ANNA UNIVERSITY, CHENNAI

AFFILIATED INSTITUTIONS

R-2013

B.E. BIOMEDICAL ENGINEERING

I TO VIII SEMESTERS CURRICULUM AND SYLLABUS

SEMESTER I

SL. No.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	HS6151	Technical English – I	3	1	0	4
2.	MA6151	Mathematics – I	3	1	0	4
3.	PH6151	Engineering Physics – I	3	0	0	3
4.	CY6151	Engineering Chemistry – I	3	0	0	3
5.	GE6151	Computer Programming	3	0	0	3
6.	GE6152	Engineering Graphics	2	0	3	4
PRACTICALS						
7.	GE6161	Computer Practices Laboratory	0	0	3	2
8.	GE6162	Engineering Practices Laboratory	0	0	3	2
9.	GE6163	Physics and Chemistry Laboratory - I	0	0	2	1
		TOTAL	**17**	**2**	**11**	**26**

SEMESTER II

SL. No.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	HS6251	Technical English – II	3	1	0	4
2.	MA6251	Mathematics – II	3	1	0	4
3.	PH6251	Engineering Physics – II	3	0	0	3
4.	CY6251	Engineering Chemistry – II	3	0	0	3
5.	EC6202	Electronic Devices and Circuits	3	1	0	4
6.	EE6201	Circuit Theory	3	1	0	4
PRACTICALS						
7.	GE6262	Physics and Chemistry Laboratory - II	0	0	2	1
8.	EC6211	Circuits and Devices Laboratory	0	0	3	2
		TOTAL	**18**	**4**	**5**	**25**

SEMESTER III

SL. NO.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	MA6351	Transforms and Partial Differential Equations	3	1	0	4
2.	BM6301	Bio Chemistry	3	0	0	3
3.	EC6303	Signals and Systems	3	1	0	4
4.	BM6302	Sensors and Measurements	3	0	0	3
5.	EC6301	Object Oriented Programming and Data Structures	3	0	0	3
6.	BM6303	Anatomy and Human Physiology	3	0	0	3
PRACTICAL						
7.	BM6311	Bio Chemistry and Human Physiology Laboratory	0	0	3	2
8.	BM6312	OOPS and Data Structures Laboratory	0	0	3	2
		TOTAL	**18**	**2**	**6**	**24**

SEMESTER IV

SL. NO.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	MA6451	Probability and Random Processes	3	1	0	4
2.	BM6401	Medical physics	3	0	0	3
3.	BM6402	Basics of Electrical Engineering	3	0	0	3
4.	BM6403	Analog and Digital ICs	3	0	0	3
5.	BM6404	Pathology and Microbiology	3	0	0	3
6.	CS6304	Analog and Digital Communication	3	0	0	3
PRACTICAL						
7.	BM6411	Circuits and ICs Laboratory	0	0	3	2
8.	BM6412	Pathology and Microbiology Laboratory	0	0	3	2
		TOTAL	**18**	**1**	**6**	**23**

SEMESTER V

SL. NO.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	BM6501	Bio Control Systems	3	1	0	4
2.	BM6502	Diagnostic and Therapeutic Equipment - I	3	0	0	3
3.	BM6503	Bio Materials and Artificial Organs	3	0	0	3
4.	BM6504	Biomedical Instrumentation	3	0	0	3
5.	EC6504	Microprocessor and Microcontroller	3	0	0	3
6.	MD6501	Hospital Management	3	0	0	3
PRACTICAL						
7.	BM6511	Microprocessor and Microcontroller Laboratory	0	0	3	2
8.	BM6512	Bio Medical Instrumentation Laboratory	0	0	3	2
9.	GE6674	Communication and Soft Skills - Laboratory Based	0	0	4	2
		TOTAL	**18**	**1**	**10**	**25**

SEMESTER VI

SL. NO.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	BM6601	Radiological Equipment	3	0	0	3
2.	BM6602	Biomechanics	3	0	0	3
3.	BM6603	Diagnostic and Therapeutic Equipment - II	3	0	0	3
4.	EC6502	Principles of Digital Signal Processing	3	1	0	4
5.	GE6351	Environmental Science and Engineering	3	0	0	3
6.		Elective –I	3	0	0	3
PRACTICAL						
7.	BM6611	Digital Signal Processing Laboratory	0	0	3	2
8.	BM6612	Diagnostic and Therapeutic Equipment Laboratory	0	0	3	2
		TOTAL	**18**	**1**	**6**	**23**

SEMESTER VII

SL. NO.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	BM6701	Pattern Recognition and Neural Networks	3	0	0	3
2.	BM6702	Medical Informatics	3	0	0	3
3.	BM6703	Medical Optics	3	0	0	3
4.	IT6005	Digital Image Processing	3	0	0	3
5.		Elective II	3	0	0	3
6.		Elective III	3	0	0	3
PRACTICAL						
7.	BM6711	Hospital Training	0	0	3	2
8.	BM6712	Digital Image Processing Laboratory	0	0	3	2
		TOTAL	**18**	**0**	**9**	**22**

SEMESTER VIII

SL. NO.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	BM6801	Rehabilitation Engineering	3	0	0	3
2.		Elective IV	3	0	0	3
3.		Elective V	3	0	0	3
4.		Elective VI	3	0	0	3
PRACTICALS						
5.	BM6811	Project Work	0	0	12	6
		TOTAL	**9**	**0**	**12**	**18**

TOTAL NO. OF CREDITS: 186

ELECTIVES

SEMESTER VI – Elective I

SL. NO.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	BM6001	Biofluids and Dynamics	3	0	0	3
2.	BM6002	Biometric Systems	3	0	0	3
3.	BM6003	Virtual Reality	3	0	0	3
4.	BM6004	Computer Organisation	3	0	0	3

SEMESTER VII – Elective II

SL. NO.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
5.	MD6702	Physiological Modeling	3	0	0	3
6.	BM6005	Bio Informatics	3	0	0	3
7.	GE6757	Total Quality Management	3	0	0	3
8.	MD6010	Telehealth Technology	3	0	0	3

SEMESTER VII – Elective III

SL. NO.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
9.	BM6006	Nano Electronics	3	0	0	3
10.	EC6703	Embedded and Real time Systems	3	0	0	3
11.	CS6551	Computer Networks	3	0	0	3
12.	EC6601	VLSI Design	3	0	0	3

SEMESTER VIII – Elective IV

SL. NO.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
13.	BM6007	Internet and Java Programming	3	0	0	3
14.	BM6008	Neural Engineering	3	0	0	3
15.	BM6009	Bio MEMS	3	0	0	3
16.	BM6010	Assist Devices	3	0	0	3
17.	CS6003	Ad hoc and Sensor Networks	3	0	0	3

SEMESTER VIII – Elective V

SL. NO.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
18.	MD6008	Fiber Optics and Lasers in Medicine	3	0	0	3
19.	BM6011	Computer Hardware and Interfacing	3	0	0	3
20.	CS6012	Soft Computing	3	0	0	3
21.	GE6075	Professional Ethics in Engineering	3	0	0	3
22.	MD6007	Body Area Networks	3	0	0	3

SEMESTER VIII – Elective VI

SL. NO.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
23.	ME6002	Refrigeration and Air Conditioning	3	0	0	3
24.	EC6007	Speech Processing	3	0	0	3
25.	GE6078	Intellectual Property Rights	3	0	0	3
26.	MF6009	Rapid Prototyping	3	0	0	3
27.	BM6012	Wearable Systems	3	0	0	3

HS6151 **TECHNICAL ENGLISH – I** **L T P C**
3 1 0 4

OBJECTIVES:

- To enable learners of Engineering and Technology develop their basic communication skills in English.
- To emphasize specially the development of speaking skills amongst learners of Engineering and Technology.
- To ensure that learners use the electronic media such as internet and supplement the learning materials used in the classroom.
- To inculcate the habit of reading and writing leading to effective and efficient communication.

UNIT I **9+3**

Listening - Introducing learners to GIE - Types of listening - Listening to audio (verbal & sounds); Speaking - Speaking about one's place, important festivals etc. – Introducing oneself, one's family / friend; Reading - Skimming a reading passage – Scanning for specific information - Note-making; Writing - Free writing on any given topic (My favourite place / Hobbies / School life, etc.) - Sentence completion - Autobiographical writing (writing about one's leisure time activities, hometown, etc.); Grammar - Prepositions - Reference words - Wh-questions - Tenses (Simple); Vocabulary - Word formation - Word expansion (root words / etymology); E-materials - Interactive exercises for Grammar & Vocabulary - Reading comprehension exercises - Listening to audio files and answering questions.

UNIT II **9+3**

Listening - Listening and responding to video lectures / talks; Speaking - Describing a simple process (filling a form, etc.) - Asking and answering questions - Telephone skills – Telephone etiquette; Reading – Critical reading - Finding key information in a given text - Sifting facts from opinions; Writing - Biographical writing (place, people) - Process descriptions (general/specific) - Definitions - Recommendations – Instructions; Grammar - Use of imperatives - Subject-verb agreement; Vocabulary - Compound words - Word Association (connotation); E-materials - Interactive exercises for Grammar and Vocabulary - Listening exercises with sample telephone conversations / lectures – Picture-based activities.

UNIT III **9+3**

Listening - Listening to specific task - focused audio tracks; Speaking - Role-play – Simulation - Group interaction - Speaking in formal situations (teachers, officials, foreigners); Reading - Reading and interpreting visual material; Writing - Jumbled sentences - Coherence and cohesion in writing - Channel conversion (flowchart into process) - Types of paragraph (cause and effect / compare and contrast / narrative / analytical) - Informal writing (letter/e-mail/blogs) - Paraphrasing; Grammar - Tenses (Past) - Use of sequence words - Adjectives; Vocabulary - Different forms and uses of words, Cause and effect words; E-materials - Interactive exercises for Grammar and Vocabulary - Excerpts from films related to the theme and follow up exercises - Pictures of flow charts and tables for interpretations.

UNIT IV **9+3**

Listening - Watching videos / documentaries and responding to questions based on them; Speaking - Responding to questions - Different forms of interviews - Speaking at different types of interviews; Reading - Making inference from the reading passage - Predicting the content of a reading passage; Writing - Interpreting visual materials (line graphs, pie charts etc.) - Essay writing – Different types of essays; Grammar - Adverbs – Tenses – future time reference; Vocabulary - Single word substitutes - Use of abbreviations and acronyms; E-materials - Interactive exercises for Grammar and Vocabulary - Sample interviews - film scenes - dialogue writing.

UNIT V **9+3**

Listening - Listening to different accents, Listening to Speeches/Presentations, Listening to broadcast and telecast from Radio and TV; Speaking - Giving impromptu talks, Making presentations on given topics; Reading - Email communication - Reading the attachment files having a poem/joke/proverb - Sending their responses through email; Writing - Creative writing, Poster making; Grammar - Direct and indirect speech; Vocabulary - Lexical items (fixed / semi fixed expressions); E-materials - Interactive exercises for Grammar and Vocabulary - Sending emails with attachment – Audio / video excerpts of different accents - Interpreting posters.

TOTAL (L:45+T:15): 60 PERIODS

OUTCOMES:

Learners should be able to:

- Speak clearly, confidently, comprehensibly, and communicate with one or many listeners using appropriate communicative strategies.
- Write cohesively and coherently and flawlessly avoiding grammatical errors, using a wide vocabulary range, organizing their ideas logically on a topic.
- Read different genres of texts adopting various reading strategies.
- Listen/view and comprehend different spoken discourses/excerpts in different accents.

TEXTBOOKS:

1. Department of English, Anna University. Mindscapes: English for Technologists and Engineers. Orient Blackswan, Chennai. 2012
2. Dhanavel, S.P. English and Communication Skills for Students of Science and Engineering. Orient Blackswan, Chennai. 2011

REFERENCES:

1. Raman, Meenakshi & Sangeetha Sharma. Technical Communication: Principles and Practice. Oxford University Press, New Delhi. 2011
2. Regional Institute of English. English for Engineers. Cambridge University Press, New Delhi. 2006
3. Rizvi, Ashraf. M. Effective Technical Communication. Tata McGraw-Hill, New Delhi. 2005
4. Rutherford, Andrea. J Basic Communication Skills for Technology. Pearson, New Delhi. 2001
5. Viswamohan, Aysha. English for Technical Communication. Tata McGraw-Hill, New Delhi. 2008

EXTENSIVE Reading (Not for Examination)

1. Kalam, Abdul. Wings of Fire. Universities Press, Hyderabad. 1999.

WEBSITES:

1. http://www.usingenglish.com
2. http://www.uefap.com

TEACHING METHODS:

- Lectures
- Activities conducted individually, in pairs and in groups like self introduction, peer introduction, group poster making, grammar and vocabulary games, etc.
- Discussions
- Role play activities
- Short presentations
- Listening and viewing activities with follow up activities like discussion, filling up worksheets, writing exercises (using language lab wherever necessary/possible) etc.

EVALUATION PATTERN:

Internal assessment: 20%

3 tests of which two are pen and paper tests and the other is a combination of different modes of assessment like

- Project
- Assignment
- Reviews
- Creative writing
- Poster making, etc.

All the four skills are to be tested with equal weightage given to each.

- ✓ Speaking assessment: Individual speaking activities, Pair work activities like role play, Interview, Group discussions
- ✓ Reading assessment: Reading passages with comprehension questions graded from simple to complex, from direct to inferential
- ✓ Writing assessment: Writing paragraphs, essays etc. Writing should include grammar and vocabulary.
- ✓ Listening/Viewing assessment: Lectures, dialogues, film clippings with questions on verbal as well as audio/visual content.

End Semester Examination: 80%

MA6151 MATHEMATICS – I L T P C
3 1 0 4

OBJECTIVES:

- To develop the use of matrix algebra techniques this is needed by engineers for practical applications.
- To make the student knowledgeable in the area of infinite series and their convergence so that he/ she will be familiar with limitations of using infinite series approximations for solutions arising in mathematical modeling.
- To familiarize the student with functions of several variables. This is needed in many branches of engineering.
- To introduce the concepts of improper integrals, Gamma, Beta and Error functions which are needed in engineering applications.
- To acquaint the student with mathematical tools needed in evaluating multiple integrals and their usage.

UNIT I MATRICES 9+3

Eigenvalues and Eigenvectors of a real matrix – Characteristic equation – Properties of eigenvalues and eigenvectors – Statement and applications of Cayley-Hamilton Theorem – Diagonalization of matrices – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms.

