterogeneity of metastatic phenotype - Metastatic cascade, basement membrane disruption - Three step theory of invasion, proteinases and tumour cell invasion

UNIT V NEW MOLECULES FOR CANCER THERAPY

Cancer screening and early detection, detection using biochemical assays, tumor markers - Molecular tools for early diagnosis of cancer-Different forms of therapy - Chemotherapy, radiation therapy, detection of cancers, prediction of aggressiveness of cancer, advances in cancer detection, use of signal targets towards therapy of cancer - Gene therapy

TEXT BOOKS

1. Weinberg, R.A., The Biology of Cancer, Garland Science Taylor and Francis Group, New York, 1st Edition, 2007.
2. Kleinsmith. L.J., Principles of Cancer Biology, Pearson Education Inc., San Francisco, CA, 1st Edition, 2006.

REFERENCE

1. DeVita Jr, V.T., Lawrence, T.S., Rosenberg, S.A., DePinho,

R.A. and Weinberg,

2. R.A., DeVita, Hellman, and Rosenberg's Cancer: Principles and Practice of Oncology, Lippincott Williams & Wilkins Philadelphia, PA, 9th Edition, 2011.

BIT311	HEALTHCARE BIOTECHNOLOGY	L	T	P	C
		3	0	0	3

Objective(s): To familiarize the students on understanding the link between biotechnology and health care techniques

Course Outcome(s):

Upon completion of the course, the student will be able to

CO1 Differentiate simple proteins and valuable therapeutic proteins

CO2 Explain the production of various recombinant growth hormones

CO3 Describe production and applications of monoclonal antibodies and vaccines

CO4 Understand the mechanism involving in gene therapy

CO5 Discuss the use of antisense oligonucleotides in neurological disorders

Mapping of COs and POs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H		H		H							
CO2		H			H							L
CO3		L			H							
CO4			H	H	H						H	
CO5	L	M		H	H							H

UNIT I SIMPLE PROTEINS AND THERAPEUTIC AGENTS

Proteins as therapeutic agents - Choice of expression systems and optimizing gene expression - Applications, delivery and targeting of therapeutic proteins , Regulatory aspects of therapeutic proteins

UNIT II HORMONES, RECOMBINANT BLOOD PRODUCTS &ENZYMES AS THERAPEUTIC AGENTS

Insulin, Glucagon, Human growth hormones - Gonadotrophins - Haemostasis , Anticoagulants - Thrombolytic agents - Enzymes of therapeutic value - Asparaginase - Dnase , Glucocerebrosidase , Galactosidase - Urate oxidase , Laronidase - Superoxide dismutase - Debriding agents - Digestive aids

UNIT III MONOCLONAL ANTIBODIES & VACCINES

Introduction to monoclonal antibodies - Development of monoclonal antibodies - Expression of antibody molecules - Purification of monoclonal antibodies - Clinical uses of monoclonal antibodies - Hybrid human - Mouse antibodies - Production of recombinant monoclonal antibodies, Bacterial polysaccharides, proteins and toxins as vaccines - Recombinant vaccines- subunit, attenuated and vector vaccines - Multivalent vaccine development against AIDS

UNIT IV CYTOKINES & GENE THERAPY

Interferons- Engineering human interferons -Tumour necrosis factor , interleukins - Haemopoietic growth factors - Gene therapy , in search of the perfect disease - Gene therapy , the real diseases - Delivery systems for gene therapy - Gene therapy in the clinic

UNIT V PEPTIDES & ANTISENSE OLIGONUCLEOTIDES

The nervous system- Immune responses to peptides - Neurological diseases - The use of peptides in the treatment of neurological disease -The science of antisense - Requirements of a genetic drug- Mechanisms of action of antisense molecules - Animal models and oligonucleotides- Clinical trials- towards the next generation of antisense drugs

TEXT BOOKS

1. Ratledge, C., Kristiansen, B., Basic Biotechnology, Cambridge University Press, USA, 2nd Edition, 2001.
2. Walsh, G., Pharmaceutical Biotechnology: Concepts and

Applications, John Wiley & Sons, England, 2007.
3. Brooks, G., Biotechnology in Healthcare: An introduction to biopharmaceuticals, Pharmaceutical Press, London, 1998.

REFERENCE

1. David, E., Technology and Future of health care, Preparing for the Next 30 years, Jhon Wiley, Singapore, 2nd Edition, 2000.

BIT409	CANCER BIOLOGY	L	T	P	C
		3	0	0	3

Objective(s): To familiarize the students on understanding the carcinogens and treating methodologies of cancer

Course Outcome(s):

Upon completion of the course, the student will be able to

CO1 Understand the regulation and modulation of cell cycle in cancer by various signal switches

CO2 Explain and compare various types of carcinogenesis and its Metabolism

CO3 Describe the role of activation of kinases, identification of oncogenes, and how telomerase induced cancer

CO4 Explain metastasis and its significant clinical markers for invasion and metastasis

CO5 Describe molecular tool for early diagnosis of cancer, different forms of cancer chemotherapy and radiation therapy

Mapping of COs and POs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H		H		H							
CO2		H			H							L
CO3		L			H							
CO4			H	H	H							
CO5	L			H	H							H

UNIT I FUNDAMENTALS OF CANCER BIOLOGY

Regulation of cell cycle, mutations that cause changes in signal molecules - Effects on receptor, signal switches, tumour suppressor genes - Modulation of

cell cycle in cancer, different forms of cancers, diet and cancer

UNIT II PRINCIPLES OF CARCINOGENESIS

Theory of carcinogenesis -Chemical carcinogenesis, metabolism of carcinogenesis, principles of physical carcinogenesis, x-ray radiation - Mechanisms of radiation carcinogenesis

UNIT III PRINCIPLES OF MOLECULAR CELL BIOLOGY OF CANCER

Signal targets and cancer, activation of kinases - Oncogenes, identification of oncogenes, retroviruses and oncogenes - Detection of oncogenes, oncogenes and proto oncogene activity - Growth factors related to transformation - Telomerases

UNIT IV PRINCIPLES OF CANCER METASTASIS

Clinical significances of invasion, heterogeneity of metastatic phenotype - Metastatic cascade, basement membrane disruption - Three step theory of invasion, proteinases and tumour cell invasion

UNIT V NEW MOLECULES FOR CANCER THERAPY

Cancer screening and early detection, detection using biochemical assays, tumor markers - Molecular tools for early diagnosis of cancer-Different forms of therapy - Chemotherapy, radiation therapy, detection of cancers, prediction of aggressiveness of cancer, advances in cancer detection, use of signal targets towards therapy of cancer - Gene therapy

TEXT BOOKS

1. Weinberg, R.A., The Biology of Cancer, Garland Science Taylor and Francis Group, New York, 1st Edition, 2007.
2. Kleinsmith. L.J., Principles of Cancer Biology, Pearson Education Inc., San Francisco, CA, 1st Edition, 2006.

REFERENCE

1. DeVita Jr, V.T., Lawrence, T.S., Rosenberg, S.A., DePinho, R.A. and Weinberg, R.A., DeVita, Hellman, and Rosenberg's Cancer: Principles and Practice of Oncology, Lippincott Williams & Wilkins Philadelphia, PA, 9th Edition, 2011.

CHE358	TRANSPORT PHENOMENA IN BIOLOGICAL SYSTEMS	L	T	P	C
		3	0	0	3

Objective(s): To gain knowledge in various transport processes carried on inside the Biological systems

Course Outcome(s):

Upon completion of the course, the student will be able to

CO1 Describe quantitatively the properties of fluids for momentum transport

CO2 Describe the dynamics of momentum transport

CO3 Develop the ability to describe quantitatively the behavior of energy transport

CO4 Develop the ability to describe quantitatively the behavior of mass transport

C05 Develop the ability to describe quantitatively the behavior of oxygen transport in biochemical systems

Mapping of COs and POs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H		H									
CO2		H										
CO3		L			H							
CO4	M		H	H	H							
CO5					L							

UNIT I INTRODUCTION TO TRANSPORT PROCESSES IN BIOLOGICAL SYSTEMS

Role of transport processes in biological systems , definition of transport processes , Relative importance of convection and diffusion , Transport within cells , Transcellular transport , Physiological transport systems , Application of transport processes in disease pathology, treatment and device development , Relative importance of transport and reaction processes

UNIT II MOMENTUM TRANSPORT IN BIOLOGICAL SYSTEMS

Rheology and flow of blood , Conservation of mass in 3-D , Conservation of linear momentum and Navier-Stokes equation , Fluid motion with more than one independent variable , Dimensional analysis and Dimensionless groups

UNIT III PHYSIOLOGICAL FLOW IN BIOLOGICAL SYSTEMS

Integral form of equation , Bernoulis equation applied to Stenotic heart valves , Boundary layer theory , Flow separation , Lubrication theory , peristaltic pumping

UNIT IV MASS TRANSPORT IN BIOLOGICAL SYSTEMS

Solute fluxes in mixtures , Conservation relations , Constitutive relations , Diffusion as random walk , Estimation of diffusion coefficients in solution , Steady state diffusion in one dimension, unsteady state diffusion in one dimension , Diffusion limited reactions , Electrolyte transport , Diffusion and convection

UNIT V POROUS MEDIA AND TRANSVASCULAR TRANSPORT

Porosity, tortuosity and volume fraction , Fluid flow in porous media , Solute transport in porous media , Fluid transport in poroelastic materials , Pathways for transendothelial transport , rates of transvascular transport , Phenomenological constants in the analysis of transvascular transport , A limitation of Starlings law

TEXT BOOKS

1. Truskey, G.A., Yuan, F., David, F.K., Transport Phenomena in Biological Systems, Prentice Hall, New Jersey, 2nd Edition, 2009.

REFERENCES

1. Bird, R.B., Stewart, W.E., Lightfoot, E.N., Transport Phenomena, Revised John Wiley and sons, Singapore, 2nd Edition, 2007.

CSE403	SOFT COMPUTING	L	T	P	C
		3	0	0	3

Objective(s):

1. To familiarize with soft computing concepts.
2. To introduce the ideas of Neural networks, fuzzy logic and use of heuristics based on human experience.
3. To introduce the concepts of Genetic algorithm and its applications to soft computing using some real time applications.

Course Outcome(s):

Upon completion of the course, the student will be able to

CO1 Explain the major part of Fuzzy sets, Genetic algorithm and Artificial Neural Network

CO2 Understand and Apply Neuro-fuzzy technology.

CO3 Analyze and evaluate existing soft computing methods.

CO4 Create and define innovative soft computing based solutions for real world problem.

CO5 Apply Genetic Algorithms and Artificial Neural Networks as computational tools to Solve a variety of problems in their area of interest ranging from Optimization problems, Pattern recognition and control tasks.

Mapping of COs and POs												
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	H		H									
CO2		H										
CO3		L										
CO4	M		H	H								
CO5					L							

UNIT I AIMS OF SOFT COMPUTING

Aims of Soft Computing-Foundations of Fuzzy Sets Theory-Basic Concepts and Properties of Fuzzy Sets- Elements of Fuzzy Mathematics-Fuzzy Relations-Fuzzy Logic

UNIT II APPLICATION OF FUZZY SETS

Application of Fuzzy Sets-Fuzzy Modeling – Fuzzy Decision Making-Pattern Analysis and Classification-Fuzzy Control Systems-Fuzzy Information Processing-Fuzzy Robotics.

UNIT III ARTIFICIAL NEURAL NETWORKS

Introduction to Artificial Neural Networks- Fundamental models of Artificial Neural Network – Perceptron Networks- Feed Forward Networks – Feedback Networks- Adaptive Resonance theory,Supervised Learning Of Neural Networks -Unsupervised Learning-Rein formation Learning-Application Of Artificial neural network- Probabilistic Reasoning

UNIT IV GENETIC ALGORITHM

Genetic Algorithm Main Operators- Genetic Algorithm Based Optimization-Genetic Algorithm With Group Principle- Comparison Of Conventional And Genetic Search Algorithms-Applications- Elements Of Chaos System-Basic Concepts--Bifurcation And Handling Of Development Of Chaos- Empirical Chaos

UNIT V NEURO-FUZZY TECHNOLOGY

Fuzzy Neural Networks And Their Learning-Architecture Of Neuro-Fuzzy Systems-Generation Of Fuzzy Rules And Membership Functions-Fuzzification And Defzzyfication In Neuro-Fuzzy Systems- Neuro-Fuzzy Identification-Neuro Fuzzy Control- Neuro Fuzzy Navigation System For Intelligent Robot-Combination Of Genetic Algorithm With Neural Networks-Combination Of Genetic Algorithms And Fuzzy Logic- Neuro-Fuzzy-Genetic Approach.