UNIT II SEQUENCES AND SERIES 9+3

Sequences: Definition and examples – Series: Types and Convergence – Series of positive terms – Tests of convergence: Comparison test, Integral test and D'Alembert's ratio test – Alternating series – Leibnitz's test – Series of positive and negative terms – Absolute and conditional convergence.

UNIT III APPLICATIONS OF DIFFERENTIAL CALCULUS 9+3

Curvature in Cartesian co-ordinates – Centre and radius of curvature – Circle of curvature – Evolutes – Envelopes - Evolute as envelope of normals.

UNIT IV DIFFERENTIAL CALCULUS OF SEVERAL VARIABLES 9+3

Limits and Continuity – Partial derivatives – Total derivative – Differentiation of implicit functions – Jacobian and properties – Taylor's series for functions of two variables – Maxima and minima of functions of two variables – Lagrange's method of undetermined multipliers.

UNIT V MULTIPLE INTEGRALS 9+3

Double integrals in cartesian and polar coordinates – Change of order of integration – Area enclosed by plane curves – Change of variables in double integrals – Area of a curved surface - Triple integrals – Volume of Solids.

TOTAL (L:45+T:15): 60 PERIODS

OUTCOMES:

- This course equips students to have basic knowledge and understanding in one fields of materials, integral and differential calculus.

TEXT BOOKS:

1. Bali N. P and Manish Goyal, "A Text book of Engineering Mathematics", Eighth Edition, Laxmi Publications Pvt Ltd., 2011.
2. Grewal. B.S, "Higher Engineering Mathematics", 41st Edition, Khanna Publications, Delhi, 2011.

REFERENCES:

1. Dass, H.K., and Er. Rajnish Verma," Higher Engineering Mathematics", S. Chand Private Ltd., 2011.
2. Glyn James, "Advanced Modern Engineering Mathematics", 3rd Edition, Pearson Education, 2012.
3. Peter V. O'Neil," Advanced Engineering Mathematics", 7th Edition, Cengage learning, (2012).
4. Ramana B.V, "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company, New Delhi, 2008.
5. Sivarama Krishna Das P. and Rukmangadachari E., "Engineering Mathematics", Volume I, Second Edition, PEARSON Publishing, 2011.

PH6151 ENGINEERING PHYSICS – I L T P C
3 0 0 3

OBJECTIVES:

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

UNIT I CRYSTAL PHYSICS 9

Lattice – Unit cell – Bravais lattice – Lattice planes – Miller indices – d spacing in cubic lattice – Calculation of number of atoms per unit cell – Atomic radius – Coordination number – Packing factor for SC, BCC, FCC and HCP structures – Diamond and graphite structures (qualitative treatment)- Crystal growth techniques –solution, melt (Bridgman and Czochralski) and vapour growth techniques (qualitative)

UNIT II PROPERTIES OF MATTER AND THERMAL PHYSICS 9

Elasticity- Hooke's law - Relationship between three modulii of elasticity (qualitative) – stress -strain diagram – Poisson's ratio –Factors affecting elasticity –Bending moment – Depression of a cantilever –Young's modulus by uniform bending- I-shaped girders

Modes of heat transfer- thermal conductivity- Newton's law of cooling - Linear heat flow – Lee's disc method – Radial heat flow – Rubber tube method – conduction through compound media (series and parallel)

UNIT III QUANTUM PHYSICS 9

Black body radiation – Planck's theory (derivation) – Deduction of Wien's displacement law and Rayleigh – Jeans' Law from Planck's theory – Compton effect. Theory and experimental verification – Properties of Matter waves – G.P Thomson experiment -Schrödinger's wave equation – Time independent and time dependent equations – Physical significance of wave function – Particle in a one dimensional box - Electron microscope - Scanning electron microscope - Transmission electron microscope.

UNIT IV ACOUSTICS AND ULTRASONICS 9

Classification of Sound- decibel- Weber–Fechner law – Sabine's formula- derivation using growth and decay method – Absorption Coefficient and its determination –factors affecting acoustics of buildings and their remedies.

Production of ultrasonics by magnetostriction and piezoelectric methods - acoustic grating -Non Destructive Testing – pulse echo system through transmission and reflection modes - A,B and C – scan displays, Medical applications - Sonogram

UNIT V PHOTONICS AND FIBRE OPTICS 9

Spontaneous and stimulated emission- Population inversion -Einstein's A and B coefficients - derivation. Types of lasers – Nd:YAG, CO_2 , Semiconductor lasers (homojunction & heterojunction)- Industrial and Medical Applications.

Principle and propagation of light in optical fibres – Numerical aperture and Acceptance angle - Types of optical fibres (material, refractive index, mode) – attenuation, dispersion, bending - Fibre Optical Communication system (Block diagram) - Active and passive fibre sensors- Endoscope.

TOTAL: 45 PERIODS

OUTCOMES:

The students will have knowledge on the basics of physics related to properties of matter, Optics, acoustics etc., and they will apply these fundamental principles to solve practical problems related to materials used for engineering applications

TEXT BOOKS:

1. Arumugam M. Engineering Physics. Anuradha publishers, 2010.
2. Gaur R.K. and Gupta S.L. Engineering Physics. Dhanpat Rai publishers, 2009
3. Mani Naidu S. Engineering Physics, Second Edition, PEARSON Publishing, 2011.

REFERENCES:

1. Searls and Zemansky. University Physics, 2009
2. Mani P. Engineering Physics I. Dhanam Publications, 2011.
3. Marikani A. Engineering Physics. PHI Learning Pvt., India, 2009.
4. Palanisamy P.K. Engineering Physics. SCITECH Publications, 2011.
5. Rajagopal K. Engineering Physics. PHI, New Delhi, 2011.
6. Senthilkumar G. Engineering Physics I. VRB Publishers, 2011.

CY6151 ENGINEERING CHEMISTRY - I L T P C
3 0 0 3

OBJECTIVES:

- To make the students conversant with basics of polymer chemistry.
- To make the student acquire sound knowledge of second law of thermodynamics and second law based derivations of importance in engineering applications in all disciplines.
- To acquaint the student with concepts of important photophysical and photochemical processes and spectroscopy.
- To develop an understanding of the basic concepts of phase rule and its applications to single and two component systems and appreciate the purpose and significance of alloys.
- To acquaint the students with the basics of nano materials, their properties and applications.

UNIT I POLYMER CHEMISTRY 9

Introduction: Classification of polymers – Natural and synthetic; Thermoplastic and Thermosetting. Functionality – Degree of polymerization. Types and mechanism of polymerization: Addition (Free Radical, cationic and anionic); condensation and copolymerization. Properties of polymers: Tg, Tacticity, Molecular weight – weight average, number average and polydispersity index. Techniques of polymerization: Bulk, emulsion, solution and suspension. Preparation, properties and uses of Nylon 6,6, and Epoxy resin.

UNIT II CHEMICAL THERMODYNAMICS 9

Terminology of thermodynamics - Second law: Entropy - entropy change for an ideal gas, reversible and irreversible processes; entropy of phase transitions; Clausius inequality. Free energy and work function: Helmholtz and Gibbs free energy functions (problems); Criteria of spontaneity; Gibbs-Helmholtz equation (problems); Clausius-Clapeyron equation; Maxwell relations – Van't Hoff isotherm and isochore(problems).

UNIT III PHOTOCHEMISTRY AND SPECTROSCOPY 9

Photochemistry: Laws of photochemistry - Grotthuss–Draper law, Stark–Einstein law and Lambert-Beer Law. Quantum efficiency – determination- Photo processes - Internal Conversion, Inter-system crossing, Fluorescence, Phosphorescence, Chemiluminescence and Photo-sensitization. Spectroscopy: Electromagnetic spectrum - Absorption of radiation – Electronic, Vibrational and rotational transitions. UV-visible and IR spectroscopy – principles, instrumentation (Block diagram only).

UNIT IV PHASE RULE AND ALLOYS 9

Phase rule: Introduction, definition of terms with examples, One Component System- water system - Reduced phase rule - Two Component Systems- classification – lead-silver system, zinc-magnesium system. Alloys: Introduction- Definition- Properties of alloys- Significance of alloying, Functions and effect of alloying elements- Ferrous alloys- Nichrome and Stainless steel – heat treatment of steel; Non-ferrous alloys – brass and bronze.

UNIT V NANOCHEMISTRY 9

Basics - distinction between molecules, nanoparticles and bulk materials; size-dependent properties. nanoparticles: nano cluster, nano rod, nanotube(CNT) and nanowire. Synthesis: precipitation, thermolysis, hydrothermal, solvothermal, electrodeposition, chemical vapour deposition, laser ablation; Properties and applications

TOTAL :45 PERIODS

OUTCOMES:

- The knowledge gained on polymer chemistry, thermodynamics. spectroscopy, phase rule and nano materials will provide a strong platform to understand the concepts on these subjects for further learning.

TEXT BOOKS:

1. Jain P.C. and Monica Jain, “Engineering Chemistry”, Dhanpat Rai Publishing Company (P) Ltd., New Delhi, 2010
2. Kannan P., Ravikrishnan A., “Engineering Chemistry”, Sri Krishna Hi-tech Publishing Company Pvt. Ltd. Chennai, 2009.

REFERENCES:

1. Dara S.S, Umare S.S, “Engineering Chemistry”, S. Chand & Company Ltd., New Delhi 2010
2. Sivasankar B., “Engineering Chemistry”, Tata McGraw-Hill Publishing Company, Ltd., New Delhi, 2008.
3. Gowariker V.R. , Viswanathan N.V. and JayadevSreedhar, “Polymer Science”, New Age International P (Ltd.,), Chennai, 2006.
4. Ozin G. A. and Arsenault A. C., “Nanochemistry: A Chemical Approach to Nanomaterials”, RSC Publishing, 2005.

GE6151 COMPUTER PROGRAMMING L T P C
3 0 0 3

OBJECTIVES:

The students should be made to:

- Learn the organization of a digital computer.
- Be exposed to the number systems.
- Learn to think logically and write pseudo code or draw flow charts for problems.
- Be exposed to the syntax of C.
- Be familiar with programming in C.
- Learn to use arrays, strings, functions, pointers, structures and unions in C.

UNIT I INTRODUCTION 8

Generation and Classification of Computers- Basic Organization of a Computer –Number System – Binary – Decimal – Conversion – Problems. Need for logical analysis and thinking – Algorithm – Pseudo code – Flow Chart.

UNIT II C PROGRAMMING BASICS 10

Problem formulation – Problem Solving - Introduction to ' C' programming –fundamentals – structure of a 'C' program – compilation and linking processes – Constants, Variables – Data Types – Expressions using operators in 'C' – Managing Input and Output operations – Decision Making and Branching – Looping statements – solving simple scientific and statistical problems.

UNIT III ARRAYS AND STRINGS 9

Arrays – Initialization – Declaration – One dimensional and Two dimensional arrays. String- String operations – String Arrays. Simple programs- sorting- searching – matrix operations.

UNIT IV FUNCTIONS AND POINTERS 9

Function – definition of function – Declaration of function – Pass by value – Pass by reference – Recursion – Pointers - Definition – Initialization – Pointers arithmetic – Pointers and arrays- Example Problems.

UNIT V STRUCTURES AND UNIONS 9

Introduction – need for structure data type – structure definition – Structure declaration – Structure within a structure - Union - Programs using structures and Unions – Storage classes, Pre-processor directives.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Design C Programs for problems.
- Write and execute C programs for simple applications

TEXTBOOKS:

1. Anita Goel and Ajay Mittal, "Computer Fundamentals and Programming in C", Dorling Kindersley (India) Pvt. Ltd., Pearson Education in South Asia, 2011.
2. Pradip Dey, Manas Ghosh, "Fundamentals of Computing and Programming in C", First Edition, Oxford University Press, 2009
3. Yashavant P. Kanetkar. "Let Us C", BPB Publications, 2011.

REFERENCES:

1. Byron S Gottfried, "Programming with C", Schaum's Outlines, Second Edition, Tata McGraw-Hill, 2006.
2. Dromey R.G., "How to Solve it by Computer", Pearson Education, Fourth Reprint, 2007.
3. Kernighan,B.W and Ritchie,D.M, "The C Programming language", Second Edition, Pearson Education, 2006.

GE6152 **ENGINEERING GRAPHICS** **L T P C**
2 0 3 4

OBJECTIVES:

- To develop in students, graphic skills for communication of concepts, ideas and design of Engineering products
- To expose them to existing national standards related to technical drawings.

CONCEPTS AND CONVENTIONS (Not for Examination) **1**

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

UNIT I PLANE CURVES AND FREE HAND SKETCHING **5+9**

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

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

UNIT II PROJECTION OF POINTS, LINES AND PLANE SURFACES **5+ 9**

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

UNIT III PROJECTION OF SOLIDS **5+9**

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

UNIT IV PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES **5+9**

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

UNIT V ISOMETRIC AND PERSPECTIVE PROJECTIONS **6+9**

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

COMPUTER AIDED DRAFTING (Demonstration Only) **3**

Introduction to drafting packages and demonstration of their use.

TOTAL :75 PERIODS

OUTCOMES:

On Completion of the course the student will be able to:

- perform free hand sketching of basic geometrical constructions and multiple views of objects.
- do orthographic projection of lines and plane surfaces.
- draw projections and solids and development of surfaces.
- prepare isometric and perspective sections of simple solids.
- demonstrate computer aided drafting

TEXT BOOK:

1. Bhatt N.D. and Panchal V.M., "Engineering Drawing", Charotar Publishing House, 50th Edition, 2010.

REFERENCES:

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

Publication of Bureau of Indian Standards:

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

Special points applicable to University Examinations on Engineering Graphics:

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

GE6161 **COMPUTER PRACTICES LABORATORY** **L T P C**
0 0 3 2

OBJECTIVES:

The student should be made to:

- Be familiar with the use of Office software.
- Be exposed to presentation and visualization tools.
- Be exposed to problem solving techniques and flow charts.
- Be familiar with programming in C.
- Learn to use Arrays, strings, functions, structures and unions.