TEXT BOOK

1. Aliev R.A, Aliev R.R., Soft Computing and its Application, World Scientific Publishing Co. Ptd. Ltd., 2001.

REFERENCE BOOKS

1. Cordón, O, Herrera, F, Hoffman F, Magdalena L., Genetic Fuzzy systems, World Scientific Publishing Co. Pvt. Ltd., 2001.
2. Kecman, V, Learning and Soft Computing, The MIT Press, 2001.
3. Mehrotra, K, Mohan C, K, Ranka, S, Elements of Artificial Neural Networks, The MIT Press, 1997.
4. S.N.Sivanandam,S.Sumathi,S.N.Deepa, Introduction to neural network using MATLAB 6.0, TMH private limited.
5. S.N.Sivanandam,S.Sumathi,S.N.Deepa , Principles of soft computing ,Wiley publications.

WEB RESOURCES

- www2.cs.uh.edu/~ceick/6367/Soft-Computing.pdf
- http://www.cb.uu.se/~joakim/course/fuzzy/vt07/lectures/L1_4.pdf
- http://utb.edu.vn/elib/Toan%20hoc/Fuzzy%20Mathematics.pdf

- http://reference.wolfram.com/applications/fuzzylogic/DemonstrationNotebooks/3.html
- http://fuzzy.cs.uni-magdeburg.de/ci/fs/fs_ch05_relations.pdf
- www.cse.unr.edu/~bebis/CS365/StudentPresentations/FuzzyLogic.ppt
- http://www.dca.fee.unicamp.br/~gomide/courses/IA861/transp/FSE_Chap10.pdf
- http://www.eenets.com/Files/Download/chapter_5.pdf
- http://www2.ece.ohio-state.edu/~passino/FCbook.pdf
- http://www.cool-ai.com/lecture.notes/fuzzy.logic.pdf
- http://www.cse.unr.edu/~bebis/MathMethods/NNs/lecture.pdf
- http://www.eis.mdx.ac.uk/staffpages/rvb/teaching/BIS3226/hand11.pdf
- http://www.cc.gatech.edu/~bhroleno/rnn_slides.pdf
- http://www.cs.bham.ac.uk/~jxb/INC/l12.pdf
- http://medusa.sdsu.edu/Robotics/Neuromuscular/Theses/Hongyu/chapter3.pdf
- http://www.astro.caltech.edu/~george/aybi199/Donalek_Classif.pdf
- https://graphics.ethz.ch/teaching/former/vc_master_06/Downloads/T7_SVM_Perceptrons_6.pdf
- http://www.obitko.com/tutorials/genetic-algorithms/ga-basic-description.php
- www.iitk.ac.in/kangal/papers/sadhana.ps.gz
- http://www.cmmacs.ernet.in/cmmacs/Lect_notes/choas%20theory.pdf
- http://www.softcomputing.net/gabrys.pdf
- http://www.cs.rit.edu/~lr/courses/ai/lectures/topic10.PDF
- http://gmm.fsksm.utm.my/~mariyam/BAHAN_MENGAJAR/HybridSoftComputing_ProfA jith_18FEB2009.pdf

BME323 DESIGN OF BIOMEDICAL INSTRUMENTS	L	T	P	C
	3	0	0	3

Objective(s)

To introduce the students to the application of biomedical instrumentation and to familiarize the students with the analysis and design of different instrument to measure biosignals. It also includes brief study of different medical instrument and their use in physiological measurements

Course Outcome(s)

Up on completion of the course, the students will be able to

CO 1 Understand the basic building blocks of Medical instrumentation system.

CO 2 Learn several signals and design parameters of ECG, EEG, EMG, ERG and MEG.

CO 3 Understand the various blood flow measurement systems.

CO 4 Design a respiratory system model and various techniques to measure air flow.

CO 5 Understand different assisting and therapeutic equioments.

Mapping of COs and POs

CO	POs												PSOs			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	L		M	L		M	M							L	M	
CO2	L		L			L	M	M				L			M	
CO3	M	L	M				L						L			L
CO4	M	M	M	M									M	L		L
CO5	M	H	H	H	M	M	L	L			M	L	M	H	M	M

UNIT I - BASIC CONCEPTS OF MEDICAL INSTRUMENTATION (9 HOURS)

General Medical Instrumentation System, Medical Measurement Constraints, Alternative Operation modes, Classification of Biomedical Instruments, Interfering and Modifying inputs, Compensation techniques, Design Criteria.

UNIT II - THE ORIGIN OF BIOPOTENTIAL (9 HOURS)

Electrical Activity of Excitable Cells, Volume Conductor fields, Functional orgsnizatoin of the peripheral nervous system, Electroneurogram, Electromyogram, Electrocardiogram, Electroretinogram, Electroencephalogram, Magnetocepahalogram.

UNIT III - MEASUREMENT OF BLOOD PRESSURE, FLOW AND VOLUME

(9 HOURS)

Direct measurement, Harmonic analysis of Blood Pressure, Indicator Dilution method that uses continuous Infusion and rapid injection, Electromagnetic flowmeters, Ultrasonic flowmeters, Chamber Plethysmography, electrical Impedance Plethysmography, Photoplethysmography.

UNIT IV - MEASUREMENT OF RESPIRATORY SYSTEM (9 HOURS)

Modeling the respiratory system, measurement of pressure, measurement of gas flow, lung volume, respiratory plethysmography.

UNIT V - THERAPEUTIC AND PROSTHETIC DEVICE (9 HOURS)

Cardiac Pacemakers and other Electric Simulators, Defibrillators and Cardioverters, Mechanical Cardiovascular orthotic and prosthetic devices,

hemodialysis, Lithotripsy, Ventilators, Infant Incubators, Surgical Instruments

TEXT BOOKS

1. J.Webster, "Medical Instrumentation: application and Design", John Wiley & Sons; 4th Revised edition 2009

REFERENCES

1. Leslie Cromwell, "Biomedical Instrumentation and Measurement", Prentice Hall of India, New Delhi, 2007
2. Joseph J. Carr and John M. Brown, "Introduction to Biomedical Equipment Technology", Pearson Education, 2004.
3. L.A Geddas and L.E.Baker "Principles of Applied Biomedical Instrumentation" 2004.
4. John G. Webster, "Bioinstrumentation", John Willey and sons, New York, 2004.
5. Myer Kutz "Standard Handbook of Biomedical Engineering & Design", McGraw-Hill Publisher, 2003.

BME322 MECHANICS OF BIOLOGICAL SYSTEMS	L	T	P	C
	3	0	0	3

Objective(s) To understand about the needs of a sports person met by a Biomedical Engineer.

Course Outcome(s)

Upon completion of the course, the student will be able to

CO1 Illustrate the basics of soft tissue mechanics
CO2 Analyze the mechanics of head and neck after having an injury
CO3 Distinguish the mechanics of different joints of the body
CO4 Interpret the gait analysis
CO5 Discuss the functions of organs during sports and exercise

COs	POs											
	1	2	3	4	5	6	7	8	9	10	11	12
CO1	H	L		L	L							L
CO2	M	H	L	M	M	M	L	M	M	M		L
CO3	M	L		L				L	M			
CO4	M	M	M	H	H	M		M	H	M	M	M
CO5	M			M		L			M	L		

UNIT I - SOFT TISSUE BIOMECHANICS
(9 HOURS)

Fundamentals of Soft Tissue Mechanics: Muscle Architecture, Max Muscle Stress, Max Muscle Contraction Velocity, Muscle Force-Length Relationship, Muscle Force-Velocity Relationship, Tendon Biomechanics.

UNIT II - MECHANICS OF HEAD AND NECK
(9 HOURS)

Injury Mechanisms, Mechanical Response, Regional Tolerance, Biomechanics of Chest and Abdominal Impact, Biomechanical Responses During Impact, Injury Risk Assessment.

UNIT III-BIOMECHANICS OF DIFFERENT JOINTS OF HUMAN BODY (9 HOURS)

Geometry of Articulating Surfaces, Joint Contact, Axes of Rotation of (Ankle, Knee, Hip, Shoulder, Elbow, Wrist, Hand), Tribology (Friction, Wear and Surface Damage), Hydrodynamic Lubrication Theories, Boundary Lubrication, Synovial Joints.

UNITIV - GAIT ANALYSIS
(9 HOURS)

Clinical Gait Analysis Information, Data Collection Protocol, Measurement Approaches and Systems (Stride and Temporal Parameters, Motion Measurement, Ground Reaction Measurement, Dynamic Electromyography).

UNIT V - PHYSIOLOGY IN SPORTS AND EXERCISE (9 HOURS)

Muscle Energetic, Cardiovascular Adjustments, Maximum Oxygen Uptake, Respiratory Responses, Optimization Techniques, Thermal Response, Applications.

TEXT BOOKS

1. J. D. Bronzino, "Biomedical Engineering Handbook", 3rd ed,CRC Press, 2006.
2. Nordine-Frankel, "Basic Biomechanics of the Musculoskeletal System", Lea & Febiger, 2012.
3. Arthur T. Johnson, "Biomechanics and Exercise Physiology", 2nd edition, John Wiley and Sons, 2007.

REFERENCES

1. Duane Knudson, "Fundamentals of Biomechanics", Springer, 2nd Edition, 2007.
2. Donald R.Peterson, Joseph D.Brozino, "Biomechanics –Principles and Applications", 2nd Edition, CRC press, 2007.
3. Ross Ethier, Craig A.Simmons, "Introductory Biomechanics-from cells to organisms", 1st edition, Cambridge University Press, 2007.
4. ees Oomens, Marcel Brekelmens, Frank Baaijens, "Biomechanics: Concepts and Computation", 1st edition, Cambridge University Press, 2010

BME414 NEURAL ENGINEERING	L	T	P	Credit
	3	0	0	3
Pre-requisite: Nil **Course Category:** Professional electives **CourseType**: Theory				

Objective(s)

The student should be made to:

- Be familiar with the nervous system development
- Be exposed to neuronal diseases and disorders
- Be familiar with nerve reconstruction and repairing.

Course Outcome(s)

Upon Completion of the course, the students will be able to

CO1 Explain the structure of neuron and nervous system development.

CO2 Discuss about the brain and Spinal cord

CO3 Describe the electrical conduction happens in nervous system.

CO4 Explain various neuro degenerative, demyelinated and injury related disorders associated with nervous system.

CO5 Apply neural tissue engineering for rehabilitation Regenerate nervous system.

	POs											
COs	1	2	3	4	5	6	7	8	9	10	11	12
CO1	M	M										
CO2	M	M										
CO3	M	M										
CO4	M	M										
CO5	M	M										

UNIT I - BASICS OF NEURON STRUCTURE AND FUNCTIONS (9 HOURS)

Nervous system development. Trophic factors, extra cellular matrix components in nervous system development.

Neuron: structure –function –classification. Glial cells – myelination - Neurotransmitter – types and functions. Synapses - Transport of materials and impulse in neurons; Blood Brain barrier.

UNIT II - BRAIN, BRAIN STEM AND SPINAL CORD (9 HOURS)

Brain: structures –lobes – functional areas. Brain stem: structures – functional areas. Spinal cord: structure –functions. Concepts of nuclei - Tracts - Reticular formation. Blood supply of Brain and spinal cord.

UNIT III - NEUROPHYSIOLOGY & NEURORADIOLOGY (9 HOURS)

Physiology of nerve conduction. Peripheral nerves – structure & Functions. Synaptic transmission and cellular signaling of Neurons. Electrical activity of the Brain and recording of brain waves. Evoked potentials. Visualization of nervous system.

UNIT IV - NEURONAL DISEASES AND DISORDERS (9 HOURS)

Neuro degeneration: Degenerative, Demyelinated and injury related disorders associated with
nervous system. Wallerian Degeneration. Neuronal plasticity - CNS acting drugs and their pharmacokinetics.

UNIT V - NERVE RECONSTRUCTION AND REPAIRING (9 HOURS)

Regeneration of the nervous system. Nerve graft; Neural tissue engineering; Drug delivery system in CNS. Cognitive & neurobehavioral rehabilitation.