LIST OF EXPERIMENTS:

1. Search, generate, manipulate data using MS office/ Open Office
2. Presentation and Visualization – graphs, charts, 2D, 3D
3. Problem formulation, Problem Solving and Flowcharts
4. C Programming using Simple statements and expressions
5. Scientific problem solving using decision making and looping.
6. Simple programming for one dimensional and two dimensional arrays.
7. Solving problems using String functions
8. Programs with user defined functions – Includes Parameter Passing
9. Program using Recursive Function and conversion from given program to flow chart.
10. Program using structures and unions.

TOTAL : 45 PERIODS

OUTCOMES:

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

- Apply good programming design methods for program development.
- Design and implement C programs for simple applications.
- Develop recursive programs.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

Standalone desktops with C compiler 30 Nos.

(or)

Server with C compiler supporting 30 terminals or more.

GE6162 **ENGINEERING PRACTICES LABORATORY** **L T P C**
0 0 3 2

OBJECTIVES:

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

GROUP A (CIVIL & MECHANICAL)

I CIVIL ENGINEERING PRACTICE 9

Buildings:

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

Plumbing Works:

(a) Study of pipeline joints, its location and functions: valves, taps, couplings, unions, reducers, elbows in household fittings.
(b) Study of pipe connections requirements for pumps and turbines.
(c) Preparation of plumbing line sketches for water supply and sewage works.
(d) Hands-on-exercise:

Basic pipe connections – Mixed pipe material connection – Pipe connections with different joining components.

(e) Demonstration of plumbing requirements of high-rise buildings.

Carpentry using Power Tools only:

(a) Study of the joints in roofs, doors, windows and furniture.
(b) Hands-on-exercise:

Wood work, joints by sawing, planing and cutting.

II MECHANICAL ENGINEERING PRACTICE 13

Welding:

(a) Preparation of arc welding of butt joints, lap joints and tee joints.
(b) Gas welding practice

Basic Machining:

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

Sheet Metal Work:

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

Machine assembly practice:

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

Demonstration on:

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

GROUP B (ELECTRICAL & ELECTRONICS)

III ELECTRICAL ENGINEERING PRACTICE **10**

1. Residential house wiring using switches, fuse, indicator, lamp and energy meter.
2. Fluorescent lamp wiring.
3. Stair case wiring
4. Measurement of electrical quantities – voltage, current, power & power factor in RLC circuit.
5. Measurement of energy using single phase energy meter.
6. Measurement of resistance to earth of an electrical equipment.

IV ELECTRONICS ENGINEERING PRACTICE **13**

1. Study of Electronic components and equipments – Resistor, colour coding measurement of AC signal parameter (peak-peak, rms period, frequency) using CR.
2. Study of logic gates AND, OR, EOR and NOT.
3. Generation of Clock Signal.
4. Soldering practice – Components Devices and Circuits – Using general purpose PCB.
5. Measurement of ripple factor of HWR and FWR.

TOTAL: 45 PERIODS

OUTCOMES:

- Ability to fabricate carpentry components and pipe connections including plumbing works.
- Ability to use welding equipments to join the structures.
- Ability to fabricate electrical and electronics circuits.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

CIVIL

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

MECHANICAL

1. Arc welding transformer with cables and holders	5 Nos.
2. Welding booth with exhaust facility	5 Nos.
3. Welding accessories like welding shield, chipping hammer, wire brush, etc.	5 Sets.
4. Oxygen and acetylene gas cylinders, blow pipe and other welding outfit.	2 Nos.
5. Centre lathe	2 Nos.
6. Hearth furnace, anvil and smithy tools	2 Sets.

7. Moulding table, foundry tools 2 Sets.
8. Power Tool: Angle Grinder 2 Nos
9. Study-purpose items: centrifugal pump, air-conditioner One each.

ELECTRICAL

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

ELECTRONICS

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

REFERENCES:

1. Jeyachandran K., Natarajan S. & Balasubramanian S., "A Primer on Engineering Practices Laboratory", Anuradha Publications, (2007).
2. Jeyapoovan T., Saravanapandian M. & Pranitha S., "Engineering Practices Lab Manual", Vikas Puplishing House Pvt.Ltd, (2006)
3. Bawa H.S., "Workshop Practice", Tata McGraw – Hill Publishing Company Limited, (2007).
4. Rajendra Prasad A. & Sarma P.M.M.S., "Workshop Practice", Sree Sai Publication, (2002).
5. Kannaiah P. & Narayana K.L., "Manual on Workshop Practice", Scitech Publications, (1999).

GE6163 PHYSICS AND CHEMISTRY LABORATORY – I L T P C
0 0 2 1

PHYSICS LABORATORY – I

OBJECTIVES:

To introduce different experiments to test basic understanding of physics concepts applied in optics, thermal physics and properties of matter.

LIST OF EXPERIMENTS

(Any FIVE Experiments)

1 (a) Determination of Wavelength, and particle size using Laser
   (b) Determination of acceptance angle in an optical fiber.
2. Determination of velocity of sound and compressibility of liquid – Ultrasonic interferometer.
3. Determination of wavelength of mercury spectrum – spectrometer grating
4. Determination of thermal conductivity of a bad conductor – Lee's Disc method.
5. Determination of Young's modulus by Non uniform bending method
6. Determination of specific resistance of a given coil of wire – Carey Foster's Bridge

OUTCOMES:

The hands on exercises undergone by the students will help them to apply physics principles of optics and thermal physics to evaluate engineering properties of materials.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

1. Diode laser, lycopodium powder, glass plate, optical fiber.
2. Ultrasonic interferometer
3. Spectrometer, mercury lamp, grating
4. Lee's Disc experimental set up
5. Traveling microscope, meter scale, knife edge, weights
6. Carey foster's bridge set up

(vernier Caliper, Screw gauge, reading lens are required for most of the experiments)

CHEMISTRY LABORATORY-I

LIST OF EXPERIMENTS

(Any FIVE Experiments)

OBJECTIVES:

To make the student to acquire practical skills in the determination of water quality parameters through volumetric and instrumental analysis.

To acquaint the students with the determination of molecular weight of a polymer by vacometry.

1 Determination of DO content of water sample by Winkler's method.
2 Determination of chloride content of water sample by argentometric method
3 Determination of strength of given hydrochloric acid using pH meter
4 Determination of strength of acids in a mixture using conductivity meter
5 Estimation of iron content of the water sample using spectrophotometer (1,10- phenanthroline / thiocyanate method)
6 Determination of molecular weight of polyvinylalcohol using Ostwald viscometer
7 Conductometric titration of strong acid vs strong base

TOTAL: 30 PERIODS

OUTCOMES:

The students will be outfitted with hands-on knowledge in the quantitative chemical analysis of water quality related parameters

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

1.	Iodine flask	-	30 Nos
2.	pH meter	-	5 Nos
3.	Conductivity meter	-	5 Nos
4.	Spectrophotometer	-	5 Nos
5.	Ostwald Viscometer	-	10 Nos

Common Apparatus : Pipette, Burette, conical flask, percelain tile, dropper (each 30 Nos.)

REFERENCES:

1. Daniel R. Palleros, "Experimental organic chemistry" John Wiley & Sons, Inc., New Yor (2001).
2. Furniss B.S. Hannaford A.J, Smith P.W.G and Tatchel A.R., "Vogel's Textbook of practical organic chemistry", LBS Singapore (1994).
3. Jeffery G.H., Bassett J., Mendham J.and Denny vogel's R.C, "Text book of quantitative analysis chemical analysis", ELBS 5th Edn. Longman, Singapore publishers, Singapore, 1996.
4. Kolthoff I.M., Sandell E.B. et al. "Quantitative chemical analysis", Mcmillan, Madras 1980.

HS6251 TECHNICAL ENGLISH II L T P C
3 1 0 4

OBJECTIVES:

- To make learners acquire listening and speaking skills in both formal and informal contexts.
- To help them develop their reading skills by familiarizing them with different types of reading strategies.
- To equip them with writing skills needed for academic as well as workplace contexts.
- To make them acquire language skills at their own pace by using e-materials and language lab components.

UNIT I 9+3

Listening - Listening to informal conversations and participating; Speaking - Opening a conversation (greetings, comments on topics like weather) - Turn taking - Closing a conversation (excuses, general wish, positive comment, thanks); Reading - Developing analytical skills, Deductive and inductive reasoning - Extensive reading; Writing - Effective use of SMS for sending short notes and messages - Using 'emoticons' as symbols in email messages; Grammar - Regular and irregular verbs - Active and passive voice; Vocabulary - Homonyms (e.g. 'can') - Homophones (e.g. 'some', 'sum'); E-materials - Interactive exercise on Grammar and vocabulary – blogging; Language Lab - Listening to different types of conversation and answering questions.

UNIT II 9+3

Listening - Listening to situation based dialogues; Speaking - Conversation practice in real life situations, asking for directions (using polite expressions), giving directions (using imperative sentences), Purchasing goods from a shop, Discussing various aspects of a film (they have already seen) or a book (they have already read); Reading - Reading a short story or an article from newspaper, Critical reading, Comprehension skills; Writing - Writing a review / summary of a story / article, Personal letter (Inviting your friend to a function, congratulating someone for his / her success, thanking one's friends / relatives); Grammar - modal verbs, Purpose expressions; Vocabulary - Phrasal verbs and their meanings, Using phrasal verbs in sentences; E-materials - Interactive exercises on Grammar and vocabulary, Extensive reading activity (reading stories / novels), Posting reviews in blogs - Language Lab - Dialogues (Fill up exercises), Recording students' dialogues.

UNIT III 9+3

Listening - Listening to the conversation - Understanding the structure of conversations; Speaking - Conversation skills with a sense of stress, intonation, pronunciation and meaning - Seeking information – expressing feelings (affection, anger, regret, etc.); Reading - Speed reading – reading passages with time limit - Skimming; Writing - Minutes of meeting – format and practice in the preparation of minutes - Writing summary after reading articles from journals - Format for journal articles – elements of technical articles (abstract, introduction, methodology, results, discussion, conclusion, appendices, references) - Writing strategies; Grammar - Conditional clauses - Cause and effect expressions; Vocabulary - Words used as nouns and verbs without any change in the

spelling (e.g. ‘rock’, ‘train’, ‘ring’); E-materials - Interactive exercise on Grammar and vocabulary - Speed Reading practice exercises; Language Lab - Intonation practice using EFLU and RIE materials – Attending a meeting and writing minutes.

UNIT IV **9+3**

Listening - Listening to a telephone conversation, Viewing model interviews (face-to-face, telephonic and video conferencing); Speaking - Role play practice in telephone skills - listening and responding, -asking questions, -note taking – passing on messages, Role play and mock interview for grasping interview skills; Reading - Reading the job advertisements and the profile of the company concerned – scanning; Writing - Applying for a job – cover letter - résumé preparation – vision, mission and goals of the candidate; Grammar - Numerical expressions - Connectives (discourse markers); Vocabulary - Idioms and their meanings – using idioms in sentences; E-materials - Interactive exercises on Grammar and Vocabulary - Different forms of résumés- Filling up a résumé / cover letter; Language Lab - Telephonic interview – recording the responses - e-résumé writing.

UNIT V **9+3**

Listening - Viewing a model group discussion and reviewing the performance of each participant - Identifying the characteristics of a good listener; Speaking - Group discussion skills – initiating the discussion – exchanging suggestions and proposals – expressing dissent/agreement – assertiveness in expressing opinions – mind mapping technique; Reading - Note making skills – making notes from books, or any form of written materials - Intensive reading; Writing – Checklist - Types of reports – Feasibility / Project report – report format – recommendations / suggestions – interpretation of data (using charts for effective presentation); Grammar - Use of clauses; Vocabulary – Collocation; E-materials - Interactive grammar and vocabulary exercises - Sample GD - Pictures for discussion, Interactive grammar and vocabulary exercises; Language Lab - Different models of group discussion.

OUTCOMES:

Learners should be able to

- Speak convincingly, express their opinions clearly, initiate a discussion, negotiate, argue using appropriate communicative strategies.
- Write effectively and persuasively and produce different types of writing such as narration, description, exposition and argument as well as creative, critical, analytical and evaluative writing.
- Read different genres of texts, infer implied meanings and critically analyse and evaluate them for ideas as well as for method of presentation.
- Listen/view and comprehend different spoken excerpts critically and infer unspoken and implied meanings.

TOTAL (L:45+T:15): 60 PERIODS

TEXT BOOKS:

1. Department of English, Anna University. Mindscapes: English for Technologists and Engineers. Orient Blackswan, Chennai. 2012
2. Dhanavel, S.P. English and Communication Skills for Students of Science and Engineering. Orient Blackswan, Chennai. 2011

REFERENCES:

1. Anderson, Paul V. Technical Communication: A Reader-Centered Approach. Cengage. New Delhi. 2008
2. Muralikrishna, & Sunita Mishra. Communication Skills for Engineers. Pearson, New Delhi. 2011
3. Riordan, Daniel. G. Technical Communication. Cengage Learning, New Delhi. 2005
4. Sharma, Sangeetha & Binod Mishra. Communication Skills for Engineers and Scientists. PHI Learning, New Delhi. 2009
5. Smith-Worthington, Darlene & Sue Jefferson. Technical Writing for Success. Cengage, Mason USA. 2007

EXTENSIVE Reading (Not for Examination)

1. Khera, Shiv. You can Win. Macmillan, Delhi. 1998.

Websites

1. http://www.englishclub.com
2. http://owl.english.purdue.edu

TEACHING METHODS:

- Lectures
- Activities conducted individually, in pairs and in groups like individual writing and presentations, group discussions, interviews, reporting, etc
- Long presentations using visual aids
- Listening and viewing activities with follow up activities like discussions, filling up worksheets, writing exercises (using language lab wherever necessary/possible) etc
- Projects like group reports, mock interviews etc using a combination of two or more of the language skills

EVALUATION PATTERN:

Internal assessment: 20%

3 tests of which two are pen and paper tests and the other is a combination of different modes of assessment like

- Project
- Assignment
- Report
- Creative writing, etc.

All the four skills are to be tested with equal weightage given to each.

- ✓ Speaking assessment: Individual presentations, Group discussions
- ✓ Reading assessment: Reading passages with comprehension questions graded following Bloom's taxonomy
- ✓ Writing assessment: Writing essays, CVs, reports etc. Writing should include grammar and vocabulary.
- ✓ Listening/Viewing assessment: Lectures, dialogues, film clippings with questions on verbal as well as audio/visual content graded following Bloom's taxonomy.

End Semester Examination: 80%

MA6251	**MATHEMATICS – II**	**L T P C**
		3 1 0 4

OBJECTIVES:

- To make the student acquire sound knowledge of techniques in solving ordinary differential equations that model engineering problems.
- To acquaint the student with the concepts of vector calculus, needed for problems in all engineering disciplines.
- To develop an understanding of the standard techniques of complex variable theory so as to enable the student to apply them with confidence, in application areas such as heat conduction, elasticity, fluid dynamics and flow the of electric current.
- To make the student appreciate the purpose of using transforms to create a new domain in which it is easier to handle the problem that is being investigated.

UNIT I VECTOR CALCULUS 9+3

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

UNIT II ORDINARY DIFFERENTIAL EQUATIONS 9+3

Higher order linear differential equations with constant coefficients – Method of variation of parameters – Cauchy's and Legendre's linear equations – Simultaneous first order linear equations with constant coefficients.

UNIT III LAPLACE TRANSFORM 9+3

Laplace transform – Sufficient condition for existence – Transform of elementary functions – Basic properties – Transforms of derivatives and integrals of functions - Derivatives and integrals of transforms - Transforms of unit step function and impulse functions – Transform of periodic functions. Inverse Laplace transform -Statement of Convolution theorem – Initial and final value theorems – Solution of linear ODE of second order with constant coefficients using Laplace transformation techniques.

UNIT IV ANALYTIC FUNCTIONS 9+3

Functions of a complex variable – Analytic functions: Necessary conditions – Cauchy-Riemann equations and sufficient conditions (excluding proofs) – Harmonic and orthogonal properties of analytic function – Harmonic conjugate – Construction of analytic functions – Conformal mapping: $w = z+k$, kz, $1/z$, z^2, e^z and bilinear transformation.

UNIT V COMPLEX INTEGRATION 9+3

Complex integration – Statement and applications of Cauchy's integral theorem and Cauchy's integral formula – Taylor's and Laurent's series expansions – Singular points – Residues – Cauchy's residue theorem – Evaluation of real definite integrals as contour integrals around unit circle and semi-circle (excluding poles on the real axis).

TOTAL (L:45+T:15): 60 PERIODS

OUTCOMES:

- The subject helps the students to develop the fundamentals and basic concepts in vector calculus, ODE, Laplace transform and complex functions. Students will be able to solve problems related to engineering applications by using these techniques.

TEXT BOOKS:

1. Bali N. P and Manish Goyal, "A Text book of Engineering Mathematics", Eighth Edition, Laxmi Publications Pvt Ltd.,2011.
2. Grewal. B.S, "Higher Engineering Mathematics", 41st Edition, Khanna Publications, Delhi, 2011.

REFERENCES:

1. Dass, H.K., and Er. Rajnish Verma," Higher Engineering Mathematics",S. Chand Private Ltd., (2011)
2. Glyn James, "Advanced Modern Engineering Mathematics", 3rd Edition, Pearson Education, (2012).
3. Peter V. O'Neil," Advanced Engineering Mathematics", 7th Edition, Cengage learning, (2012).
4. Ramana B.V, "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company, New Delhi, (2008).
5. Sivarama Krishna Das P. and Rukmangadachari E., "Engineering Mathematics" Volume II, Second Edition, PEARSON Publishing 2011.

PH6251 ENGINEERING PHYSICS – II L T P C
3 0 0 3

OBJECTIVES:

- To enrich the understanding of various types of materials and their applications in engineering and technology.

UNIT I CONDUCTING MATERIALS 9

Conductors – classical free electron theory of metals – Electrical and thermal conductivity – Wiedemann – Franz law – Lorentz number – Draw backs of classical theory – Quantum theory – Fermi distribution function – Effect of temperature on Fermi Function – Density of energy states – carrier concentration in metals.

UNIT II SEMICONDUCTING MATERIALS 9

Intrinsic semiconductor – carrier concentration derivation – Fermi level – Variation of Fermi level with temperature – electrical conductivity – band gap determination – compound semiconductors -direct and indirect band gap- derivation of carrier concentration in n-type and p-type semiconductor – variation of Fermi level with temperature and impurity concentration –– Hall effect –Determination of Hall coefficient – Applications.

UNIT III MAGNETIC AND SUPERCONDUCTING MATERIALS 9

Origin of magnetic moment – Bohr magneton – comparison of Dia, Para and Ferro magnetism – Domain theory – Hysteresis – soft and hard magnetic materials – antiferromagnetic materials – Ferrites and its applications

Superconductivity : properties – Type I and Type II superconductors – BCS theory of superconductivity(Qualitative) - High T_c superconductors – Applications of superconductors – SQUID, cryotron, magnetic levitation.

UNIT IV DIELECTRIC MATERIALS 9

Electrical susceptibility – dielectric constant – electronic, ionic, orientational and space charge polarization – frequency and temperature dependence of polarisation – internal field – Claussius – Mosotti relation (derivation) – dielectric loss – dielectric breakdown – uses of dielectric materials (capacitor and transformer) – ferroelectricity and applications.

UNIT V ADVANCED ENGINEERING MATERIALS 9

Metallic glasses: preparation, properties and applications. Shape memory alloys (SMA): Characteristics, properties of NiTi alloy, application, Nanomaterials– Preparation -pulsed laser deposition – chemical vapour deposition – Applications – NLO materials –Birefringence- optical Kerr effect – Classification of Biomaterials and its applications

TOTAL: 45 PERIODS

OUTCOMES:

The students will have the knowledge on physics of materials and that knowledge will be used by them in different engineering and technology applications

TEXT BOOKS:

1. Arumugam M., Materials Science. Anuradha publishers, 2010
2. Pillai S.O., Solid State Physics. New Age International(P) Ltd., publishers, 2009

REFERENCES:

1. Palanisamy P.K. Materials Science. SCITECH Publishers, 2011
2. Senthilkumar G. Engineering Physics II. VRB Publishers, 2011
3. Mani P. Engineering Physics II. Dhanam Publications, 2011
4. Marikani A. Engineering Physics. PHI Learning Pvt., India, 2009

CY6251 ENGINEERING CHEMISTRY-II L T P C
3 0 0 3

OBJECTIVES:

- To make the students conversant with boiler feed water requirements, related problems and water treatment techniques.
- Principles of electrochemical reactions, redox reactions in corrosiion of materials and methods for corrosion prevention and protection of materials.
- Principles and generation of energy in batteries, nuclear reactors, solar cells, wind mills and fuel cells.
- Preparation, properties and applications of engineering materials.
- Types of fuels, calorific value calculations, manufacture of solid, liquid and gaseous fuels.

UNIT I WATER TECHNOLOGY 9

Introduction to boiler feed water-requirements-formation of deposits in steam boilers and heat exchangers- disadvantages (wastage of fuels, decrease in efficiency, boiler explosion) prevention of scale formation -softening of hard water -external treatment zeolite and demineralization - internal treatment- boiler compounds (phosphate, calgon, carbonate, colloidal) - caustic embrittlement-boiler corrosion-priming and foaming- desalination of brackish water –reverse osmosis.

UNIT II ELECTROCHEMISTRY AND CORROSION 9

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

UNIT III ENERGY SOURCES 9

Introduction- nuclear energy- nuclear fission- controlled nuclear fission- nuclear fusion- differences between nuclear fission and fusion- nuclear chain reactions- nuclear reactor power generator-classification of nuclear reactor- light water reactor- breeder reactor- solar energy conversion- solar cells- wind energy. Batteries and fuel cells:Types of batteries- alkaline battery- lead storage battery-nickel-cadmium battery- lithium battery- fuel cell H_2 -O_2 fuel cell- applications.

UNIT IV ENGINEERING MATERIALS 9

Abrasives: definition, classification or types, grinding wheel, abrasive paper and cloth. Refractories: definition, characteristics, classification, properties – refractoriness and RUL, dimensional stability, thermal spalling, thermal expansion, porosity; Manufacture of alumina, magnesite and silicon carbide, Portland cement- manufacture and properties - setting and hardening of cement, special cement-waterproof and white cement–properties and uses. Glass - manufacture, types, properties and uses.

UNIT V FUELS AND COMBUSTION 9

Fuel: Introduction- classification of fuels- calorific value- higher and lower calorific values- coal-analysis of coal (proximate and ultimate)- carbonization- manufacture of metallurgical coke (Otto Hoffmann method) - petroleum- manufacture of synthetic petrol (Bergius process)- knocking- octane number - diesel oil- cetane number - natural gas- compressed natural gas(CNG)- liquefied petroleum gases(LPG)- producer gas- water gas. Power alcohol and bio diesel. Combustion of fuels: introduction- theoretical calculation of calorific value- calculation of stoichiometry of fuel and air ratio-ignition temperature- explosive range - flue gas analysis (ORSAT Method).

TOTAL: 45 PERIODS

OUTCOMES:
The knowledge gained on engineering materials, fuels, energy sources and water treatment techniques will facilitate better understanding of engineering processes and applications for further learning.

TEXT BOOKS:

1. Vairam S, Kalyani P and SubaRamesh.,"Engineering Chemistry"., Wiley India PvtLtd.,New Delhi., 2011
2. Dara S.S and Umare S.S. "Engineering Chemistry", S. Chand & Company Ltd., New Delhi , 2010

REFERENCES:

1. Kannan P. and Ravikrishnan A., "Engineering Chemistry", Sri Krishna Hi-tech Publishing Company Pvt. Ltd. Chennai, 2009
2. AshimaSrivastava and Janhavi N N., "Concepts of Engineering Chemistry", ACME Learning Private Limited., New Delhi., 2010.
3. RenuBapna and Renu Gupta., "Engineering Chemistry", Macmillan India Publisher Ltd., 2010.
4. Pahari A and Chauhan B., "Engineering Chemistry"., Firewall Media., New Delhi., 2010

EC6202 ELECTRONIC DEVICES AND CIRCUITS L T P C
3 1 0 4

OBJECTIVES:
The student should be made to:
- Be familiar with the structure of basic electronic devices.
- Be exposed to the operation and applications of electronic devices

UNIT I PN JUNCTION DEVICES 9
PN junction diode –structure, operation and V-I characteristics, diffusion and transient capacitance - Rectifiers – Half Wave and Full Wave Rectifier,– Display devices- LED, Laser diodes, Zener diode-characteristics-Zener Reverse characteristics – Zener as regulator

UNIT II TRANSISTORS 9
BJT, JFET, MOSFET- structure, operation, characteristics and Biasing UJT, Thyristor and IGBT - Structure and characteristics.

UNIT III AMPLIFIERS 9
BJT small signal model – Analysis of CE, CB, CC amplifiers- Gain and frequency response – MOSFET small signal model– Analysis of CS and Source follower – Gain and frequency response-High frequency analysis.

UNIT IV MULTISTAGE AMPLIFIERS AND DIFFERENTIAL AMPLIFIER 9
BIMOS cascade amplifier, Differential amplifier – Common mode and Difference mode analysis – FET input stages – Single tuned amplifiers – Gain and frequency response – Neutralization methods, power amplifiers –Types (Qualitative analysis).

UNIT V FEEDBACK AMPLIFIERS AND OSCILLATORS 9

Advantages of negative feedback – voltage / current, series , Shunt feedback –positive feedback – Condition for oscillations, phase shift – Wien bridge, Hartley, Colpitts and Crystal oscillators.

TOTAL (L:45+T:15): 60 PERIODS

OUTCOMES:

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

- Explain the structure of basic electronic devices.
- Design applications using basic *electronic devices

TEXT BOOKS:

1. David A. Bell ,"Electronic devices and circuits", Prentice Hall of India, 2004.
2. Sedra and smith, "Microelectronic circuits " Oxford University Press, 2004.

REFERENCES:

1. Rashid, "Micro electronic circuits" Thomson publications, 1999.
2. Floyd, "Electron devices" Pearson Asia 5th Edition, 2001.
3. Donald A Neamen, "Electronic Circuit Analysis and Design" Tata McGraw Hill, 3rd Edition, 2003.
4. Robert L.Boylestad, "Electronic devices and circuit theory", 2002.
5. Robert B. Northrop, "Analysis and Application of Analog Electronic Circuits to Biomedical Instrumentation", CRC Press, 2004.

EE6201 CIRCUIT THEORY L T P C
3 1 0 4

OBJECTIVES:

- To introduce electric circuits and its analysis
- To impart knowledge on solving circuits using network theorems
- To introduce the phenomenon of resonance in coupled circuits.
- To educate on obtaining the transient response of circuits.
- To Phasor diagrams and analysis of three phase circuits

UNIT I BASIC CIRCUITS ANALYSIS 12

Ohm's Law – Kirchoffs laws – DC and AC Circuits – Resistors in series and parallel circuits – Mesh current and node voltage method of analysis for D.C and A.C. circuits – Phasor Diagram – Power, Power Factor and Energy

UNIT II NETWORK REDUCTION AND NETWORK THEOREMS FOR DC AND AC CIRCUITS 12

Network reduction: voltage and current division, source transformation – star delta conversion. Thevenins and Novton & Theorem – Superposition Theorem – Maximum power transfer theorem – Reciprocity Theorem.

UNIT III RESONANCE AND COUPLED CIRCUITS 12

Series and paralled resonance – their frequency response – Quality factor and Bandwidth - Self and mutual inductance – Coefficient of coupling – Tuned circuits – Single tuned circuits.

UNIT IV TRANSIENT RESPONSE FOR DC CIRCUITS 12

Transient response of RL, RC and RLC Circuits using Laplace transform for DC input and A.C. with sinusoidal input – Characterization of two port networks in terms of Z,Y and h parameters.

UNIT V THREE PHASE CIRCUITS 12

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

TOTAL: 60 PERIODS

OUTCOMES:

- Ability analyse electrical circuits
- Ability to apply circuit theorems
- Ability to analyse AC and DC Circuits

TEXT BOOKS:

1. William H. Hayt Jr, Jack E. Kemmerly and Steven M. Durbin, "Engineering Circuits Analysis", Tata McGraw Hill publishers, 6th edition, New Delhi, 2003.
2. Joseph A. Edminister, Mahmood Nahri, "Electric circuits", Schaum's series, Tata McGraw-Hill, New Delhi, 2001.

REFERENCES:

1. Paranjothi SR, "Electric Circuits Analysis," New Age International Ltd., New Delhi, (1996).
2. Sudhakar A and Shyam Mohan SP, "Circuits and Network Analysis and Synthesis",Tata McGraw Hill, (2007).
3. Chakrabati A, "Circuits Theory (Analysis and synthesis), Dhanpath Rai & Sons, New Delhi, (1999).
4. Charles K. Alexander, Mathew N.O. Sadiku, "Fundamentals of Electric Circuits", Second Edition, McGraw Hill, (2003).