TEXT BOOKS

1. Mathews G.G. "Neurobiology", 2nd edition, Blackwell Science, UK, 2000.
2. Malcom Carpenter, "Neuroanatomy", Mc Graw Hill 4thEdition.

REFERENCES

1. W. Mark Saltzman Tissue Engineering –Engineering principles for design of replacement organs and tissue –-Oxford University Press Inc New York 2004.
2. Park J.B., "Biomaterials Science and Engineering", Plenum Press, 2005

BME415 ADVANCED DIGITAL SIGNAL PROCESSING	L	T	P	C
	3	0	0	3

Objective(s)

To strengthen students' knowledge of DSP fundamentals and familiarize them with practical aspects of DSP algorithm development and implementation.

Course Outcome(s)

Up on completion of the course, the students will be able to

CO 1 Know the analysis of discrete time signals.

CO 2 Understand the modern digital signal processing algorithms and estimate unknown parameters from the measured data.

CO 3 Design a filter to remove different types of noises.

CO 4 Design a model for speech signal and estimate parameters using modern algorithms.

CO 5 Understand different types of transforms.

Mapping of COs and POs

	POs											
COs	1	2	3	4	5	6	7	8	9	10	11	12
CO1	M											
CO2		M										
CO3			H	H	H							
CO4			H	H	H							
CO5	H											

UNIT I - DISCRETE RANDOM PROCESS
(9 HOURS)

Discrete Random Processes- Expectation- Variance- Co-Variance- Uniform- Gaussian and Exponentially distributed noise - Hilbert space and inner product for discrete signals -Energy of Discrete Signals- Parseval's Theorem- Wiener Khintchine Relation- Power Spectral Density- Sum Decomposition Theorem- Spectral Factorization Theorem - Discrete Random Signal Processing by Linear Systems - Simulation of White Noise - Low Pass Filtering of White Noise-

UNIT II - POWER SPECTRUM ESTIMATION (9 HOURS)

Sample auto correlation–Periodogram- Use of DFT in power spectrum estimation- Non– parametric methods:-Bartlett- Welch and Blackman-Tukey method- Parametric methods:- Model based Approach - AR-MA- ARMA Signal Modeling-Parameter Estimation using Yule-Walker Method- Solutions using Durbin's algorithm.

UNIT III - ADAPTIVE & MULTIRATE SIGNAL PROCESSING
(9 HOURS)

FIR adaptive filters – steepest descent adaptive filter – LMS algorithm – convergence of LMS algorithms – Application: noise cancellation – channel equalization – adaptive recursive filters – recursive least squares- Decimation by a factor D – Interpolation by a factor I – Filter Design and implementation for sampling rate conversion: Direct form FIR filter structures – Polyphase filter structure.

UNIT IV - SPEECH SIGNAL PROCESSING (9 HOURS)

Digital models for speech signal : Mechanism of speech production – model for vocal tract- radiation and excitation – complete model – time domain processing of speech signal:- Pitch period estimation – using autocorrelation function – Linear predictive Coding: Basic Principles – autocorrelation method – Durbin recursive solution.

UNIT V - ADVANCED TRANSFORMS (9 HOURS)

Fourier Transform : Its power and Limitations – Short Time Fourier Transform – The Gabor Transform - Discrete Time Fourier Transform and filter banks – Continuous Wavelet Transform – Wavelet Transform Ideal Case – Perfect Reconstruction Filter Banks and wavelets – Recursive multi-resolution decomposition – Haar Wavelet – Daubechies Wavelet-

REFERENCES

1. Monson H-Hayes – Statistical Digital Signal Processing and Modeling- Wiley- 20002.
2. John G-Proakis- Dimitris G-Manobakis- Digital Signal Processing- Principles- Algorithms and Applications- Third edition- (2000) Pearson/PHI.
3. Roberto Crist- Modern Digital Signal Processing- Thomson Brooks/Cole (2004).
4. Raghuveer- M- Rao- Ajit S-Bopardikar- Wavelet Transforms- Introduction to Theory and applications- Pearson Education- Asia- 2000.

HUMANITIES ELECTIVES

HSS001	TOTAL QUALITY MANAGEMENT	L	T	P	C
		3	0	0	3

Prerequisite: HSS101, HSS102 , Basic knowledge in Management

Objective(s): To familiarize the students with

1. Implement the principles and concepts inherent in a Total Quality Management (TQM) approach to managing a manufacturing or service organization.
2. Understand the philosophies--including similarities and differences--of the gurus of TQM in order to better evaluate TQM implementation proposals offered by quality management organizations and consultants.
3. Successfully implement process improvement teams trained to use the various quality tools for identifying appropriate process improvements.
4. Assess exactly where an organization stands on quality management with respect to the ISO 9000 quality management standard and the Baldrige Award criteria.
5. Develop a strategy for implementing TQM in an organization.

Course Outcome(s):

Upon completion of the course, the student should be able to:

CO1 Explain meaning of TQM and frameworks

CO2 Describe the evolution of TQM

CO3 Identify the features of TQM and philosophy

CO4 Derive tools for identity and solving quality problem

CO5 Apply the knowledge of quality management in their field of use

Mapping of COs and POs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1						H				L	L	
CO2							L			L		M
CO3						M	M	L	L	L	L	
CO4									H	L	M	H
CO5							M	L	L	L	L	L

UNIT I INTRODUCTION TO QUALITY MANAGEMENT

Definitions – TOM framework, benefits, awareness and obstacles. Quality – vision, mission and policy statements. Customer Focus – customer perception of quality, Translating needs into requirements, customer retention. Dimensions of product and service quality. Cost of quality.

UNIT II PRINCIPLES AND PHILOSOPHIES OF QUALITY MANAGEMENT

Overview of the contributions of Deming, Juran Crosby, Masaaki Imai, Feigenbaum, Ishikawa, Taguchi, Shingeo and Walter Shewhart. Concepts of Quality circle, Japanese 5S principles and 8D methodology.

UNIT III STATISTICAL PROCESS CONTROL AND PROCESS CAPABILITY

Meaning and significance of statistical process control (SPC) – construction of control charts for variables and attributed. Process capability – meaning, significance and measurement – Six sigma concepts of process capability. Reliability concepts – definitions, reliability in series and parallel, product life characteristics curve. Business process re-engineering (BPR) – principles, applications, reengineering process, benefits and limitations.

UNIT IV TOOLS AND TECHNIQUES FOR QUALITY MANAGEMENT

Quality functions development (QFD) – Benefits, Voice of customer, information organization, House of quality (HOQ), building a HOQ, QFD process. Failure mode effect analysis (FMEA) – requirements of reliability, failure rate, FMEA stages, design, process and documentation.

UNIT V TAGUCHI TECHNIQUES

Taguchi techniques – introduction, loss function, parameter and tolerance design, signal to noise ratio. Seven old (statistical) tools. Seven new management tools. Bench marking and POKA YOKE.

References:

1. Dale H.Besterfield et al, Total Quality Management, Thrid edition, Perarson Education (First Indian Reprints 2004).
2. Shridhara Bhat K, Total Quality Management – Text and Cases, First Edition 2002, Himalaya Publishing House.
3. William J.Kolarii, Creating quality, Mcgraw Hill, 1995
4. Poornima M.Charantimath., Total quality management, Pearson Education, First Indian Reprint 2003

HSS002	ENGINEERING MANAGEMENT	L	T	P	C
		3	0	0	3

Prerequisite: HSS101, HSS102

Objective(s):

To familiarize the students with Understanding and functional knowledge of the following processes:

1. Production Analysis and Plant Location
2. Demand Forecasting and Economic Optimization
3. Business and Coordination
4. Leadership, Team Work and Creativity
5. Product development and Management Techniques Just in time Managerial Ethics and Social Responsibilities

Course Outcome(s):

Upon completion of the course, the student should be able to:

CO1 Explain the Management Techniques in Product Development

CO2 Describe cognitive and affective growth related to ethics and leadership skills and emotional intelligence.

CO3 Assess team, team member and project performance.

CO4 Explain multinational strategies in Global environment.

CO5 Improve skills in effective communication both Oral and written, especially with regard to Management issues in Engineering.

CO6 Engage with their peers in public discourse with diversity in culture on ethical challenges, which serves to inform autonomous choices and manage differing opinions on complex management scenarios.

Mapping of COs and POs												
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1							M				H	
CO2						L		H	H	L		H
CO3											M	
CO4						M		L				M
CO5												L
CO6						L		M	L	L	L	L

UNIT I DEMAND AND REVENUE ANALYSIS

Introduction - Demand and Revenue Analysis - Demand Forecasting - Production Analysis - Cost and Supply Analysis, Price and output Determination - Investment Analysis - Plant Location - Economic Optimization.

UNIT II FORMS OF BUSINESS AND FUNCTIONS

Types of Business Organization, Forms, Planning - Organizing - Designing effective organizations - Coordination.

UNIT III HUMAN RESOURCE DEVELOPMENT

Motivating individuals and workgroups - Leadership for Managerial Effectiveness - Team working and Creativity - Managerial Communication - Personal Management – Time Management - Stores Management - Career Planning.

UNIT IV FINANCIAL MANAGEMENT

Product development - Management techniques in product development - Nature of controlling - Operations Management - Just-in-Time.

UNIT V GLOBAL ENVIRONMENT

Managing World Economic Change - The global environment - Multinational Strategies - Economic Cycles and Director Investment - Change and Organization Development - Managerial Ethics and Social responsibilities.

References:

1. Harold Koontz& Heinz Weihrich - Essentials of Management Tata McGraw Hill publishing company Ltd.
2. Koontz, Weihrich& Aryasri – Priniciples of Management Tata McGraw Hill publishing company Ltd.
3. Tripathi& Reddy - Priniciples of Management Tata McGraw Hill publishing company Ltd.
4. Hampton – Management Tata McGraw Hill publishing company Ltd.
5. L.M.Prasad - Principles of Management.

HSS004	INDUSTRIAL PSYCHOLOGY	L	T	P	C
		3	0	0	3

Prerequisite: HSS101, HSS102

Objective(s): To familiarize the students with

1. Critically evaluate psychological research as well as the popular notions of human behavior.
2. Use the primary literature of the field and prepare a clear, organized summary of a topic.
3. Use computers for the preparation of manuscripts, the analysis of data, and communication.

Course Outcome(s):

Upon completion of the course, the student should be able to:

CO1 Apply psychological theories and concepts to problems and questions they find personally important

CO2 Apply psychological theories concepts and principles to personal and broader social systems and issues

CO3 Recognize and understand the complexity of cultural diversity

CO4 Apply basic methods in psychology

CO5 Design of equipments based on different work methods

Mapping of COs and POs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1						H	M		M	L		H
CO2						M	L	H	L	L		M
CO3						L			M	L	H	M

CO4										L	H	
CO5										L	H	H

UNIT I ROLE OF THE PSYCHOLOGY

The role of the psychologist in industry, The field of occupational Psychology: Study of behaviour in work situation and applications of psychological principles to problems of selection, placement, counselling and training

UNIT II DESIGN OF WORK ENVIRONMENTS:

Human engineering and physical environment techniques of job analysis, Social environment- Group dynamics in Industry Personal psychology: Selection, training, placement, promotion, counseling, job motivations, job satisfaction. Special Study of problem of fatigue, boredom and accidents

UNIT III UNDERSTANDING CONSUMER BEHAVIOUR

Consumer behavior; study of consumer preference, effects of advertising, Industrial morale The nature and scope of engineering psychology, its application to industry.

UNIT IV WORK METHODS

Efficiency at work: the concept of efficiency, the work curve, its characteristics. The work methods; hours of work, nature of work, fatigue and boredom, rest pauses. The personal factors; age abilities, interest, job satisfaction The working environment: noise, illumination atmospheric conditions. Increasing efficiency at work; improving the work methods; Time and motion study, its contribution and failure resistance to time and motion studies, need for allowances in time and motion study.

UNIT V WORK AND EQUIPMENT DESIGN

Criteria in evaluation of job-related factor, job design, human factors, Engineering information, input processes, mediation processes, action processes, methods design, work space and its arrangement, human factors in

job design. Accident and Safety: The human and economic costs of accidents, accident record and statistics, the causes of accidents situational and individual factors related to accident reduction.

References:

1. Tiffin,J and McCormic E.J.: Industrial Psychology, (Prentice Hall), 6th Edn., 1975
2. McCormic E.J.: Human Factors engineering and design (McGraw Hill), 4th Edn.,1976 Mair, N.R.F.: Principles of Human relations
3. Gilmer: Industrial Psychology
4. Ghiselli & Brown: Personnel and Industrial Psychology
5. Myer: Industrial Psychology
6. Dunnete, M.D.: Handbook of Industrial and Organizational Psychology Blum & Taylor: Industrial Psychology

HSS005	CONSUMER PSYCHOLOGY	L	T	P	C
		3	0	0	3

Prerequisite: HSS101, HSS102, Basics in Management

Objective(s): To familiarize the students with Understanding and functional knowledge of the following processes:

1. To understand current psychological, sociological and anthropological theories that provide insight into consumer behavior
2. Recognize which theoretical concepts are relevant to a particular decision- making context (such as a case study or discussion question), demonstrate clearly how these principles apply, and provide responses that are supported with evidence

Course Outcome(s):

Upon completion of the course, the student should be able to:

CO1 Identify the mental processes that guide consumer perception attitudes memory and choices

CO2 Analyze how these processes might differ as a consequence of social, cultural and group influences and apply this knowledge to generate effective marking tactics

CO3 Provide recommendations if needed for public policy to protect consumer right

Mapping of COs and POs												
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1						H		H	M		M	H
CO2						H		L		H	L	M
CO3						M	L	L	M	L		M

UNIT I CONSUMER BEHAVIOUR

Introduction – Consumer behaviour – concepts – dimensions of consumer behaviours – application of consumer behaviour knowledge in marketing decisions – approaches to the study of consumer behaviour.

UNIT II LEARNING AND DECISION MAKING PROCESS

Motivation, ability and opportunity; exposure, attention and perception Categorizing and comprehending information Attitude formation and change – memory and retrieval Process of decision making – psychographics Consumer behaviour outcomes – consumer welfare

UNIT III GROUP BEHAVIOUR

Group dynamics and consumer reference groups – Family – Social class cultural and sub-cultural aspects – cross cultural consumer behaviour.

UNIT IV INFLUENCE BEHAVIOUR

Personal influence and opinion leadership – diffusion of innovations – consumer decision – making process – models of consumer decision process – Nicosia- Howard Sheth and Engel- Kollat model- post purchase behavior

UNIT V CONSUMERISM

Consumer protection – difficulties and challenges in predicting consumer behaviour – online consumer behaviour – organizational and industrial buyer behaviour – consumer behaviour in Indian context – emerging issues.

REFERENCES:

1. David L.Loudon, Albert J Della Bitta, “Consumer Behaviour”, McGraw Hill, New Delhi 2002.

2. Jay D. Lindquist and M.Joseph sirgy, “Shopper, buyer & consumer Behaviour, Theory and Marketing application”, Biztantra Publication, New Delhi 2005.
3. Sheth Mittal, “Consumer Behaviour A Managerial Perspective”, Thomson Asia (P) Ltd., Singapore, 2003.
4. K.K.Srivastava, “Consumer Behaviour in Indian Context”, Goal Gotia Publishing Co, New Delhi 2002.
5. S.L. Gupta & Sumitra Pal, “Consumer Behaviour an Indian Perspective”, Sultan Chand, New Delhi 2001.
6. Ms.Raju, Dominique Xavedel, “Consumer behaviour, Concepts Applications and Cases”, Vikas publishing house (P) Ltd., New Delhi – 2004.

HSS006	PROFESSIONAL ETHICS	L	T	P	C
		3	0	0	3

Prerequisite: HSS101, HSS102, Basics in Management

Objective(s): Understanding and functional knowledge of the following processes:

1. To develop understanding of the contemporary ethical issues that engineers often face in professional practice.
2. To develop the appreciation and the ability to more clearly and deeply about ethical issues.
3. To understand about codes of ethics.
4. To explore to resources for dealing with professional and personal conflicts.
5. To develop the need for health and safety in the workplace.

Course Outcome(s):

Upon completion of the course, the student should be able to:

CO1 Understand the importance of balancing professional and personal commitments

CO2 Appreciate the spirit of team-play in attaining group-specific goals

CO3 Recognize the importance of avoiding conflicts of interest at the workplace

CO4 Cite case-studies for unethical conduct and behavior in corporations and government organizations

CO5 Explain how ethical theories help in resolving moral dilemmas confronting professionals

CO6 Describe the dividing line between loyalty to employers and commitments to public welfare

CO7 Appreciate the need to avoid gender-bias and related discrimination at the workplace

CO8 Improve skills in effective communication, both oral and written, especially with regard to ethical and professional issues in engineering.

CO9 Engage with their peers in a public discourse with diversity in culture on ethical challenges, which serves to inform autonomous choices and manage differing opinions on complex ethical scenarios.

Mapping of COs and POs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1						L		H	M	M		L
CO2									H	M	M	L
CO3						M		L		L		
CO4							H			M		
CO5								M		M		
CO6						H			M			
CO7								H		L		
CO8								H		H		H
CO9								M	L	L	L	L

UNIT I ENGINEERING ETHICS

Functions of Being a Manager – Stock holder and stakeholder management. Ethical treatment of employees - ethical treatment of customers- supply chain management and other issues

UNIT II ENGINEERING AS SOCIAL EXPERIMENTATION

Senses of Ethics – Variety of moral issues – Types of inquiry – Moral dilemmas. Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy – Professions and Professionalism – Professional ideals and virtues – Theories about right action – Self-interest – Customs and religion – Use of Ethical Theories

UNIT III ENGINEER REPONSIBILITY FOR SAFETY

Corporate social responsibility. Collegiality and loyalty – Respect for

Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Discrimination

UNIT IV RESPONSIBILITY AND RIGHTS

Moral imagination, stake holder theory and systems thinking. One approach to management Decision – making Leadership

UNIT VGLOBAL ISSUES

Multinational Corporations – Environmental Ethics – Computer Ethics – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Moral Leadership – Sample code of conduct.

REFERENCES:

1. Mike Martin and Roland Schinzinger, Ethics in Engineering, McGraw Hill, New York, 1996
2. Charles D Fledderman, Engineering Ethics, Prentice Hall, New Mexico, 1999.
3. Laura Schlesinger, How Could You Do That: The Abdication of Character, Courage, and Conscience, Harper Collins, New York, 1996.
4. Stephen Carter, Integrity, Basic Books, New York 1996.
5. Tom Rusk, The Power of Ethical Persuasion: From Conflict to Partnership at Work and in Private Life, Viking, New York, 1993

HSS007	OPERATIONS MANAGEMENT	L	T	P	C
		3	0	0	3

Prerequisite: HSS101, HSS102, Basics in Management

Objective(s): To familiarize the students with Understanding and functional knowledge of the following processes:

1. Understand the different challenges businesses face when they operate in a global environment
2. Know the national differences in Political, Economic and Legal systems.

3. Know the various International Trade theories
4. Appreciate the interaction of business and governments as they relate to international commerce

Course Outcome(s):

Upon completion of the course, the student should be able to:

CO1 assess the various cultural, legal and political issues that impact international business effort.

CO2 Trace investment theory, foreign exchange and the determination of foreign exchange rates.

CO3 Develop insight into the management implications of international business strategy and operations.

Mapping of COs and POs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1						H		M		H		H
CO2						M	L		H		H	L
CO3						H		L			M	H

UNIT I INTRODUCTION TO PRODUCTION AND OPERATION MANAGEMENT

Production and Operations Management (POM) – Need, History, System, Types, functions and communication in POM.

UNIT II MATERIAL AND INVENTORY MANAGEMENT:

Material Management (MM) – Handling Technology (Robots, Automated storage and retrieval systems (ASRS) and methods (JIT, / Kanban, ABC Systems). Independent Demand Inventory Models – Fixed order system, Basic EOQ, EBQ Models, Quantity discount models. Dependent Demand Inventory models – MRP and MRP II systems Introduction to ERP, e-business and e-operations strategies.

UNIT III PLANNING AND FORECASTING:

Introduction to Strategic, Tactical, Operational, Aggregate and Capacity Planning. Planning Product design and development – Applications of CAD, CAM, Computer Integrated Manufacturing.

UNIT IV FORECASTING AND SCHEDULING:

Forecasting – Types, Methods (Qualitative and Quantitative), Types of variation in data, Minimizing forecasting errors and selection of forecasting methods. Johnson's Algorithm for job sequencing (n job thro' 2 machines, n jobs thro' 3 machines, n jobs thro' m machines and 2 jobs thro' m machines) Use of Gantt charts, Queuing analysis and Critical Ratios as methods for job scheduling.

UNIT V FACILITY, LAYOUT LOCATION AND WORK MEASUREMENT

Facility Location Decisions (FLcD) –. Facility Layout Decision (FlyD) – Types (Fixed Position, and Production, Process, Flexible), Methodologies (Distance Minimising, Computer software systems (CRAFT, CORELAP, ALDEP), Line Balancing and performance ratios, work measurement methods (WM) - Time study, methods-time measurement

REFERENCES:

1. R.Paneer Selvam, Production and Operations Management, Prentice Hall of India, 2002.
2. Sang M Lee and Marc J Schniederjans, Operation Management, All India Publishers and Distributors, First Indian edition 1997.
3. Robert H. Lowson, Strategic operations Management (The new competitive advantage), Vikas Publishing House, First Indian reprint 2003.

HSS008	INTRODUCTION TO ECONOMICS	L	T	P	C
		3	0	0	3

Prerequisite: HSS101, HSS102

Objective(s): To familiarise the students with understanding and functional knowledge of the following processes:

1. Explain the behaviour of buyers and sellers in the market using basic economic theories

2. Explain the role of government in influencing buyer and seller behaviour in the market
3. Describe basic economic theories that explain economic outcomes of the aggregate economy
4. Recognize and analyze common economic issues which relate to individual markets and the aggregate economy
5. Explain economic events in individual markets and the aggregate economy using basic economic theory and tools

Appreciate how your individual decisions and actions, as a member of society, affect the economy locally, nationally and internationally.

Course Outcome(s):

Upon completion of the course, the student should be able to:

CO1 Define the main concepts and describe the models and methods in economic analysis

CO2 Explain economic events in individual markets and the aggregate economy using basic theory and tools

CO3 Apply supply and demand analysis to relevant economic issues

CO4 Explain how individual decisions and actions as a member of society affect the economy locally , nationally and internationally

CO5 Distinguish between perfect competition and imperfect competition and explain the welfare loss in non-competitive markets.

Mapping of COs and POs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1						H	M		M	L		H
CO2						M	L	H	L	L		M
CO3						L			M	L	H	M
CO4										L	H	
CO5										L	H	H

UNIT I DEFINITION AND SCOPE OF ECONOMICS:

Definitions by A. Smith, A. Marshal and L. Robbins, P.Samuelson and their critical examination Nature and scope of Economics. Micro-economics in relation to other branches of Economics.

UNIT II LAW OF DEMAND

Elasticity of demand - price, income and cross, concepts and measurement. Marshallian theory of consumers' behaviour and its critical examination. Indifference curve analysis. Price, income and substitution effects. Giffen goods. Engel curve.

UNIT III MARKET STRUCTURE

Definition of market. Concepts of product and factor markets. Different types of market: perfec competition, monopoly, imperfect competition, monopolistic, competition and oligopoly.Demand and Supply schedules. Price determination under perfect competition in long and short run Price determination under monopoly. Discriminating monopoly.

UNIT IV MACRO-ECONOMICS

Meaning, Macro-economic Policy and Its Objective(s)s and Instruments. National Income and Social Accounting: Concepts, components, and measurement. Basic circular flow of income model Unemployment, trade cycle, Inflation**:** causes, types, effects and control.

UNIT VCOMMERCIAL AND CENTRAL BANKS

Credit creation, monetary policy and tools. Balance of payments: Items in the balance of payments account, equilibrium in the balance of payments.

References:

1. Ackley, G. (1978). Macroeconomics: Theory and Policy, Macmillan Publishing Company, New York.
2. Gupta, S.B. (1994). Monetary Economics, S. Chand & Co., New Delhi.
3. Ruddar Datt and K.P.M.Sundharam, Indian Economy, S.Chand & Company Ltd., New Delhi, 2003.
4. Kindleberger, C.P. (1973). International Economics, R.D. Irwin, Home Wood. Lewis, M.K. and P.D. Mizan (2000). Monetary Economics, Oxford University Press, New Delhi.