GE6262 PHYSICS AND CHEMISTRY LABORATORY – II

L	T	P	C
0	0	2	1

PHYSICS LABORATORY – II

OBJECTIVES:

- To introduce different experiments to test basic understanding of physics concepts applied in optics, thermal physics and properties of matter.

(Any FIVE Experiments)

1. Determination of Young's modulus by uniform bending method
2. Determination of band gap of a semiconductor
3. Determination of Coefficient of viscosity of a liquid –Poiseuille's method
4. Determination of Dispersive power of a prism - Spectrometer
5. Determination of thickness of a thin wire – Air wedge method
6. Determination of Rigidity modulus – Torsion pendulum

OUTCOMES:

- The students will have the ability to test materials by using their knowledge of applied physics principles in optics and properties of matter.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

1. Traveling microscope, meter scale, Knife edge, weights
2. Band gap experimental set up
3. Burette, Capillary tube, rubber tube, stop clock, beaker and weighing balance
4. spectrometer, prism, sodium vapour lamp.
5. Air-wedge experimental set up.
6. Torsion pendulum set up.

(vernier Caliper, Screw gauge, reading lens are required for most of the experiments)

CHEMISTRY LABORATORY -II
(Any FIVE Experiments)

OBJECTIVES:

- To make the student acquire practical skills in the wet chemical and instrumental methods for quantitative estimation of hardness, alkalinity, metal ion content, corrosion in metals and cement analysis.

1 Determination of alkalinity in water sample
2 Determination of total, temporary & permanent hardness of water by EDTA method
3 Estimation of copper content of the given solution by EDTA method
4 Estimation of iron content of the given solution using potentiometer
5 Estimation of sodium present in water using flame photometer
6 Corrosion experiment – weight loss method
7 Conductometric precipitation titration using $BaCl_2$ and Na_2SO_4
8 Determination of CaO in Cement.

TOTAL : 30 PERIODS

OUTCOMES:

The students will be conversant with hands-on knowledge in the quantitative chemical analysis of water quality related parameters, corrosion measurement and cement analysis.

REFERENCES:

1. Daniel R. Palleros, “Experimental organic chemistry” John Wiley & Sons, Inc.,New York 2001.
2. Furniss B.S. Hannaford A.J, Smith P.W.G and Tatchel A.R., “Vogel’s Textbook of practical organic chemistry, LBS Singapore (1994).
3. Jeffery G.H, Bassett J., Mendham J. and Denny R.C., “Vogel’s Text book of
4. quantitative analysis chemical analysis”, ELBS 5th Edn. Longman, Singapore publishers, Singapore, 1996.
5. Kolthoff I.M. and Sandell E.B. et al. Quantitative chemical analysis, Mcmillan, Madras 1980

Laboratory classes on alternate weeks for Physics and Chemistry.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

1.	Potentiometer	-	5 Nos
2.	Flame photo meter	-	5 Nos
3.	Weighing Balance	-	5 Nos
4.	Conductivity meter	-	5 Nos

Common Apparatus : Pipette, Burette, conical flask, percelain tile, dropper (30 Nos each)

EC6211 CIRCUITS AND DEVICES LABORATORY L T P C
0 0 3 2

OBJECTIVES:

The student should be made to:

- Be exposed to the characteristics of basic electronic devices
- Be exposed to RL and RC circuits

  Be familiar with Thevinin & Norton theorem KVL & KCL, and Super Position Theorems

LIST OF EXPERIMENTS

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

TOTAL: 45 PERIODS

OUTCOMES:

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

- Learn the characteristics of basic electronic devices
- Design RL and RC circuits
- Verify Thevinin & Norton theorem KVL & KCL, and Super Position Theorems

LABORATORY REQUIREMENTS FOR A BATCH OF 30 STUDENTS

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

MA6351 TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS L T P C
3 1 0 4

OBJECTIVES:

- To introduce Fourier series analysis which is central to many applications in engineering apart from its use in solving boundary value problems.
- To acquaint the student with Fourier transform techniques used in wide variety of situations.
- To introduce the effective mathematical tools for the solutions of partial differential equations that model several physical processes and to develop Z transform techniques for discrete time systems.

UNIT I PARTIAL DIFFERENTIAL EQUATIONS 9+3

Formation of partial differential equations – Singular integrals -- Solutions of standard types of first order partial differential equations - Lagrange's linear equation -- Linear partial differential equations of second and higher order with constant coefficients of both homogeneous and non-homogeneous types.

UNIT II FOURIER SERIES 9+3

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

UNIT III APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS 9+3

Classification of PDE – Method of separation of variables - Solutions of one dimensional wave equation – One dimensional equation of heat conduction – Steady state solution of two dimensional equation of heat conduction (excluding insulated edges).

UNIT IV FOURIER TRANSFORMS 9+3

Statement of Fourier integral theorem – Fourier transform pair – Fourier sine and cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity.

UNIT V Z - TRANSFORMS AND DIFFERENCE EQUATIONS 9+3

Z- transforms - Elementary properties – Inverse Z - transform (using partial fraction and residues) – Convolution theorem - Formation of difference equations – Solution of difference equations using Z - transform.

TOTAL (L:45+T:15): 60 PERIODS

OUTCOMES:

- The understanding of the mathematical principles on transforms and partial differential equations would provide them the ability to formulate and solve some of the physical problems of engineering.

TEXT BOOKS:

1. Veerarajan. T., "Transforms and Partial Differential Equations", Tata McGraw Hill Education Pvt. Ltd., New Delhi, Second reprint, 2012.
2. Grewal. B.S., "Higher Engineering Mathematics", 42nd Edition, Khanna Publishers, Delhi, 2012.
3. Narayanan.S, Manicavachagom Pillay.T.K and Ramanaiah.G "Advanced Mathematics for Engineering Students" Vol. II & III, S.Viswanathan Publishers Pvt Ltd. 1998.

REFERENCES:

1. Bali.N.P and Manish Goyal, "A Textbook of Engineering Mathematics", 7th Edition, Laxmi Publications Pvt Ltd , 2007.
2. Ramana.B.V., "Higher Engineering Mathematics", Tata McGrawHill Publishing Company Limited, New Delhi, 2008.
3. Glyn James, "Advanced Modern Engineering Mathematics", 3rd Edition, Pearson Education, 2007.
4. Erwin Kreyszig, "Advanced Engineering Mathematics", 8th Edition, Wiley India, 2007.
5. Ray Wylie. C and Barrett.L.C, "Advanced Engineering Mathematics" Tata Mc Graw Hill Education Pvt Ltd, Sixth Edition, New Delhi, 2012.
6. Datta.K.B., "Mathematical Methods of Science and Engineering", Cengage Learning India Pvt Ltd, Delhi, 2013.

BM6301 **BIO CHEMISTRY** **L T P C**
3 0 0 3

OBJECTIVES:

The student should be:

- Introduced to Biochemistry
- Familiarized with the Classification, structure and properties of carbohydrates, Lipids, Protein and Enzyme.

UNIT I INTRODUCTION TO BIOCHEMISTRY 6

Introduction to Biochemistry, water as a biological solvent, weak acid and bases, pH, buffers, Handerson-Hasselbalch equation, physiological buffers, fitness of the aqueous environment for living organism . Principle of viscosity, surface tension, adsorption, diffusion, osmosis and their applications in biological systems.

UNIT II CARBOHYDRATES 9

Classification of carbohydrates - mono, di, oligo and polysaccharides. Isomerism, racemisation and mutarotation .Structure, physical and chemical properties of carbohydrates. Metabolic pathways and bioenergetics – Glycolysis, glycogenesis, glycogenolysis and its hormonal regulation. TCA cycle and electron transport chain.Oxidative phosphorylation

UNIT III LIPIDS 12

Classification of lipids- simple, compound and derived lipids. Nomenclature of fatty acid, physical and chemical properties of fat. Saponification number, Reichert- Meissl number and iodine number.Metabolic pathways: synthesis and degradation of fatty acid (beta oxidation), hormonal regulation of fatty acid metabolism, ketogenesis, structural architecture and significance of biological membrane.

UNIT IV NUCLEIC ACID & PROTEIN 9

Structure of purines and pyrimidines, nucleoside , nucleotide , DNA act as a genetic material , chargoffs rule. Watson and crick model of DNA. Structure of RNA and its type. Classification, structure and properties of proteins, structural organization of proteins, classification and properties of aminoacids.Separation of protein: gel filtration, electrophoresis and ultracentrifugation.

UNIT V ENZYME AND ITS KINETICS 9

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

TOTAL: 45 PERIODS

OUTCOMES:

Upon Completion of the Coursę the students will be able to

- Explain the fundamentals of biochemistry

TEXT BOOKS:

1. David.W.Martin, Peter.A.Mayes , Victor. W.Rodwell, “Harper’s Review of Biochemistry”, LANGE Medical Publications, 1981
2. Keith Wilson & John Walker, “Practical Biochemistry - Principles & Techniques”, Oxford University Press, 2009.

REFERENCES:

1. Trevor palmer, “Understanding Enzymes”, Ellis Horwood Ltd. 1991.
2. Pamela.C.Champe & Richard.A.Harvey, “Lippincott Biochemistry Lippincott’s Illustrated Reviews”, Raven publishers,1994.

EC6303	SIGNALS AND SYSTEMS	L T P C
		3 1 0 4

OBJECTIVES:

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

UNIT I CLASSIFICATION OF SIGNALS AND SYSTEMS 9

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

UNIT II ANALYSIS OF CONTINUOUS TIME SIGNALS 9

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

UNIT III LINEAR TIME INVARIANT- CONTINUOUS TIME SYSTEMS 9

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

UNIT IV ANALYSIS OF DISCRETE TIME SIGNALS 9

Baseband Sampling - DTFT – Properties of DTFT - Z Transform – Properties of Z Transform

UNIT V LINEAR TIME INVARIANT-DISCRETE TIME SYSTEMS 9

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

TOTAL (L:45+T:15): 60 PERIODS

OUTCOMES:

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

- Analyze the properties of signals & systems
- Apply Laplace transform, Fourier transform, Z transform and DTFT in signal analysis
- Analyze continuous time LTI systems using Fourier and Laplace Transforms
- Analyze discrete time LTI systems using Z transform and DTFT

TEXT BOOK:

1. Allan V.Oppenheim, S.Wilsky and S.H.Nawab, “Signals and Systems”, Pearson, 2007.

REFERENCES:

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

BM6302 SENSORS AND MEASUREMENTS L T P C
3 0 0 3

OBJECTIVES:

The student should be made to:

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

UNIT I SCIENCE OF MEASUREMENT 7

Measurement System – Instrumentation – Classification and Characteristics of Transducers – Static and Dynamic – Errors in Measurements – Calibration – Primary and secondary standards.

UNIT II DISPLACEMENT, PRESSURE, TEMPERATURE SENSORS 11

Strain Gauge: Gauge factor, sensing elements, configuration, unbounded strain gage, biomedical applications; strain gauge as displacement & pressure transducers: Capacitive transducer, Inductive transducer, LVDT, Passive types: RTD materials & range, relative resistance vs. temperature characteristics, thermistor characteristics, biomedical applications of Temperature sensors. Active type: Thermocouple – characteristics.

UNIT III PHOTOELECTRIC AND PIEZO ELECTRIC SENSORS 9

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

UNIT IV SIGNAL CONDITIONING & SIGNAL ANALYSER 9

AC and DC Bridges –wheat stone bridge, Kelvin, Maxwell, Hay, Schering – Concepts of filters, Pre-amplifier – impedance matching circuits – isolation amplifier. Spectrum analyzer.

UNIT V DISPLAY AND RECORDING DEVICES 9

Digital voltmeter – Multi meter – CRO – block diagram, CRT – vertical & horizontal deflection system, DSO, LCD monitor, PMMC writing systems, servo recorders, photographic recorder, magnetic tape recorder, Inkjet recorder, thermal recorder.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Describe the purpose and methods of measurements
- Explain different display and recording devices for various applications.

TEXT BOOK:

1. A.K.Sawhney, "Electrical & Electronics Measurement and Instrumentation",10th edition, Dhanpat Rai & Co, New Delhi, 2010.

REFERENCES:

1. Ernest O Doebelin and Dhanesh N Manik, Measurement systems, Application and design, 5th edition, Mc Graw-Hill, 2007.
2. Khandpur R.S, "Handbook of Biomedical Instrumentation", Tata McGraw-Hill, New Delhi, 2003.
3. Leslie Cromwell, "Biomedical Instrumentation and measurement", Prentice hall of India, New Delhi, 2007.
4. John G. Webster, "Medical Instrumentation Application and Design", John Wiley and sons, New York, 2004.
5. L.A Geddas and L.E.Baker, "Principles of Applied Biomedical Instrumentation", John Wiley and Sons, Third Edition, Reprint 2008.
6. Albert D.Helfrick and William D. Cooper. Modern Electronic Instrumentation and Measurement Techniques", Prentice Hall of India, 2007.

EC6301 OBJECT ORIENTED PROGRAMMING AND DATA STRUCTURES L T P C
3 0 0 3

OBJECTIVES:

- To comprehend the fundamentals of object oriented programming, particularly in C++.
- To use object oriented programming to implement data structures.
- To introduce linear, non-linear data structures and their applications.

UNIT I DATA ABSTRACTION & OVERLOADING 9

Overview of C++ – Structures – Class Scope and Accessing Class Members – Reference Variables – Initialization – Constructors – Destructors – Member Functions and Classes – Friend Function – Dynamic Memory Allocation – Static Class Members – Container Classes and Integrators – Proxy Classes – Overloading: Function overloading and Operator Overloading.

UNIT II INHERITANCE & POLYMORPHISM 9

Base Classes and Derived Classes – Protected Members – Casting Class pointers and Member Functions – Overriding – Public, Protected and Private Inheritance – Constructors and Destructors in derived Classes – Implicit Derived – Class Object To Base – Class Object Conversion – Composition Vs. Inheritance – Virtual functions – This Pointer – Abstract Base Classes and Concrete Classes – Virtual Destructors – Dynamic Binding.