5. Ahuja H.L., Economic Environment of Business, Macroeconomic analysis, S.Chand & Company Ltd., New Delhi, 2005.
6. Gupta, G.S. Macroeconomics, Theory and Applications, Tata McGraw-Hill publishing company Ltd., New Delhi, 2001.
7. D.N.Dewedi, Macroeconomic – Theory and policy, Tata McGraw-Hill publishing company Ltd., New Delhi, 2001.
8. K.P.M.Sundaram, Money Banking and international Trade, Himalaya Publishing House.

HSS010	INTERNATIONAL TRADE AND FINANCE	L	T	P	C
		3	0	0	3

Prerequisite: HSS101, HSS102

Objective(s): To familiarize the students with Understanding and functional knowledge of the following processes:

1. Enables you to understand the roles and responsibilities of all parties involved in international trade product
2. Improves your career and promotion prospects
3. Enables you to advise clients appropriately on international trade and finance
4. Improves your understanding of the processes involved in each type of international trade product.
5. Helps you to appreciate the risks involved in international trade and how to mitigate them

Course Outcome(s):

Upon completion of the course, the student should be able to:

CO1 Identify the reasons for international trade

CO2 Describe the importance of balance of trade and balance of payments to the development of macroeconomic policy.

CO3 Explain the role that international institutions play in the global arena.

CO4 Analyze whether international parity conditions are met

Mapping of COs and POs												
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1						H		H			L	H
CO2						M	L		H	M	L	M
CO3						L	M			L	L	H
CO4						H						M

UNIT I INTERNATIONAL TRADE

International Trade – Meaning and Benefits – Basis of International Trade – Foreign Trade and Economic Growth – Balance of Trade – Balance of Payment – Current Trends in India – Barriers to International Trade – WTO – Indian EXIM Policy.

UNIT II EXPORT AND IMPORT FINANCE

Special need for Finance in International Trade – INCO Terms (FOB, CIF, etc.,) – Payment Terms– Letters of Credit – Pre Shipment and Post Shipment Finance – Forfaiting – Deferred Payment Terms – EXIM Bank – ECGC and its schemes – Import Licensing – Financing methods for import of Capital goods.

UNIT III FOREX MANAGEMENT

Foreign Exchange Markets – Spot Prices and Forward Prices – Factors influencing Exchange rates – The effects of Exchange rates in Foreign Trade – Tools for hedging against Exchange rate variations – Forward, Futures and Currency options – FEMA – Determination of Foreign Exchange rate and Forecasting.

UNIT IV DOCUMENTATION IN INTERNATIONAL TRADE

Export Trade Documents: Financial Documents – Bill of Exchange- Type- Commercial Documents - Performa, Commercial, Consular, Customs, Legalized Invoice, Certification of Origin Certificate Value, Packing List, Weight Certificate, Certificate of Analysis and Quality, Certificate of Inspection, Health certificate. Transport Documents - Bill of Landing, Airway Bill, Postal Receipt, Multimodal Transport Document. Risk Covering Document: Insurance Policy, Insurance Cover Note. Official Document: Export

Declaration Forms, GR Form, PP From, COD Form, Softer Forms, Export Certification, Certification of Origin, GSPS – UPCDC Norms

UNIT V EXPORT PROMOTION SCHEMES

Government Organizations Promoting Exports – Export Incentives : Duty Exemption – IT Concession – Marketing Assistance – EPCG, DEPB – Advance License – Other efforts I Export Promotion – EPZ – EQU – SEZ and Export House.

References:

1. Apte P.G., 'International Financial Management'– Tata McGraw Hill
2. Larceny & Bhattacharya, 'International Marketing' - Sultan Chand & Sons.
3. B.M.Wali and AB Kalkumdrikas, 'Export Management' - Sterling Publishers Pvt., Ltd.
4. Websites of WTO, World Bank, IMF, Ministry of Commerce, ECGC and EXIM Bank

HSS011	INFORMATIONAL SYSTEMS FOR MANAGERIAL DECISION MAKING	L	T	P	C
		3	0	0	3

Prerequisite: HSS101, HSS102, CSE102

Objective(s): To familiarize the students with understanding and functional knowledge of the following processes:

1. Understand the strategic importance of various information systems.
2. Understand and apply the fundamental concepts and theories of information systems management.
3. Understand main concepts and applications of formulating and solving business decision making problems by utilizing quantitative analysis and quantitative methods.

Justify the ethical and security issues in information systems management.

Course Outcome(s):

Upon completion of the course, the student should be able to:

CO1 Develop essential skills of analyzing and solving quantitative models

with computer programs used in business (especially spread sheets).

CO2 Explain the roles played by information technology in today's business and define various technology architectures and methodologies on which information systems are built

CO3 Define and analyze typical information system and identify how they meet the needs of the firm to deliver efficiency and competitive advantage

CO4 Identify the basic steps in systems and software developments

CO5 Apply specific quantitative models and tools in various functional areas in business

CO6 Explain critical ethical and social issues in information systems

UNIT I INTRODUCTION

Information system – establishing the framework – business model – information system architecture – evolution of information systems.

UNIT II INFORMATION SYSTEM

Functional areas, Finance, marketing, production, personnel – levels, Concepts of DSS, EIS, ES comparison, concepts and knowledge representation – managing international information system.

UNIT III SYSTEM DEVELOPMENT

Modern information system – system development life cycle – structured methodologies – designing computer based method, procedures control, designing structured programs.

UNIT IV IMPLEMENTATION AND CONTROL

Testing security – coding techniques – detection of error – validation – cost benefits analysis – assessing the value and risk information systems.

UNIT V SOFTWARE ENGINEERING

Software engineering qualities – design, production, service, software specification, software metrics, and software quality assurance – software life

cycle models – verification and validation.

REFERENCES:

1. Kenneth C. Laudon and Jane Price Laudon, Management Information systems Managing the digital firm, Pearson Education Asia.
2. Gordon B.Davis, Management Information system: Conceptual Foundations, Structure and Development, McGraw Hill, 1974.
3. Joyce J. Elam, Case series for Management Information System Silmon and Schuster, Custom Publishing 1996.
4. Steven Alter, Information system – A Management Perspective – Addison – Wesley, 1999.
5. James AN O' Brein, Management Information Systems, Tata McGraw Hill, New Delhi, 1999.
6. Turban Mc Lean, Wetherbe, Information Technology Management making connection for strategic advantage – John Wiley, 1999.
7. Ralph M.Stair and George W.Reynolds Principles of Information Systems – A Managerial Approach Learning, 2001.

HSS014	INTRODUCTION TO MARKETING MANAGEMENT	L	T	P	C
		3	0	0	3

Prerequisite: HSS101, HSS102

Objective(s): The main Objective(s)s of this course are to improve your ability to:

1. Assess market opportunities by analyzing customers, competitors, collaborators, context, and the strengths and weaknesses of a company.
2. Develop effective marketing strategies to achieve organizational Objectives.
3. Design a strategy implementation program to maximize its chance of success.
4. Communicate and defend your recommendations and critically examine and build upon the recommendations of your classmates

both quantitatively and qualitatively.

Course Outcome(s):

Upon completion of the course, the student should be able to:

CO1 Analyze the relevance of marketing concepts and theories in evaluating the impacts of environmental changes on marketing planning, strategies and practices.

CO2 Explain the importance of consumer behaviour as it relates to buying behaviour.

CO3 Apply key marketing concepts.

Mapping of COs and POs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1						H	H		L	M	M	L
CO2						H				H		
CO3						L	H	H	L	H	M	L

UNIT I MARKETING:

Meaning - concept - functions - marketing Planning & implementation marketing Programmes - Marketing environment – Market Segmentation and consumer behaviour – Influencing factors, Decision process – Marketing mix – Marketing department.

UNIT II PRODUCT:

Meaning - Product planning - policies - positioning - New product development Product life cycle – BCG Matrix-branding. Packing, labelling.

UNIT III PRICING:

Pricing Objective(s)s – Setting and modifying the price – Different pricing method Product line pricing and new product pricing

UNIT IV: DISTRIBUTION:

Nature of Marketing channels - Types of Channel flows - Channel functions - Channel co-operation, conflict and competition - Direct Marketing Telemarketing, Internet shopping.

UNIT V PROMOTION:

Promotion Mix - Advertisement - Message - copy writing - Advertisement budgeting - Measuring advertisement effectiveness -

Media strategy - sales promotion - Personal selling, publicity and direct marketing

REFERENCES:

1. Philip Kotler: MARKETING MANAGEMENT- ANALYSIS PLANNING AND CONTROL
2. Prentice Hall of India, New Delhi
3. Cundiff, Still & Govoni: FUNDAMENTALS OF MODERN MARKETING, Prentice Hall of India, New Delhi
4. Ramaswamy. V S & Namakumari. S: Marketing Management- Planning Implementation And Control, Macmillan Business Books, 2002Jobber, Principles and Practice of Marketing, Mcgraw-Hill.

HSS017	INTERNATIONAL ECONOMICS	L	T	P	C
		3	0	0	3

Prerequisite: HSS101, HSS102, HSS008

Objective(s): To familiarize the students with understanding and functional knowledge of the following processes:

1. Understand how households (demand) and businesses (supply) interact in various market structures
2. To determine price and quantity of goods and services produced and consumed.

Course Outcome(s):

Upon completion of the course, the student should be able to:

CO1 Apply economic reasoning to the analysis of selected contemporary economic problems.

CO2 Analyze the efficiency and equity implications of government interference in markets.

CO3 Recognize and identify situations leading to market failures and government failures.

CO4 Evaluate the intent and outcomes of government stabilization policies designed to correct macroeconomic problems.

CO5 Use economic problem solving skills to discuss the opportunities and

challenges of the increasing globalization of the world economy.

Mapping of COs and POs												
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1						H	M	M		M		M
CO2							L	M			H	M
CO3						H			M			L
CO4							L	M			L	M
CO5						L		M		M		M

UNIT I INTRODUCTION:

The Traditional Theory of International Trade, The Basic Trade Model, Huckster-Ohlin-Samuelson Model, Effects of Tariffs & Quotas, Theory of Factor Movements. New Theories of International Trade and Industrial Policies.

UNIT II EXCHANGE RATE & BALANCE OF PAYMENT

The Balance of Payments and National Accounts, Determinants of Exchange Rates. The Exchange-Rate Regime Choice and a Common Currency Area, International Debt and Currency Crises.

UNIT III INTERNATIONAL REGULATORY AUTHORITY

Political Economy of Trade Disputes, the FTA and the WTO.The role of the IMF and other International Financial Organizations.

UNIT IV PROTECTION OF WORLD TRADE

Reasons for Protection World Trade, International Movements of Capital. The Balance of Trade and Other Measures of International Transactions. Export and import policies.

UNIT V INTERNATIONAL MACROECONOMICS

European Monetary Unification and the Euro Preferential Trading Arrangements and the NAFTA International Policies for Economic Development, Trade Outsourcing and Off shoring

REFERENCES:

1. N. Bhagwati, A. Panagariya and T. N. Srinivasan, Lectures on International Trade, 2nd edition, MIT Press, 1998.
2. M. Obstfeld and K. Rogoff, Foundation of International Macroeconomics, McGraw-Hill, 1996.
3. Romer, D. (1996), Advanced Macroeconomics, McGraw Hill.

HSS018	COMMUNICATION SKILLS	L	T	P	C
		3	0	0	3

Prerequisite: HSS101, HSS102

Objective(s): To familiarize the students with Understanding and functional knowledge of the following processes:

1. Demonstrate critical and innovative thinking.
2. Display competence in oral, written, and visual communication.
3. Show an understanding of opportunities in the field of communication.
4. Increase your ability to communicate with intention,
5. Develop effective listening skills,
6. Practice your conversation skills to foster interactive dialogue.
7. Develop facilitation strategies for getting results and building trust, plus giving and receiving support.
8. Choose optimal communication channels and strategies.
9. Improve your group communication skills to make effective presentations, facilitate useful meetings, and write clear communications.

Course Outcome(s):

Upon completion of the course, the student should be able to:

CO1 Apply communication theories.

CO2 Use current technology related to the communication field.

CO3 Respond effectively to cultural communication differences.

CO4 Communicate ethically.

CO5 Demonstrate positive group communication exchanges.

Mapping of COs and POs												
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1						H	H	M	L	H		H
CO2						H	H			H		H
CO3						H	H		L	H	M	H
CO4						H	H			H	M	H
CO5						H	H		L	H		H

UNIT I COMMUNICATION IN BUSINESS

Systems approach, forms of business communication, management and communication, factors facilitating communication.

UNIT II COMMUNICATION PROCESS

Interpersonal perception, selective attention, feedback, variables, listening barriers to listening, persuasion, attending and conducting interviews, participating in discussions, debates and conferences, presentation skills, paralinguistic features, oral fluency development.

UNIT III BUSINESS CORRESPONDENCE

Business letter. Memos, minutes, agendas, enquiries, orders, sales letters, notice, tenders, letters of application, letter of complaints.

UNIT IV TECHNICAL REPORTS

Format, Choice of vocabulary, coherence and cohesion, paragraph writing, organization.

UNIT V PROJECT REPORTS

Project proposal, project reports, and appraisal reports.

REFERENCES:

1. Sharan J.Genrson and Steven M.Gerson – "Technical Writing – Process and Product" – Pearson Education – 2000.
2. Raymond V.Lesikar, John D. Pettit and Mary E.Flatley – Lesikass Basic Communication Tata McGraw Will 8th Edition – 1999.
3. Stevel. E. Pauley, Daniel G.Riordan – Technical Report Writing Today – AITBS Publishing & Distributors, India 5th edition – 2000.
4. Robert L.Shurter, Effective letters in business Third Ed. 1983.
5. McGraith – Basic Managerial Skills for all Prentice Hall of India – 6th Edition 2002.
6. Halliday, M.A.Ky R.Hasan, Cohesion in English, Longman, London 1976.

HSS022	BANKING THEORY AND PRACTICE	L	T	P	C
		3	0	0	3

Prerequisite: HSS101, HSS102

Objective(s): To familiarize the students with

1. Understand and define basic terminology used in banking theory and practice
2. Knowledge to choose suitable bank products for savings and credits
3. Understand basic trends in banking
4. Discuss and evaluate the theories relating to the role of banks as financial intermediaries.
5. Explain how bank-based systems differ from market-based systems.

Course Outcome(s):

Upon completion of the course, the student should be able to:

CO1 Calculate yield from banking investments and an impact of inflation on savings and banking investments

CO2 Explain accounting methods

CO3 Explain the role of transactions costs and informational asymmetries in the operation of the banking system.

CO4 Explain why bank need regulation, a central bank and illustrate the

key reason for and against the regulation of banking systems

Mapping of COs and POs												
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1						H	M	L	L			H
CO2						H		M	M	L	L	H
CO3						M	L		H			L
CO4						M	L	L	H	H		L

UNIT I EVOLUTION OF BANKING SYSTEM

Central Banking functions, Reserve Bank control over banks

UNIT II BANKER - CUSTOMER RELATIONSHIP

Bank as borrowers, customer accounts, duties of paying and collecting bankers

UNIT III LENDING BY BANKS

RBI control over loans and advances, Securities for loans

UNIT IV AGENCY SERVICES BY BANKS

Banker as bailey, safe deposit vaults, credit cards

UNIT V CONSUMERS OF BANKING SERVICES

Protection against deficiency in banking services.

REFERENCES:

1. M.L.Tannan, "Tannan's Banking Law and Practice in India", India Law House, New Delhi (1997).
2. S.N.Gupta, "The Banking Law in theory and Practice", Vol. I & II, Universal Law Publishing Co. (1999).
3. M.S.Parthasarathy, "Banking Law-Leading Indian Cases", N.M.Tripathi, (1985).
4. L.C.Goyle, "Law of Banking and Bankers", Eastern Law House, (1995).

FREE ELECTIVES

BCY501	NANO CHEMISTRY	L	T	P	C
		3	0	0	3
Objective(s)	Educate them in synthesis and characterization of nano- materials				
Course Outcome(s)					
CO1	Summarize the basis of nano technology				
CO2	Compare the properties of nanomaterials with micro and macro materials				
CO3	Sketch the synthesis of nanomaterials				
CO4	Illustrate the synthesis techniques of nanomaterials				
CO5	Choose best technologies for characterization of nanomaterials				

Unit-I: Basics of Nano chemistry

Basics of nanomaterials: Properties of nanomaterials, quantum confinement effect, surface to volume ratio, surface properties of nanoparticles. Classification of the nano materials – zero dimensional, one dimensional, two dimensional and three dimensional nanostructures.

Unit-II: Properties of Nanomaterials

Mechanical, optical, electronic, magnetic, thermal and chemical properties of nanomaterials. Size dependent properties-size dependent absorption spectra

Unit-III: Synthetic Techniques

Chemical methods: sol-gel synthesis, solvothermal synthesis, thermolysis route. Physical methods: Pulsed laser deposition- Magnetron sputtering

Unit-IV: Applications of Nanomaterials

Catalysis on nanoparticles, semiconductors, sensors, and electronic devices, photochemistry and nanophotonics, applications of CNTs, nanomaterials in biology and medicine.

Unit-V: Characterization Techniques

X-ray diffraction- Electron microscopes – scanning electron microscopes (SEM) – transmission electron microscopes (TEM) – scanning probe microscopy – atomic force microscopy (AFM) – scanning tunneling electron microscope (STEM) – basic principles only.

Reference Books:

1. S.Shanmugam, Nanotechnology, , MJP Publishers, Chennai (2010).
2. Patrick Salomon , A Handbook on Nanochemistry,, Dominant Publishers and Distributers, New Delhi.
3. S. Balaji , Nanobiotechnology, MJP Publishers, Chennai (2010).
4. CNR Rao The Chemistry of Nanomaterial: Synthesis, Properties and Applications, Vol. I and II, Springer (2006).
5. Nanotechnology: Basic Science and Emerging Technologies, Mick Wilson, Kamali Kannangara, Geoff Smith, Michelle Simmons, Burkhard Raguse, Overseas Press, (2005).
6. G. B. Segreev, Nanochemistry, , Elsevier, Science, New York, (2006).
7. C. N. R. Rao, A. Mu¨ller, A. K. Cheetham, "The Chemistry of Nanomaterials:Synthesis, Properties and Applications" WILEY-VCH Verlag GmbH & Co. KGaA, weinheim, 2004
8. C.N.R. Rao, G.U. Kulkarni, P.J. Thomas, Nanocrystals: Synthesis, Properties and Applications" Springer Series in materials science-95, Springer-Verlag Berlin Heidelberg 2007
9. Znong Lin Wang, "Characterization of nanophase materials" WILEY-VCH Verlag
GmbH & Co. KGaA, Weinheim, 2000.

BCY504	**APPLIED CHEMISTRY**	L	T	P	C
		3	0	0	3
Objective(s)	Awareness about recent technologies in applied chemistry				
Course Outcome(s)					
CO1	Solve water related problems				
CO2	Illustrate electrochemical concepts				
CO3	Employ corrosion prevention methodologies				
CO4	Develop innovative fuels				
CO5	Formulate novel polymers				

Unit-I: Water Treatment

Brief introduction regarding sources, impurities in water. Hardness of water, types, determination of hardness using EDTA method. Brief discussion and chemistry involved in the process of sedimentation, coagulation, filtration and sterilization, UV, Ozone, chlorination including break point chlorination. Softening of Water: (i) Lime-soda, process: Principles in hot, cold, lime-soda process. (ii) Zeolite softener, demineralization by synthetic ion exchange resins, Comparison between lime-soda, Zeolite and ion exchange process.

Unit-II: Electrochemistry

Introduction, Arrhenius ionic theory, Debye-Huckel theory of strong electrolytes, Activity and Activity coefficient, Conductivity of electrolytes, Kohlrausch's law of independent migration of ions, Oswald's dilution law, Acids and Bases, Concept of pH and pOH , Buffer solutions, Solubility product, common ion effect, Hydrolysis of salts, Conductometric titrations, transport number. Potentiometric titrations.

Unit-III: Corrosion of Metals and Alloys

Definition and classification of corrosion. Electrochemical corrosion- General revision of concept of electrode potential, galvanic cells, electrochemical and galvanic series, causes of corrosion, mechanism of direct chemical attack, pilling- Bed worth rule, concentration cells. Differential aeration theory of corrosion, types of corrosion, pitting corrosion, intergranular stress, waterline and microbial corrosion. Corrosion prevention : (a) Design and material selection, (b) Anodic and Cathodic inhibitors, (c) Cathodic and Anodic protection, (d) Protective coatings- types of surface, coatings and its application.

Unit-IV: Fuels

Introduction, Classification of fuels, Calorific value, Characteristics of a good fuel, comparison between solid, liquid and gaseous fuels. Bomb calorimeter. Calorific value of a gaseous fuel, Theoretical calculation of calorific value of a fuel, Wood, Coal, Classification of coal, selection of coal , analysis of coal, Types of carbonization of coal. Diesel engine fuel, Petroleum, synthetic petrol. LPG as a fuel. Non petroleum fuels, Natural gas, Coal gas, water gas. Non conventional sources of energy-bio mass, biogas, wind energy, solar.

Unit-V: Polymers

Introduction, Nomenclature and functionality of polymers, Classification of polymers, Types of polymersation. Methods of polymerization, Characteristics of polymers, structure and properties of polymers. Plastics, Inorganic polymers, Silicones, Rubbers, vulcanization of rubbers, synthetic rubber or elastomers, Application of rubber, Conducting polymers and bio polymers.

Reference Books:

1. S.S. Dara, A Text Book of Engineering Chemistry, S.Chand & Co. New Delhi, first Edition, 1985.
2. P.C.Jain and Monika Jain, Engineering Chemistry, Dhanpat Rai & Sons, New Delhi, Fifteenth Edition,2009.
3. Fontana and Green , Corrosion Engineering, Tata McGraw Hill International Book Co. 2nd edition, 2005.
4. V.R.Gowariker, N.V.Viswanathan, Jayadev sreedhar, Polymer Science, New Age International publishers, (1986) Reprint 2010.

BCY506	**ENVIRONMENTAL CHEMISTRY**	L	T	P	C
		3	0	0	3
Objective(s)	Demonstrate the analysis of environmental degradation				
Course Outcome(s)					
CO1	Examine various water quality parameters				
CO2	Model instrumental methods of water analysis				
CO3	Identify gaseous pollutants and its effects				
CO4	Point out degradation of atmosphere by electromagnetic radiation				
CO5	Categorize various soil pollutants				

Unit-I: Environmental Chemistry of Water

The principles and application of aqueous chemistry to the environmental systems. Unique properties of water, Water Quality Parameters: physico-chemical, biological, bacteriological; Water Quality Criteria and Standards; Water quality monitoring and management aspects, Chemical methods

involved in treating water and wastewater, Removal of dissolved organics and inorganics, Heavy metal pollution and its abatement.

Unit-II: Water and Wastewater Analysis

Basic concepts and Instrumental methods of analysis; Determination of major parameters of water such as pH, acidity, alkalinity, hardness, BOD, COD, solids, fluoride, nitrogen, iron, manganese, sulphate, phosphate, volatile acids and trace contaminants.

Unit-III: Atmospheric Chemistry

Structure and properties of atmosphere, Classification and chemistry of major air pollutants and their control. Types and sources of air pollution-natural, Combustion and other combustion sources.

Atmospheric Composition & Behaviour: Gaseous & particulate constituents of the atmosphere, Temperature and pressure profile of atmosphere, General circulation of atmosphere.

Unit-IV: Atmospheric Photochemistry

Electromagnetic radiations, Kinetics of thermal and photochemical processes, Reactions in the upper atmosphere, Photo processes in the troposphere, Photochemical smog, Photosynthesis, Ozone chemistry.

Unit-V: Soil Chemistry

The nature and importance of soil; Soil in the natural and man-made environment, Soil properties; Acid-Base and Ion-exchange reactions in soils. Macro and Micronutrients; Fertilisers and other soil amendments.

Waste and pollutants in soil, Heavy metals and radio-nuclides in soil. Colloidal chemistry of inorganic constituents, clays, OM and soil humus; Absorption in soils - forces and isotherms; Soil as cation and anion exchanger; Degradation of natural substances; Remediation of metal contaminated soil.