UNIT III LINEAR DATA STRUCTURES 10

Abstract Data Types (ADTs) – List ADT – array-based implementation – linked list implementation –– singly linked lists –Polynomial Manipulation - Stack ADT – Queue ADT - Evaluating arithmetic expressions

UNIT IV NON-LINEAR DATA STRUCTURES 9

Trees – Binary Trees – Binary tree representation and traversals – Application of trees: Set representation and Union-Find operations – Graph and its representations – Graph Traversals – Representation of Graphs – Breadth-first search – Depth-first search - Connected components.

UNIT V SORTING AND SEARCHING 8

Sorting algorithms: Insertion sort - Quick sort - Merge sort - Searching: Linear search –Binary Search

TOTAL: 45 PERIODS

OUTCOMES:

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

- Explain the concepts of Object oriented programming.
- Write simple applications using C++.
- Discuss the different methods of organizing large amount of data.

TEXT BOOKS:

1. Deitel and Deitel, " C++, How To Program", Fifth Edition, Pearson Education, 2005.
2. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C++", Third Edition, Addison-Wesley, 2007.

REFERENCES:

1. Bhushan Trivedi, " Programming with ANSI C++, A Step-By-Step approach", Oxford University Press, 2010.
2. Goodrich, Michael T., Roberto Tamassia, David Mount, "Data Structures and Algorithms in C++", 7th Edition, Wiley. 2004.
3. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, "Introduction to Algorithms", Second Edition, Mc Graw Hill, 2002.
4. Bjarne Stroustrup, "The C++ Programming Language", 3rd Edition, Pearson Education, 2007.
5. Ellis Horowitz, Sartaj Sahni and Dinesh Mehta, Fundamentals of Data Structures in C++, Galgotia Publications, 2007.

BM6303 ANATOMY AND HUMAN PHYSIOLOGY L T P C

3 0 0 3

OBJECTIVES:

The student should be made to:

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

UNIT I BASIC ELEMENTS OF HUMAN BODY 8

Cell: Structure and organelles - Functions of each component in the cell. Cell membrane –transport across membrane – origin of cell membrane potential – Action potential. **Tissue**: Types – Specialized tissues – functions.

UNIT II SKELETAL AND RESPIRATORY SYSTEM 9

Skeletal system: Bone types and functions – Joint - Types of Joint - Cartilage and functions. Respiratory System: Components of respiratory system – Respiratory Mechanism. Types of respiration - Oxygen and carbon dioxide transport and acid base regulation

UNIT III CIRCULATORY SYSTEM 10

Blood composition - functions of blood – functions of RBC. WBC types and their functions. Blood groups – importance of blood groups – identification of blood groups. Blood vessels- Structure of heart – Properties of Cardiac muscle – Conducting system of heart – Cardiac cycle – ECG - Heart sound - Volume and pressure changes and regulation of heart rate –Coronary Circulation. Factors regulating Blood flow.

UNIT IV URINARY AND SPECIAL SENSORY SYSTEM 9

Urinary system: Structure of Kidney and Nephron. Mechanism of Urine formation and acid base regulation – Urinary reflex – Homeostasis and blood pressure regulation by urinary system. Special senses: Eye and Ear.

UNIT V NERVOUS SYSTEM 9

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.

TOTAL: 45 PERIODS

OUTCOMES:

The student will have knowledge to:

- Describe basic structural and functional elements of human body.
- Explain organs and structures involving in system formation and functions.
- Identify all systems in the human body.

TEXT BOOK:

1. Elaine.N. Marieb , "Essential of Human Anatomy and Physiology", Eight Edition, Pearson Education, New Delhi ,2007.

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.
4. Guyton & Hall, "Medical Physiology", 12th Edition, Elsevier Saunders, 2010

BM6311 BIOCHEMISTRY AND HUMAN PHYSIOLOGY LABORATORY L T P C
0 0 3 2

OBJECTIVES:

To provide practice on:

- Estimation and quantification of biomolecules.
- Separation of macromolecules.

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

OUTCOMES:

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

- Do estimation and interpret the changes in biomolecules.
- Separate and analyze the importance of macromolecules.

LAB REQUIREMENT FOR A BATCH OF 30 STUDENTS:

Requirement for a batch of 30 students

Spectrophotometer	1 No
Colorimeter	2 Nos.
pH meter	1 No
Weighing balance	1 No
Refrigerator	1 No
Vortex Shaker	2 Nos.
SDS gel electrophoresis	1 No
TLC, ready TLC plates	1 No
Wintrobe's tube	2 Nos.
Centrifuge Normal	1 No
Centrifuge Cooling	1 No
Microslides	2 packets
Lancet	5 boxes
Microscope	1 No
Neubaur's Chamber	2 Nos.
Heparinized Syringe	1box
Haemoglobinometer	1 No
Capillary tubes	1 box
Ophthalmoscope (direct & Indirect)	1 No
Tuning fork (256Hz to 512Hz)	5 Nos.
Blood grouping kit	1 No

TOTAL : 45 PERIODS

BM6312 OOPS AND DATA STRUCTURES LABORATORY L T P C
0 0 3 2

OBJECTIVES:

The student should be made to:

- Learn C++ programming language.
- Be exposed to the different data structures
- Be familiar with applications using different data structures

LIST OF EXPERIMENTS:

1. Basic Programs for C++ Concepts
2. Array implementation of List Abstract Data Type (ADT)
3. Linked list implementation of List ADT
4. Cursor implementation of List ADT
5. Stack ADT - Array and linked list implementations
6. The next two exercises are to be done by implementing the following source files
   i. Program source files for Stack Application 1
   ii. Array implementation of Stack ADT

iii. Linked list implementation of Stack ADT
iv. Program source files for Stack Application 2
v. An appropriate header file for the Stack ADT should be included in (i) and (iv)

7. Implement any Stack Application using array implementation of Stack ADT (by implementing files (i) and (ii) given above) and then using linked list
8. Implementation of Stack ADT (by using files (i) and implementing file (iii))
9. Implement another Stack Application using array and linked list implementations of Stack ADT (by implementing files (iv) and using file (ii), and then by using files (iv) and (iii))
11. Queue ADT – Array and linked list implementations
12. Search Tree ADT - Binary Search Tree
13. Implement an interesting application as separate source files and using any of the searchable ADT files developed earlier. Replace the ADT file alone with other appropriate ADT files. Compare the performance.
14. Quick Sort

TOTAL: 45 PERIODS

REFERENCE:

spoken-tutorial.org.

OUTCOMES:

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

- Design and implement C++ programs for manipulating stacks, queues, linked lists, trees, and graphs.
- Apply good programming design methods for program development.
- Apply the different data structures for implementing solutions to practical problems.

LAB EQUIPMENT FOR A BATCH OF 30 STUDENTS:

Standalone desktops with C++ complier 30 Nos.

(or)

Server with C++ compiler supporting 30 terminals or more.

MA6451 PROBABILITY AND RANDOM PROCESSES L T P C
3 1 0 4

OBJECTIVES

To provide necessary basic concepts in probability and random processes for applications such as random signals, linear systems etc in communication engineering.

UNIT I RANDOM VARIABLES 9+3

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

UNIT II TWO - DIMENSIONAL RANDOM VARIABLES 9+3

Joint distributions – Marginal and conditional distributions – Covariance – Correlation and Linear regression – Transformation of random variables.

UNIT III RANDOM PROCESSES 9+3

Classification – Stationary process – Markov process - Poisson process – Random telegraph process.

UNIT IV CORRELATION AND SPECTRAL DENSITIES 9+3

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

UNIT V LINEAR SYSTEMS WITH RANDOM INPUTS 9+3

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

TOTAL (L:45+T:15): 60 PERIODS

OUTCOMES:

The students will have an exposure of various distribution functions and help in acquiring skills in handling situations involving more than one variable. Able to analyze the response of random inputs to linear time invariant systems.

TEXT BOOKS:

1. Ibe.O.C., "Fundamentals of Applied Probability and Random Processes", Elsevier,1st Indian Reprint, 2007.
2. Peebles. P.Z., "Probability, Random Variables and Random Signal Principles", Tata McGraw Hill, 4th Edition, New Delhi, 2002.

REFERENCES:

1. Yates. R.D. and Goodman. D.J., "Probability and Stochastic Processes", Wiley India Pvt. Ltd., Bangalore, 2nd Edition, 2012.
2. Stark. H., and Woods. J.W., "Probability and Random Processes with Applications to Signal Processing", Pearson Education, Asia, 3rd Edition, 2002.
3. Miller. S.L. and Childers. D.G., "Probability and Random Processes with Applications to Signal Processing and Communications", Academic Press, 2004.
4. Hwei Hsu, "Schaum's Outline of Theory and Problems of Probability, Random Variables and Random Processes", Tata McGraw Hill Edition, New Delhi, 2004.
5. Cooper. G.R., McGillem. C.D., "Probabilistic Methods of Signal and System Analysis", Oxford University Press, New Delhi, 3rd Indian Edition, 2012.

BM6401 MEDICAL PHYSICS L T P C

3 0 0 3

OBJECTIVES:

- To Study effects of sound and light in human body
- To study effects of radiation in matter and how isotopes are produced

UNIT I NON IONIZING RADIATION AND ITS MEDICAL APPLICATION 9

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 9

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 9

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 radionuclides – Cyclotron produced Radionuclide- Reactor produced Radio- nuclide-fission and electron Capture reaction, radionuclide Generator-Technetium generator.

UNIT IV INTERACTION OF RADIATION WITH MATTER 9

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

UNIT V BASIC RADIATION QUANTITIES 9

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.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Analyze mechanics involved with various physiological systems.
- Perform derivation of mathematical models related to blood vessels

TEXT BOOKS:

1. John R Cameran , James G Skofronick "Medical Physics" John-Wiley & Sons. 1978
2. W.J.Meredith and J.B. Massey " Fundamental Physics of Radiology" Varghese Publishing house. 1992

REFERENCES:

1. P.Uma Devi, A.Nagarathnam , B S SatishRao , "Intorduction to Radiation Biology" B.I Chur Chill Livingstone pvt Ltd, 2000
2. S.Webb " The Physics of Medical Imaging", Taylor and Francis, 1988
3. J.P.Woodcock, Ultrasonic,Medical Physics Handbook series 1, Adam Hilger, Bristol, 2002
4. Hylton B.Meire and Pat Farrant "Basic Ultrasound" John Wiley & Sons, 1995

BM6402 BASICS OF ELECTRICAL ENGINEERING L T P C
3 0 0 3

OBJECTIVES:

The student should be made to Understand:

• Magnetic circuits, principle and application of transformers
• Principle of operation of DC motors and AC Machines
• Principle of fractional-kW motors and their applications.

UNIT I INDUCTION THEORY 9

Magnetic effects of electric current- Magnetic circuits- Magnetic materials and B-H relationship – Electromagnetic induction and force – Hysteresis and eddy current losses

UNIT II TRANSFORMER 9

Introduction – Single phase transformer construction and principle of operation – EMF equation of transformer-Transformer no–load phasor diagram –– Transformer on–load phasor diagram – Equivalent circuit of transformer – Regulation of transformer –Transformer losses and efficiency-All day efficiency –auto transformers.

UNIT III DC MACHINES 9

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

UNIT IV INDUCTION MACHINES AND SYNCHRONOUS MACHINES 9

Principle of operation of three-phase induction motors – Construction –Types – Equivalent circuit – Construction of single-phase induction motors – Types of single phase induction motors – Double revolving field theory – starting methods

Principles of alternator – Construction details – Types – Equation of induced EMF – Voltage regulation. Methods of starting of synchronous motors – Torque equation – V curves – Synchronous motors.

UNIT V FRACTIONAL KILOWATT MOTORS 9

Single phase induction motor, principle of operation, torque-speed characteristics – Types of single phase motors- Split phase motors; Split Phase Resistance Start Induction motor, Split phase capacitor start induction motor, Permanent –split capacitor induction motor-Single phase Commutator Motors- Repulsion motor, Repulsion start Induction run motor - AC Series Motor.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Describe principles and applications of transformers.
- Explain the working of DC Motors, fractional kW motors, AC machines.

TEXT BOOKS:

1. D P Kothari and I J Nagrath, “Basic Electrical Engineering”, 2nd Edition, TMH, 2002
2. P. C Sen, “Principles of Electric Machines and Power Electronics”, 2nd Edition, John - Wiley & Sons, 2001

REFERENCE:

1. R.K. Rajput, “Basic Electrical &Electronics Engineering”, Lakshmi Publishers, Reprint 2008

BM6403 ANALOG AND DIGITAL ICs L T P C
3 1 0 4

OBJECTIVES:

- To study the application of analog ICs in the designing circuit.
- To study the applications of these Digital ICs.
- To understand the basic of the Digital systems.
- To study the design of the various functional circuits using these ICs.

UNIT I NUMBER SYSTEMS AND LOGIC GATES 9

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 9

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 9

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 noninverting 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 9

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 9

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

TOTAL (L:45+T:15): 60 PERIODS

OUTCOMES:

The student is able to:

- Explain the application of analog ICs in the designing circuit.
- Do applications of Digital ICs.
- Understand the basic of the Digital systems.
- Design various functional circuits using these ICs.

TEXT BOOKS:

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

REFERENCES:

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

BM6404 PATHOLOGY AND MICROBIOLOGY L T P C
3 0 0 3

OBJECTIVES:

The student should be made to:

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

UNIT I CELL DEGENERATION, REPAIR AND NEOPLASIA 9

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

UNIT II FLUID AND HEMODYNAMIC DERRANGEMENTS 9

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

UNIT III MICROSCOPES 9

Light microscope – bright field, dark field, phase contrast, fluorescence, Electron microscope (TEM & SEM). Preparation of samples for electron microscope. Staining methods – simple, gram staining and AFB staining.

UNIT IV MICROBIAL CULTURES 9

Morphological features and structural organization of bacteria, growth curve, identification of bacteria , culture media and its types , culture techniques and observation of culture.

UNIT V IMMUNOLOGY 9

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.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Analyze structural and functional aspects of living organisms.
- Explain the function of microscope
- Discuss the importance of public health.
- Describe methods involved in treating the pathological diseases.

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", 5th edition, McGraw Hill, 2002 (Units III,IV & 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

CS6304 ANALOG AND DIGITAL COMMUNICATION L T P C
3 0 0 3

OBJECTIVES:

The student should be made to:

- Understand analog and digital communication techniques
- Learn data and pulse communication techniques
- Be familiarized with source and Error control coding
- Gain knowledge on multi-user radio communication

UNIT I ANALOG COMMUNICATION 9

Noise: Source of Noise - External Noise- Internal Noise - Noise Calculation. Introduction to Communication Systems: Modulation – Types - Need for Modulation. Theory of Amplitude Modulation - Evolution and Description of SSB Techniques - Theory of Frequency and Phase Modulation – Comparison of various Analog Communication System (AM – FM – PM).

UNIT II DIGITAL COMMUNICATION 9

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

UNIT III DATA AND PULSE COMMUNICATION 9

Data Communication: History of Data Communication - Standards Organizations for Data Communication- Data Communication Circuits - Data Communication Codes - Error Detection and Correction Techniques - Data communication Hardware - serial and parallel interfaces.

Pulse Communication**:** Pulse Amplitude Modulation (PAM) – Pulse Time Modulation (PTM) – Pulse code Modulation (PCM) - Comparison of various Pulse Communication System (PAM – PTM – PCM)

UNIT IV SOURCE AND ERROR CONTROL CODING 9

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

UNIT V MULTI-USER RADIO COMMUNICATION 9

Advanced Mobile Phone System (AMPS) - Global System for Mobile Communications (GSM) - Code division multiple access (CDMA) – Cellular Concept and Frequency Reuse - Channel Assignment and Hand off - Overview of Multiple Access Schemes - Satellite Communication - Bluetooth.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Apply analog and digital communication techniques
- Use data and pulse communication techniques
- Analyze Source and Error control coding
- Utilize multi-user radio communication

TEXT BOOK:

1. Wayne Tomasi, "Advanced Electronic Communication Systems", 6th Edition, Pearson Education, 2009.

REFERENCES:

1. Simon Haykin, "Communication Systems", 4th Edition, John Wiley & Sons, 2004
2. Rappaport T.S, "Wireless Communications: Principles and Practice", 2nd Edition, Pearson Education, 2007
3. H.Taub, D L Schilling and G Saha, "Principles of Communication", 3rd Edition, Pearson Education, 2007.
4. B. P.Lathi, "Modern Analog and Digital Communication Systems", 3rd Edition, Oxford University Press, 2007.
5. Blake, "Electronic Communication Systems", Thomson Delmar Publications, 2002.
6. Martin S.Roden, "Analog and Digital Communication System", 3rd Edition, Prentice Hall of India, 2002.
7. B.Sklar, "Digital Communication Fundamentals and Applications" 2nd Edition Pearson Education, 2007.

BM6411 CIRCUITS AND IC'S LABORATORY L T P C

0 0 3 2

OBJECTIVES:

The student should be made to:

- Design digital logic and circuits
- Learn the function of different ICs
- Understand the applications of operation amplifier.
- Learn the working of multivibrators
- Design circuits for generating waveforms using ICs.

LIST OF EXPERIMENTS:

1. Study of logic gates, Half adder and Full adder
2. Encoder and BCD to 7 segment decoder
3. Multiplexer and demultiplexer using digital ICs
4. Universal shift register using flip flops
5. Design of mod-N counter
6. Inverting, non-inverting amplifier and comparator
7. Integrator and Differentiator
8. Active filter – first order and second order LPF and HPF
9. Current to Voltage convertor and Voltage to Current Convertor
10. Comparator, Peak detector and Average detector
11. Instrumentation amplifier using IC741

12. Wein bridge oscillator
13. Multivibrator using IC555 Timer
14. Timer
15. Phase Lock Loop
16 A/D and D/A convertor

TOTAL: 45 PERIODS

OUTCOMES:

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

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

LAB EQUIPMENTS FOR A BATCH OF 30 STUDENTS:

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

BM6412	**PATHOLOGY AND MICROBIOLOGY LABORATORY**	**L T P C**
		0 0 3 2

OBJECTIVES:

The student should be made to:

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

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.
9. Gram stain.
10. AFB stain.

11. Slides of malarial parasites, micro filaria and leishmania donovani.
12. Haematology slides of anemia and leukemia. Study of bone marrow charts.
13. Bleeding time and clotting time.

TOTAL : 45 PERIODS

OUTCOMES:

- Student can perform practical experiments on tissue processing, cryoprocessing, staining processes etc.

LAB EQUIPMENTS FOR 30 STUDENTS:

Wax dispenser	1 No
Slide warming	1 No
Microtome	1 No
Microscope	
Microphotographic unit	1 No
Slides	1 box
Coverslip	1 box
Distillation Unit	1 No
Water bath normal	1 No
Incubator	1 No
Autoclave	1 No
Oven	1 No

BM6501 BIO CONTROL SYSTEMS L T P C
3 1 0 4

OBJECTIVES:

- To study the concept and different mathematical techniques applied in analyzing any given system
- To learn the analysis of given system in time domain and frequency domain
- To study the stability analysis of the given system
- To study the concept of physiological control system

UNIT I MODELING OF SYSTEMS 9

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 electro mechanical 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 9

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

UNIT III STABILITY ANALYSIS 9

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

UNIT IV FREQUENCY RESPONSE ANALYSIS 9

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

UNIT V PHYSIOLOGICAL CONTROL SYSTEM 9

Example of physiological control system, difference between engineering and physiological control systems, generalized system properties, models with combination of system elements, linear models of physiological systems-Examples, introduction to simulation.

TOTAL (L:45+T:15): 60 PERIODS

OUTCOMES:

The learner will be able to:

- Analyze the time and frequency domains of the given system using different mathematical techniques

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.

BM6502 DIAGNOSTIC AND THERAPEUTIC EQUIPMENT- I L T P C
3 0 0 3

OBJECTIVES:

The student should be made to:

- Understand the medical devices applied in measurement of parameters related to cardiology, neurology and the methods of continuous monitoring and transmitting them
- Learn some of the cardiac assist devices
- Learn to measure the signals generated by muscles
- Understand the need and use of some of the extracorporeal devices

UNIT I CARDIAC EQUIPMENT 9

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 9

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 9

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 9

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 9

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.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Use different medical devices applied in measurement of parameters related to cardiology, neurology
- Explain about cardiac assist devices, its continuous monitoring and transmission
- Measure signals generated by muscles

TEXT BOOK:

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

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 Publisher Ltd, Illinois, USA, 2008.
5. Joseph J. Carr and John M. Brown, “Introduction to Biomedical Equipment Technology”, Pearson education, 2004.
6. John G.Webster, “Medical Instrumentation Application and Design”, third edition, John Wiley and Sons, New York, 2006.

BM6503 BIO MATERIALS AND ARTIFICIAL ORGANS L T P C

3 0 0 3

OBJECTIVES

The student should be made to:

- Learn characteristics and classification of Biomaterials
- Understand different metals and ceramics used as biomaterials
- Learn polymeric materials and combinations that could be used as a tissue replacement implants
- Know artificial organ developed using these materials

UNIT I STRUCTURE OF BIO-MATERIALS AND BIO-COMPATIBILITY 9

Definition and classification of bio-materials, mechanical properties, visco elasticity, wound healing process, body response to implants, blood compatibility.

UNIT II IMPLANT MATERIALS 9

Metallic implant materials, stainless steels, co-based alloys, Ti-based alloys, ceramic implant materials, aluminum oxides, hydroxyapatite, glass ceramics, carbons, medical applications.

UNIT III POLYMERIC IMPLANT MATERIALS 9

Polymerization, polyamides, Acryrilic polymers, rubbers, high strength Thermoplastics, medical applications. Bio polymers: Collagen and Elastin. Medical Textiles: Silica, Chitosan, PLA composites, Sutures, wound dressings. Materials for ophthalmology: contact lens, Intraocular lens. Membranes for plasma separation and Blood oxygenation.

UNIT IV TISSUE REPLACEMENT IMPLANTS 9

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

UNIT V ARTIFICIAL ORGANS 9

Artificial blood, Artificial skin, Artificial Heart, Prosthetic Cardiac Valves, Artificial lung (oxygenator), Artificial Kidney (Dialyser membrane), Dental Implants.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Analyze different types of Biomaterials and its classification**.**
- Perform combinations of materials that could be used as a tissue replacement implant.

TEXT BOOK:

1. Sujata V. Bhatt, “Biomaterials”, Second Edition, Narosa Publishing House, 2005.

REFERENCES:

1. Park J.B., “Biomaterials Science and Engineering”, Plenum Press, 1984.
2. Myer Kutz, “Standard Handbook of Biomedical Engineering & Design” Mc Graw Hill, 2003
3. John Enderle, Joseph D. Bronzino, Susan M.Blanchard, “Introduction to Biomedical Engineering”, Elsevier, 2005.
4. A.C Anand, J F Kennedy, M.Miraftab, S.Rajendran,“Woodhead Medical Textiles and Biomaterials for Healthcare”, Publishing Limited 2006.
5. D F Williams, “Materials Science and Technology: Volume 14, Medical and Dental Materials: A comprehensive Treatment Volume”, VCH Publishers 1992.
6. BD Ratner, AS Hoffmann,FJ Schoen, JE Lemmons, “An introduction to Materials in Medicine” Academic Press 1996

BM6504 BIOMEDICAL INSTRUMENTATION L T P C

3 0 0 3

OBJECTIVES:

The students will be exposed to electrical and non-electrical physiological measurements and bioamplifiers.

UNIT I BIO POTENTIAL ELECTRODES 9

Origin of bio potential and its propagation. Electrode-electrolyte interface, electrode–skin interface, half cell potential, impedance, polarization effects of electrode – nonpolarizable electrodes. Types of electrodes - surface, needle and micro electrodes and their equivalent circuits. Recording problems - measurement with two electrodes.

UNIT II ELECTRODE CONFIGURATIONS 9

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

UNIT III BIO AMPLIFIER 8

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

UNIT IV MEASUREMENT OF NON-ELECTRICAL PARAMETERS 10

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 V BIO-CHEMICAL MEASUREMENT 9

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

TOTAL: 45 PERIODS

OUTCOMES:

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

- Perform electrical and non-electrical physiological measurements
- Explain the function of bio amplifiers.

TEXT BOOKS:

1. John G. Webster, "Medical Instrumentation Application and Design", John Wiley and sons, New York, 2004. (Units I, II & V)
2. Khandpur R.S, "Handbook of Biomedical Instrumentation", Tata McGraw-Hill, New Delhi, 2003.(Units II & IV)

REFERENCES:

1. Leslie Cromwell, "Biomedical Instrumentation and measurement", Prentice hall of India, New Delhi, 2007.
2. Myer Kutz, "Standard Handbook of Biomedical Engineering and Design", McGraw Hill Publisher, 2003.
3. Joseph J. Carr and John M. Brown, "Introduction to Biomedical Equipment Technology", Pearson Education, 2004.

EC6504 MICROPROCESSOR AND MICROCONTROLLER L T P C
3 0 0 3

OBJECTIVES:

The student should be made to:

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

UNIT I THE 8086 MICROPROCESSOR 9

Introduction to 8086 – Microprocessor architecture – Addressing modes - Instruction set and assembler directives – Assembly language programming – Modular Programming - Linking and Relocation - Stacks - Procedures – Macros – Interrupts and interrupt service routines – Byte and String Manipulation.

UNIT II 8086 SYSTEM BUS STRUCTURE 9

8086 signals – Basic configurations – System bus timing –System design using 8086 – IO programming – Introduction to Multiprogramming – System Bus Structure - Multiprocessor configurations – Coprocessor, Closely coupled and loosely Coupled configurations – Introduction to advanced processors.

UNIT III I/O INTERFACING 9

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

UNIT IV MICROCONTROLLER 9

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

UNIT V INTERFACING MICROCONTROLLER 9

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

TOTAL: 45 PERIODS

OUTCOMES:

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

- Design and implement programs on 8086 microprocessor.
- Design I/O circuits.
- Design Memory Interfacing circuits.
- Design and implement 8051 microcontroller based systems.

TEXT BOOKS:

1. Yu-Cheng Liu, Glenn A.Gibson, “Microcomputer Systems: The 8086 / 8088 Family - Architecture, Programming and Design”, Second Edition, Prentice Hall of India, 2007.
2. Mohamed Ali Mazidi, Janice Gillispie Mazidi, Rolin McKinlay, “The 8051 Microcontroller and Embedded Systems: Using Assembly and C”, Second Edition, Pearson education,2011

REFERENCE:

1. Doughlas V.Hall, “Microprocessors and Interfacing, Programming and Hardware:,TMH,2012

MD6501 **HOSPITAL MANAGEMENT** **L T P C**
3 0 0 3

OBJECTIVES:

The student should be made to:

Understand the principles, practices and areas of application in Hospital management.

UNIT I OVERVIEW OF HOSPITAL ADMINISTRATION 8

Distinction between Hospital and Industry, Challenges in Hospital Administration – Hospital Planning – Equipment Planning – Functional Planning - Current Issues in Hospital Management - Telemedicine - Bio-Medical Waste Management

UNIT II HUMAN RESOURCE MANAGEMENT IN HOSPITAL 9

Principles of HRM – Functions of HRM – Profile of HRD Manager – Tools of HRD –Human Resource Inventory – Manpower Planning. Different Departments of Hospital, Recruitment, Selection, Training Guidelines –Methods of Training – Evaluation of Training – Leadership grooming and Training, Promotion – Transfer.

UNIT III MARKETING RESEARCH & CONSUMER BEHAVIOUR 10

Marketing information systems - assessing information needs, developing & disseminating information - Market Research process - Other market research considerations – Consumer Markets & Consumer Buyer Behaviour - Model of consumer behaviour - Types of buying decision behaviour - The buyer decision process - Model of business buyer behaviour – Major types of buying situations - global marketing in the medical sector - WTO and its implications

UNIT IV HOSPITAL INFORMATION SYSTEMS & SUPPORTIVE SERVICES 9

Management Decisions and Related Information Requirement - Clinical Information Systems - Administrative Information Systems - Support Service Technical Information Systems – Medical Transcription, Medical Records Department – Central Sterilization and Supply Department – Pharmacy– Food Services - Laundry Services.

UNIT V QUALITY AND SAFETY ASPECTS IN HOSPITAL 9

Quality system – Elements, implementation of quality system, Documentation, Quality auditing, International Standards ISO 9000 – 9004 – Features of ISO 9001 – ISO 14000 – Environment Management Systems. NABA, JCI, NABL. Security – Loss Prevention – Fire Safety – Alarm System – Safety Rules. Health Insurance & Managing Health Care – Medical Audit – Hazard and Safety in a hospital Setup.