Reference Books:

1. T.G. Spiro and W.M.Stigliani, Chemistry of the Environment, 2nd ed., Tsinghua University Press, 2003.
2. V.Snoeyink and D.Jenkins, Water Chemistry, J.Wiley and Sons, 1980.
3. Shugui Dai, Environmental Chemistry, (ed.), Higher Education Press, 1997.
4. C.N. Sawyer, P.L. McCarty, G. F. Parkin, Chemistry for Environmental Engineering, McGraw Hill, 4th edition, 2002.

5. L.D. Bene_eld, J. F. Judkins and B. L. Weand, Process Chemistry for Water and Wastewater Treatment, Prentice Hall, 1982.
6. R.A. Bailey, H. M. Clark, J. P. Ferris, S. Krause, R. L. Strong, Chemistry of the Environment, Academic Press Second Edition, 2002.

BMA331	COMBINATORICS	L	T	P	C
		3	0	0	3

Unit I

Basic Combinatorial Numbers – Stirling Numbers of the First Kind – Stirling Numbers of the Second Kind.

Unit II

Generating Functions and Recurrence Relations – Symmetric Functions.

Unit III

Multinomials – Multinomial Theorem – Inclusion and Exclusion Principle.

Unit IV

Euler Function – Permutations with Forbidden Positions – The 'Menage' Problem – Problem of Fibonacci.

Unit V

Polya Theory – Necklace Problem and Burnside's Lemma – Cycle Index of a Permutation Group – Polya's theorems and their Immediate Applications.

Text Book:

1. Kenneth P. Boggart, Introductory Combinatorics, Pitman Books Ltd, 1983.

Reference Books:

1. V. Krishnamurthy, Combinatorics Theory and Applications, East – West Press, 1989.
2. V.K. Balakrishnan, Theory and Problems of combinatorics, Schaums outline series – McGraw Hill, 1994.

3. Ian Anderson, Combinatorics of finite sets, Oxford Science Publication, 2011.

BMA332	MATHEMATICAL MODELLING	L	T	P	C
		3	0	0	3

UNIT I Mathematical Modeling through Ordinary Differential Equations of First order:
Linear Growth and Decay Models – Non-Linear Growth and Decay Models – Compartment Models – Dynamic problems – Geometrical problems.

UNIT II Mathematical Modeling through Systems of Ordinary Differential Equations of First Order:
Population Dynamics – Epidemics – Compartment Models –Economics – Medicine, Arms Race, Battles and International Trade – Dynamics.

UNIT III Mathematical Modeling through Ordinary Differential Equations of Second Order:

Planetary Motions – Circular Motion and Motion of Satellites –Mathematical Modeling through Linear Differential Equations of Second Order – Miscellaneous Mathematical Models.

UNIT IV Mathematical Modeling through Difference Equations:

Simple Models – Basic Theory of Linear Difference Equations with Constant Coefficients – Economics and Finance – Population Dynamics and Genetics – Probability Theory.

UNIT V Mathematical Modeling through Graphs:

Solutions that can be Modelled Through Graphs – Mathematical Modeling in Terms of Directed Graphs, Signed Graphs, Weighted Digraphs and Unoriented Graphs.

Text Book:

1. Mathematical Modeling, J.N. Kapur, Wiley Eastern Limited, New Delhi, 1988.

Reference:

1. J.N. Kapur, Mathematical Models in biology and Medicine, EWP, New Delhi,1985.

BPY502	LASER PHYSICS (common to B.Sc Physics)	L	T	P	C
		3	0	0	3

Prerequisite Basic ideas on properties of lasers

Objective This paper deals with the fundamental concepts of laser

Course Outcomes

CO1 At the end of the course, students should be able to: Know about the fundamentals of laser

CO2 Get the basic ideas on the production of laser

CO3 Understand the classification of laser

CO4 Acquire the knowledge on applications of laser in various fields

CO5 Carry out the research work on laser

Mapping of COs with POs

CO	PO1	PO2	PO3	PO4	PO5
CO1	**H**				**L**
CO2	**H**				**L**
CO3	**H**		**L**		
CO4	**H**				**L**
CO5	**H**		**M**		**L**

Course Delivery Methodologies: PowerPoint presentation, Lecture notes

Assessment Tools

Direct Method	Indirect Method
1) Asking questions relevant to the topic conducted. 2)Conducting Exams	1) Assigning new problems 2) Making assignments

Course Topics

Fundamentals of LASER

Spontaneous emission – stimulated emission – meta stable state – Population inversion – pumping – Laser Characteristics

Production of LASER

Helium – Neon Laser – Ruby Laser – CO2 Laser – Semiconductor Laser

Industrial Applications of LASER

Laser cutting – welding – drilling – Hologram – Recording and reconstruction of hologram

Lasers in Medicine:

Lasers in Surgery – Lasers in ophthalmology – Lasers in cancertreatment

Lasers in Communication

Optic fibre communication- Total internal reflection – Block diagram of fibre optic communication system – Advantages of fibre optic communication

Text Books

1. Laser fundamentals – William T. Silfvast Cambridge University Press – Published in South Asia by foundation books, 23, Ansari Road, New Delhi , 2008
2. An introduction to LASERS – N. Avadhanulu, S. Chand & Company, 2001.

References

1. LASER Theory and Application – K. Thyagarajan and A.K. Ghatak, Mac millan, India Ltd., 1981.
2. Lasers and non-linear optics, B. B. Laud, New Age International (P) Ltd., IIIrd Edn., 2011

		L	T	P	C
BPY504	**RADIATION PHYSICS** (common to B.Sc Physics)	3	0	0	3

Prerequisite Basic ideas on properties of radiation physics

Objective This paper deals with the detailed theoretical and experimental concepts on radiation physics.

Course Outcomes

CO1	At the end of the course, students should be able to: Gain knowledge on the concepts of radiation
CO2	Get the basic ideas on the x-rays
CO3	Acquire the knowledge on radiation therapy
CO4	Get the knowledge on instrumentation techniques in radiation therapy

CO5 Gain the knowledge on clinical radiation therapy

Mapping of COs with POs

CO	PO1	PO2	PO3	PO4	PO5
CO1	**H**				
CO2	**H**				**L**
CO3	**H**				
CO4	**H**		**M**	**L**	**L**
CO5	**H**	**L**			**L**

Course Delivery Methodologies: PowerPoint presentation, Lecture notes

Assessment Tools

Direct Method	Indirect Method
1) Asking questions relevant to the topic conducted. 2)Conducting Exams	1) Assigning new problems 2) Making assignments

Course Topics

STRUCTURE OF MATTER, NUCLEAR TRANSFORMATION AND X-RAYS

Elementary particles - Electromagnetic radiation-wave model and quantum model. Nuclear Transformation - Nuclear transformation-radioactivity - Decay constant – Activity - Radioactive series - Radioactive equilibrium -Activation of nuclides.X-Rays-Production of X-rays - X-ray tube - X-ray circuit - voltage rectification - Physics of X-ray production - X-ray energy spectra - Operating characteristics.

Clinical Radiation Generators

Kilo-voltage units- Grenz-ray therapy - Contact therapy - Superficial therapy - Orthovoltage therapy or deep therapy - Super voltage therapy - Resonant transformer units - Megavoltage therapy - Van de graff generator - Linear accelerator - Betatron - Cyclotron - Microtron - Machines using radionuclides-Cobalt-60 unit - Heavy particle beams.

Ionizing Radiation, Quality of X-Ray Beams, Measurement of Absorbed Dose

Ionizing Radiation - Interaction of ionizing radiation-Ionization - Photon beam description - Photon beam attenuation - Attenuation coefficient - Energy transfer - energy absorption coefficient - Interaction of photons with matter - Coherent scattering - The Roentgen - Free air ionization chamber - String electrometer - Ion collection-Saturation and collection efficiency - Measurement of exposure. Quality of X-Ray Beams- Half value layer and its measurement - Peak voltage-Direct indirect measurement - Effective energy. measurement of Absorbed Dose-Radiation absorbed dose - Relation between Kerma - Exposure - Absorbed dose.

Classical Radiation Therapy

Dose distribution and scatter analysis-Phantoms - Depth dose distribution - percentage depth dose-Dependence on beam quality and depth - Tissue air ratio (TAR)-relationship between TAR and percent depth dose- Dose calculation parameters- Collimator Scatter Factor - Phantom Scatter Factor - Tissue-Phantom and Tissue-Maximum Ratios - Scatter-Maximum Ratio- Practical Applications - Accelerator Calculations- SSD Technique - Cobalt 60 Calculations. Treatment planning-Acquisition of Patient Data- Internal Structures- Computed Tomography - Magnetic Resonance Imaging-Ultrasound. Skin Dose. Electron beam therapy - Brachytherapy.

Modern Radiation Therapy, Dosimetry and Radiation Protection

Modern Radiation Therapy-Image-Guided Radiation Therapy - Proton Beam Therapy. Dosimetry-Dosimeter - Film badge dosimeter - Pocket dosimeter. Radiation Protection-Radiation Protection - Dose Equivalent - Effective Dose Equivalent - Background Radiation - Low-Level Radiation Effects - Effective Dose-Equivalent Limits- Occupational and Public Dose Limits.

Text Books

1. Meredith W.J. and J.B. Massey, *Fundamental Physics of Radiology*, A. John Wright and Sons Ltd.,3rd Edition, 1983.
2. William.R.Hendee, Geoffery.S.Ibbott and Eric.G.Hendee, *Radiation Therapy Physics*, A.John Wiley and Sons.,Inc, 3rd Edition, 2005.

References

1. Smith F.A., *A Primer in Applied Radiation Physics*, World scientific publishing Co., 2000.
2. Podgarsak E.B., *Radiation Physics for Medical Physicists*, Springer, 2006.
3. Evans R. D., *Atomic Nucleu*s, Textbook Publications, 2003.
4. Fiaz.M.Khan, *The Physics of Radiation Therapy*, Lippincott Williams and Wilkins, 4th Edition, 2010.

BPY506	NUCLEAR PHYSICS (common to B.Sc Physics)	L	T	P	C
		3	0	0	3

Prerequisite Basic ideas on nuclear physics

Objective This paper deals with the detailed theoretical and experimental concepts on radioactivity and elementary particles

Course Outcomes

CO1	At the end of the course, students should be able to: Gain knowledge on nucleus and nuclear models.
CO2	Get the basic ideas on the nuclear reactions
CO3	Acquire the knowledge on fundamentals in elementary particles
CO4	Carry out research in nuclear physics
CO5	Acquire the knowledge on Radioactive materials

Mapping of COs with POs

CO	PO1	PO2	PO3	PO4	PO5
CO1	**H**				
CO2	**H**				
CO3	**H**				**L**
CO4	**H**			**L**	
CO5	**H**				**L**

Course Delivery Methodologies: PowerPoint presentation, Lecture notes

Assessment Tools

Direct Method	Indirect Method
1) Asking questions relevant to the topic conducted. 2)Conducting Exams	1) Assigning new problems 2) Making assignments

Course Topics

Nucleus and nuclear models

Introduction to nucleus- classification of nuclei – general properties of nucleus – charge, mass, spin , magnetic moment, quadruple moment – mass defect - binding energy- models of nuclear structure - liquid drop model – shell model.

Radioactivity

Introduction – discovery of radioactivity - natural radioactivity - alpha, beta and gamma rays - properties of the rays - experimental measurement of the range of alpha particles – beta ray spectra – origin of the line and continuous spectrum – the neutrino theory of beta decay.

Nuclear Reactions

Soddy Fajan's displacement law - law of radioactive disintegration - the mean life - measurements of decay constants - units of radioactivity - law of successive disintegration - radioactive dating -nuclear reactions - energy balance in nuclear reactions - threshold energy of an endoergic reaction- applications of radio isotopes.

Particle accelerators, detectors, Cosmic rays

GM Counter - Wilson cloud chamber - bubble chamber – cyclotron – synchrotron – synchrocyclotron - betatron – Cosmic rays : introduction – discovery of cosmic rays

–cosmic showers –origin of cosmic radiation.

Elementary particles

Introduction – fundamental interactions - elementary particle quantum numbers – quark model.

Text Book

1. Modern Physics by R. Murugesan and Kiruthiga Sivaprasath, S.Chand & Co., 2005.

References

1. Atomic and Nuclear Physics by Shatendra Sharma, Dorling Kindersley India, 2005.
2. Nuclear Physics by D.C. Tayal, Himalaya Publishing House, reprint 2007.
1. Nuclear Physics, An introduction by S.B.Patel, New Age international(P) Ltd., (reprint 2003)

BPY506	NUCLEAR PHYSICS (common to B.Sc Physics)	L	T	P	C
		3	0	0	3

Prerequisite Basic ideas on nuclear physics

Objective This paper deals with the detailed theoretical and experimental concepts on radioactivity and elementary particles

Course Outcomes

CO1 At the end of the course, students should be able to:
Gain knowledge on nucleus and nuclear models.

CO2 Get the basic ideas on the nuclear reactions

CO3 Acquire the knowledge on fundamentals in elementary particles

CO4 Carry out research in nuclear physics

CO5 Acquire the knowledge on Radioactive materials

Mapping of COs with POs

CO	PO1	PO2	PO3	PO4	PO5
CO1	**H**				
CO2	**H**				
CO3	**H**				**L**
CO4	**H**			**L**	
CO5	**H**				**L**

Course Delivery Methodologies: PowerPoint presentation, Lecture notes

Assessment Tools

Direct Method	Indirect Method
1) Asking questions relevant to the topic conducted. 2)Conducting Exams	1) Assigning new problems 2) Making assignments

Course Topics

Nucleus and nuclear models

Introduction to nucleus- classification of nuclei – general properties of nucleus – charge, mass, spin , magnetic moment, quadruple moment – mass defect - binding energy- models of nuclear structure - liquid drop model – shell model.

Radioactivity

Introduction – discovery of radioactivity - natural radioactivity - alpha, beta and gamma rays - properties of the rays - experimental measurement of the range of alpha particles – beta ray spectra – origin of the line and continuous spectrum – the neutrino theory of beta decay.

Nuclear Reactions

Soddy Fajan's displacement law - law of radioactive disintegration - the mean life - measurements of decay constants - units of radioactivity - law of successive disintegration - radioactive dating -nuclear reactions - energy balance in nuclear reactions - threshold energy of an endoergic reaction- applications of radio isotopes.

Particle accelerators, detectors, Cosmic rays

GM Counter - Wilson cloud chamber - bubble chamber – cyclotron – synchrotron –synchrocyclotron - betatron – Cosmic rays : introduction – discovery of cosmic rays –cosmic showers –origin of cosmic radiation.

Elementary particles

Introduction – fundamental interactions - elementary particle quantum numbers – quark model.

Text Book

2. Modern Physics by R. Murugesan and Kiruthiga Sivaprasath, S.Chand & Co., 2005.

References

3. Atomic and Nuclear Physics by Shatendra Sharma, Dorling Kindersley India, 2005.
4. Nuclear Physics by D.C. Tayal, Himalaya Publishing House, reprint 2007.
2. Nuclear Physics, An introduction by S.B.Patel, New Age international(P) Ltd., (reprint 2003)

BPY507	SPACE PHYSICS (common to B.Sc Physics)	L	T	P	C
		3	0	0	3

Prerequisite Basic ideas on space physics

Objective This paper deals with the detailed concepts on space science.

Course Outcomes

CO1 At the end of the course, students should be able to:
Know about the earth's atmosphere.

CO2 Get the basic ideas on the interplanetary medium

CO3 Acquire the knowledge on planets

CO4 Carry out the research work on space physics

CO5 Acquire the knowledge on sun atmosphere

Mapping of COs with POs

CO	PO1	PO2	PO3	PO4	PO5
CO1	**H**				
CO2	**H**				**M**
CO3	**H**				**M**
CO4	**H**		**L**		**M**
CO5	**H**				**M**

Course Delivery Methodologies: PowerPoint presentation, Lecture notes

Assessment Tools

Direct Method	Indirect Method
1) Asking questions relevant to the topic conducted. 2)Conducting Exams	1) Assigning new problems 2) Making assignments

Course Topics

The Earth's Upper Atmosphere

Variations of atmospheric densities and temperature. Formation and structure of Ionosphere. Studies of ionosphere by ground based and space techniques. The radiation belts. Auroras. Lyman glow of the night sky. The geo-corona and airglow studies.

Sun

Structure of solar atmosphere. Solar convection and differential rotation. Large scale and small scale magnetic fields. Solar granulation and super granulation. Sunspots. Solar flares.

Unit III Interplanetary Medium

Xray and g-ray studies of sun. Solar X-ray and radio bursts. Solar wind. Interaction with planetary atmosphere. Structure of bow shocks. Magnetosphere. Ring Current. Radiation belts and interplanetary magnetic field.

Unit - IV Moon

Origin of Moon. Solar and Lunar eclipses. Lunar ranging experiments. Studies of lunar surface from various space missions and their results. Satellites of other planets of the solar system.

Unit - V Planets

Infrared spectroscopy of planetary atmospheres. Principal results of the Mariner, Venera and Viking Space Missions to Mars and Venus. Voyager space mission studies of outer planets and their satellites and rings. Comparative studies of planetary atmospheres. Planetary ionospheres. Extra-solar system planets.

Text Books

1. Sun, Earth and radio: An Introduction to the Ionosphere and Magnetosphere, J.A.Ratcliffe, 1970, Littlehampton Book Services Ltd

2. An Intoduction to Planetary Physics: The Terrestrial Plants, Kaula. W.M, 1969, John Wiley & Sons Inc.

3. Harold Zirin: Astrophysics of the Sun, 1988, Cambridge

University Press

References

1. W.N.Hess and G.Mead(Ed): Introduction to Space Science, 1965, Gorden and Breach,

2. V.Bumba and Kleczek, Basic Mechanism of Solar Activity, 1976.

3. W. J. Kaufmann, Exploration of the Solar System, Mac Millan, 1978, New york.

BPY503	**NON-LINEAR OPTICS**	L	T	P	C
		4	1	0	4
Prerequisite	Basic ideas on properties of non linear optics				
Objective	This paper deals with physics of non-linearity and their applications.				

Course Outcomes

CO1	At the end of the course, students should be able to: Get the basic ideas on information in light.
CO2	Get the basic ideas on the electromagnetic phenomena
CO3	Acquire the knowledge on photophysical phenomena
CO4	Find out the applications in non linear optics
CO5	Get the ideas on Fiber optics

Mapping of COs with POs

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	**H**				
CO2	**H**		**L**		
CO3	**H**		**L**		
CO4	**H**		**L**		
CO5	**H**	**L**			**L**

Course Delivery Methodologies: Power point presentation, Lecture notes

Assessment Tools

Direct Method	**Indirect Method**
1) Asking questions relevant to the topic conducted. 2)Conducting Exams	1) Assigning new problems 2) Making assignments

Course Topics

Information in Light

Semiconductors for optoelectronics - Optoelectronic semiconductor devices - Bright light from cool solids - Seeing The Light- The human eye - Color vision - Color blindness - Polarization sensitivity - Speed of response - Optical illusions - Contemporary Optics- Waveguides - Optical fibres - Optical amplification - Conveying sound by light - The long and the short of optical communication.

Fundamental Tools

Electromagnetic Phenomena - Gauss' Law - Gauss Law For Magnetic Fields - Faraday's Law - Ampere's Law - Maxwell's Adjustment To Ampere's Law - Polarization of Materials - Plane Wave Solutions To The Wave Equation - Complex Plane Waves - Real And Complex Indices of Refraction - The Lorentz Model of Dielectrics - Poynting's Theorem - Irradiance of A Plane Wave - Energy Density of Electric And Magnetic Fields.

Photophysical Phenomena

Optical Propagation in Media - Diffraction and Dispersion effects - Wave Propagation in Homogeneous Linear Isotropic Media - Anisotropic media - The Origin and Modeling of Optical Nonlinearity - A Simple Physical Model for Optical Nonlinearity - Physical Effects of Nonlinear Polarization - Mathematical Modeling of Optical Nonlinearities - An Alternative Approach For Reflection And Refraction:-Refraction at an Interface - The Fresnel Coefficients' - Reflectance - Transmittance - Double-Interface Problem Solved Using Fresnel Coefficients' - Beyond Critical Angle: Tunneling of Evanescent Waves - Multiple Interfaces - Multilayer Coatings.

Physics of Non-Linearities

The Physics of Second Harmonic Generation - SHG in Crystals - Frequency Doubling and Mixing - Optical Parametric Generation Amplification - Oscillation - Mathematical Formulation - Phase Matching in Anisotropic Crystal – Nonlinear Transverse Effects in Second Harmonic Generation - Self-Refraction of Optical/Gaussian Beams - Optical Bistability phenomena - Optical Phase conjugation effects.

Optical Communication Today

Components - Fabrication And Materials - Light Sources – Coupling- Micro Components Tapers - Splices/Connectors - Characteristics of optical fibers - Diameter Control And Measurement - Attenuation - NLO Properties In Media - Fiber-Optic Solitons - Magnetic Solitons - Optical Shocks And Self-Steepening Of Pulses - Two-Wave Mixing In Photorefractive Materials - Four-Wave Mixing And Phase Conjugation In Photorefractive Materials - Self-Phase

Conjugation And Edge Enhancement - Non-Linearities In Nematic Liquid Crystals - Photonic Bandgap Structures

Text Books

1. Richard L Sutherland, *Handbook of Nonlinear Optics, 2nd Edition (Revised and Expanded),* Marcel Dekker, Inc, 2003.
2. Newell, Alan C., and Jerome V. Moloney, *Nonlinear optics,* Addison-Wesley, 1992.

References

1. Justin Peatross and Michael Ware, *Physics of Light and Optics,* 2013.
2. David A. Boas, Constantinos Pitris and Nimmi Ramanujam, *Handbook of Biomedical Optics,* CRC Press, Taylor and Francis Group, 2011.
3. David Greene, *Light and Dark* Institute of Physics Publishing Ltd, 2003.
4. Goure P and Verrier I, *Optical Fibre Devices Series in Optics and Optoelectronics,*Institute of Physics Publishing Ltd, 2002

BCY505	**INSTRUMENTAL METHODS OF ANALYSIS**	L	T	P	C
		3	0	0	3
Objective(s)	Educate them in operating analytical instruments				
Course Outcome(s)					
CO1	Summarize chromatographic techniques				
CO2	Interpret spectroscopic data				
CO3	Compute the spectral results				
CO4	Employ gas chromatography in separating mixture of compounds				
CO5	Identification of elements using microscopic analysis				

Unit-I: Chromatography

Introduction – solvent extraction (basic concepts only) – ion exchange (basic concepts only) – electrophoresis (basic concepts only) – column and thin layer chromatography - Principles, instrumentation, theory and applications of GC and HPLC.

Unit-II: Qualitative Optical Spectroscopy

Introduction-Principles, instrumentation, theory and applications of Infrared spectroscopy, Raman spectroscopy, Nuclear Magnetic Resonance (NMR) spectroscopy and X-ray diffraction methods.

Unit-III: Quantitative Optical Spectroscopy

Introduction - Principles, instrumentation, theory and applications of Atomic absorption spectroscopy(AAS)–Inductively coupled plasma atomic emission spectroscopy- Inductively coupled plasma mass spectrometry - Atomic fluorescence spectroscopy-
X-ray fluorescence spectroscopy – Ultraviolet (UV)-visible spectroscopy.

Unit-IV: Mass Spectrometry

Introduction-Principles, instrumentation, theory and applications of Gas chromatography mass spectrometry (GCMS) – High performance liquid chromatography electrospray ionization mass spectrometry (LC-ESI-MS) – Laser mass spectrometry (MALDI).

Unit-V: Microscopic and Surface Analysis

Introduction-Principles, instrumentation, theory and applications of Atomic force microscopy (AFM)–Auger electron spectroscopy-X-ray

photoelectron spectroscopy (XPS)- Scanning electron microscopy (SEM)–Transmission electron microscopy (TEM).

Reference Books:

1. Frank A.Settle (Editor), Handbook of instrumental techniques for analytical chemistry, Prentice-Hall Inc., New Jersey, 1997.

2. Vogel's Textbook of quantitative chemical analysis, G.H.Jefferey, J Bassett, J Mendham, and R C Denney, Longman scientific and technical publishers, London

3. D.A.Skoog, F.J.Holler, S.R.Crouch, Instrumental Analysis, Cengage Learning, New Delhi, 2007.

4. H.H. Willard, L.L.Merritt, and J.A.Dean, Instrumental Methods of Analysis, 6th Edition (1986),CBS Publishers & Distributors, Shahdara, Delhi.