TOTAL: 45 PERIODS

OUTCOMES:

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

• Explain the principles, practices and areas of application in Hospital Management.

TEXT BOOKS:

1. R.C.Goyal, “Hospital Administration and Human Resource Management”, PHI – Fourth Edition, 2006 (Units I, II & III).
2. G.D.Kunders, “Hospitals – Facilities Planning and Management – TMH, New Delhi – Fifth Reprint 2007 (Units III, IV & V).

REFERENCES:

1. Cesar A.Caceres and Albert Zara, “The Practice of Clinical Engineering, Academic Press, New York, 1977.
2. Norman Metzger, “Handbook of Health Care Human Resources Management”, 2nd edition Aspen Publication Inc. Rockville, Maryland, USA, 1990.

3. Peter Berman “Health Sector Reform in Developing Countries” - Harvard University Press, 1995.
4. William A. Reinke “Health Planning For Effective Management” - Oxford University Press.1988
5. Blane, David, Brunner, “Health and SOCIAL Organization: Towards a Health Policy for the 21st Century” Eric Calrendon Press 2002.
6. Arnold D. Kalcizony & Stephen M. Shortell, “Health Care Management”, 6th Edition Cengage Learning, 2011.

BM6511 MICROPROCESSOR AND MICROCONTROLLER LABORATORY L T P C
0 0 3 2

OBJECTIVES:

The student should be made to:

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

LIST OF EXPERIMENTS:

8086 Programs using kits and MASM

1. Basic arithmetic and Logical operations
2. Move a data block without overlap
3. Code conversion, decimal arithmetic and Matrix operations.
4. Floating point operations, string manipulations, sorting and searching
5. Password checking, Print RAM size and system date
6. Counters and Time Delay

Peripherals and Interfacing Experiments

7. Traffic light control
8. Stepper motor control
9. Digital clock
10. Key board and Display
11. Printer status
12. Serial interface and Parallel interface
13. A/D and D/A interface and Waveform Generation

8051 Experiments using kits and MASM

14. Basic arithmetic and Logical operations
15. Square and Cube program, Find 2’s complement of a number
16. Unpacked BCD to ASCII

TOTAL: 45 PERIODS

OUTCOMES:

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

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

LAB EQUIPMENT FOR A BATCH OF 30 STUDENTS:

HARDWARE:

8086 development kits	- 30 nos
Interfacing Units	- Each 10 nos
Microcontroller	- 30 nos

SOFTWARE:

Intel Desktop Systems with MASM - 30 nos
8086 Assembler
8051 Cross Assembler

BM6512	BIO MEDICAL INSTRUMENTATION LABORATORY	L	T	P	C
		0	0	3	2

OBJECTIVES:

- To provide hands on training on Measurement of physiological parameters , biochemical parameters measurement and biosignal analysis.

LIST OF EXPERIMENTS:

1. Design and analysis of biological pre amplifiers
2. Recording of ECG signal and analysis
3. Recording of EMG-Signal
4. Recording of EEG-Signal
5. Recording of various physiological parameters using patient monitoring system and telemetry units.
6. Measurement of pH and conductivity.
7. Measurement and recording of peripheral blood flow
8. Measurement of visually evoked potential.
9. Study of characteristics of optical Isolation amplifier
10. Galvanic skin resistance (GSR) measurement

TOTAL: 45 PERIODS

LAB REQUIREMENTS FOR A BATCH OF 30 STUDENTS:

- Multiparameter patient monitoring system : 1 No.
- EEG recorder with accessories for evoked studies : 1 No.
- ECG recorder : 1 No.
- EMG recorder : 1 No.
- pH meter, conductivity meter : 1 No.
- Blood flow measurement system using ultrasound transducer: 1 No.
- GSR measurement setup. : 1 No.
- Function Generators
- DSOs
- Regulated Power supplies
- Bread boards
- IC 741

OUTCOMES:

Student is able to:

- Design the amplifier for Bio signal measurements
- Recording and analysis of bio signals

GE6674 COMMUNICATION AND SOFT SKILLS - LABORATORY BASED L T P C
0 0 4 2

OBJECTIVES:

- To enable learners to develop their communicative competence.
- To facilitate them to hone their soft skills.
- To equip them with employability skills to enhance their prospect of placements.

UNIT I LISTENING AND SPEAKING SKILLS 12

Conversational skills (formal and informal) – group discussion and interview skills – making presentations.

Listening to lectures, discussions, talk shows, news programmes, dialogues from TV/radio/Ted talk/Podcast – watching videos on interesting events on Youtube.

UNIT II READING AND WRITING SKILLS 12

Reading different genres of tests ranging from newspapers to philosophical treatises – reading strategies such as graphic organizers, summarizing and interpretation.

Writing job applications – cover letter – resume – emails – letters – memos – reports – blogs – writing for publications.

UNIT III ENGLISH FOR NATIONAL AND INTERNATIONAL EXAMINATIONS AND PLACEMENTS 12

International English Language Testing System (IELTS) – Test of English as a Foreign Language (TOEFL) – Graduate Record Examination (GRE) – Civil Service (Language related) – Verbal ability.

UNIT IV SOFT SKILLS (1) 12

Motivation – self image – goal setting – managing changes – time management – stress management – leadership traits – team work – career and life planning.

UNIT V SOFT SKILLS (2) 12

Multiple intelligences – emotional intelligence – spiritual quotient (ethics) – intercultural communication – creative and critical thinking – learning styles and strategies.

TOTAL: 60 PERIODS

TEACHING METHODS:

1. To be totally learner-centric with minimum teacher intervention as the course revolves around practice.
2. Suitable audio/video samples from Podcast/YouTube to be used for illustrative purposes.
3. Portfolio approach for writing to be followed. Learners are to be encouraged to blog, tweet, text and email employing appropriate language.
4. GD/Interview/Role Play/Debate could be conducted off the laboratory (in a regular classroom) but learners are to be exposed to telephonic interview and video conferencing.
5. Learners are to be assigned to read/write/listen/view materials outside the classroom as well for graining proficiency and better participation in the class.

LAB INFRASTRUCTURE:

S. No.	Description of Equipment (minimum configuration)	Qty Required
1	**Server**	1 No.
	• PIV System	
	• 1 GB RAM / 40 GB HDD	
	• OS: Win 2000 server	
	• Audio card with headphones	

	• JRE 1.3	
2	**Client Systems**	60 Nos.
	• PIII System	
	• 256 or 512 MB RAM / 40 GB HDD	
	• OS: Win 2000	
	• Audio card with headphones	
	• JRE 1.3	
3	Handicam	1 No.
4	Television 46"	1 No.
5	Collar mike	1 No.
6	Cordless mike	1 No.
7	Audio Mixer	1 No.
8	DVD recorder/player	1 No.
9	LCD Projector with MP3/CD/DVD provision for Audio/video facility	1 No.

EVALUATION:

INTERNAL: 20 MARKS

Record maintenance: Students should write a report on a regular basis on the activities conducted, focusing on the details such as the description of the activity, ideas emerged, learning outcomes and so on. At the end of the semester records can be evaluated out of 20 marks.

EXTERNAL: 80 MARKS

Online Test	- 35 marks
Interview	- 15 marks
Presentation	- 15 marks
Group Discussion	- 15 marks

NOTE ON INTERNAL AND EXTERNAL EVALUATION:

1. Interview – mock interview can be conducted on one-on-one basis.
2. Speaking **–** example for role play:
   a. Marketing engineer convincing a customer to buy his product.
   b. Telephonic conversation- fixing an official appointment / placing an order / enquiring and so on.
3. Presentation – should be extempore on simple topics.
4. Discussion – topics of different kinds; general topics, case studies and abstract concept.

OUTCOMES:

At the end of the course, learners should be able to

- Take international examination such as IELTS and TOEFL
- Make presentations and Participate in Group Discussions.
- Successfully answer questions in interviews**.**

REFERENCES:

1. Business English Certificate Materials, Cambridge University Press.
2. Graded Examinations in Spoken English and Spoken English for Work downloadable materials from Trinity College, London.
2. International English Language Testing System Practice Tests, Cambridge University Press.
3. Interactive Multimedia Programs on Managing Time and Stress.
4. Personality Development (CD-ROM), Times Multimedia, Mumbai.
5. Robert M Sherfield and et al. "Developing Soft Skills" 4th edition, New Delhi: Pearson Education, 2009.

WEB SOURCES:

http://www.slideshare.net/rohitjsh/presentation-on-group-discussion
http://www.washington.edu/doit/TeamN/present_tips.html
http://www.oxforddictionaries.com/words/writing-job-applications
http://www.kent.ac.uk/careers/cv/coveringletters.htm
http://www.mindtools.com/pages/article/newCDV_34.htm

BM6601	RADIOLOGICAL EQUIPMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

The student should be made to:

- Understand generation of x-rays and its uses in imaging.
- Learn different types of radio diagnostic techniques.
- Know techniques used for visualizing different sections of the body.
- Learn radiation therapy methodologies and the radiation safety.

UNIT I MEDICAL X-RAY EQUIPMENT 9

Nature of X-rays- X-Ray absorption – Tissue contrast. X- Ray Equipment (Block Diagram) – X-Ray Tube, the collimator, Bucky Grid, power supply, 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 9

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

UNIT III MAGNETIC RESONANCE IMAGING 9

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

UNIT IV NUCLEAR MEDICINE SYSTEM 9

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

UNIT V RADIATION THERAPY AND RADIATION SAFETY 9

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

TOTAL: 45 PERIODS

OUTCOMES:

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

- Explain the different radio diagnostic and therapeutic techniques.

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

BM6602 BIOMECHANICS L T P C
3 0 0 3

OBJECTIVES:

The student should be made to:

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

UNIT I INTRODUCTION TO MECHANICS 9

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 9

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 9

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 9

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 9

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.

OUTCOMES:

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

- Explain the mechanics of physiological systems.
- Analyze the biomechanical systems.
- Design orthopaedic applications.

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.
2. Shrawan Kumar, "Biomechanics in Ergonomics", Second Edition, CRC Press 2007.

BM6603 DIAGNOSTIC AND THERAPEUTIC EQUIPMENT – II L T P C

3 0 0 3

OBJECTIVES:

The student should be made to:

• Gather basic knowledge about measurements of parameters related to respiratory system
• Learn measurement techniques of sensory responses
• Understand different types and uses of diathermy units.
• Know ultrasound imaging technique and its use in diagnosis
• Know the importance of patient safety against electrical hazard

UNIT I RESPIRATORY MEASUREMENT STSTEM 9

Instrumentation for measuring the mechanics of breathing – Spirometer -Lung Volume and vital capacity, measurements of residual volume, pneumotachometer – Airway resistance measurement, Whole body plethysmography, Intra-Alveolar and Thoracic pressure measurements, Apnea Monitor. Types of Ventilators – Pressure, Volume, Time controlled. Flow, Patient Cycle Ventilators, Humidifiers, Nebulizers, Inhalators.

UNIT II SENSORY MEASUREMENT 9

Psycho Physiological Measurements-for testing and sensory Responses, Electro occulograph, Electro retinograph, Audiometer-Pure tone, Speech. EGG (Electrogastrograph), galvanic skin resistance (GSR).

UNIT III DIATHERMY 9

IR and UV lamp and its application. Short wave diathermy, ultrasonic diathermy, Microwave diathermy, Electro surgery machine - Current waveforms, Tissue Responses, Electro surgical current level, Hazards and safety procedures.

UNIT IV ULTRASONIC TECHNIQUE 9

Diagnosis: Tissue Reaction, Basic principles of Echo technique, display techniques A, B and M mode, B Scan, Application of ultrasound as diagnostic tool – Echocardiogram, Echoencephalogram, abdomen, obstetrics and gynecology, ophthalmology.

UNIT V PATIENT SAFETY 9

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

TOTAL: 45 PERIODS

OUTCOMES:

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

- Explain about measurements of parameters related to respiratory system
- Describe the measurement techniques of sensory responses
- Analyze different types and uses of diathermy units
- Discuss ultrasound imaging techniques and its usefulness in diagnosis
- Outline the importance of patient safety against electrical hazard

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.

EC6502 PRINCIPLES OF DIGITAL SIGNAL PROCESSING L T P C

3 1 0 4

OBJECTIVES:

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

UNIT I DISCRETE FOURIER TRANSFORM 9

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 9

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 III FIR FILTER DESIGN 9

Structures of FIR – Linear phase FIR filter – Fourier Series - Filter design using windowing techniques (Rectangular Window, Hamming Window, Hanning Window), Frequency sampling techniques – Finite word length effects in digital Filters: Errors, Limit Cycle, Noise Power Spectrum.

UNIT IV FINITE WORDLENGTH EFFECTS 9

Fixed point and floating point number representations – ADC –Quantization- Truncation and Rounding errors - Quantization noise – coefficient quantization error – Product quantization error - Overflow error – Roundoff noise power - limit cycle oscillations due to product round off and overflow errors – Principle of scaling

UNIT V DSP APPLICATIONS 9

Multirate signal processing: Decimation, Interpolation, Sampling rate conversion by a rational factor – Adaptive Filters: Introduction, Applications of adaptive filtering to equalization.

TOTAL (L:45+T:15): 60 PERIODS

OUTCOMES:

Upon completion of the course, students will be able to

- apply DFT for the analysis of digital signals & systems
- design IIR and FIR filters
- characterize finite Word length effect on filters
- design the Multirate Filters
- apply Adaptive Filters to equalization

TEXT BOOK:

1. John G. Proakis & Dimitris G.Manolakis, “Digital Signal Processing – Principles, Algorithms & Applications”, Fourth Edition, Pearson Education / Prentice Hall, 2007.

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.

GE6351 ENVIRONMENTAL SCIENCE AND ENGINEERING L T P C
3 0 0 3

OBJECTIVES:

To the study of nature and the facts about environment.

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

UNIT I ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY 12

Definition, scope and importance of Risk and hazards; Chemical hazards, Physical hazards, Biological hazards in the environment – concept of an ecosystem – structure and function of an ecosystem – producers, consumers and decomposers-Oxygen cycle and Nitrogen cycle – energy flow in the ecosystem – ecological succession processes – Introduction, types, characteristic features, structure and function of the (a) forest ecosystem (b) grassland ecosystem (c) desert ecosystem (d) aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) – Introduction to biodiversity definition: genetic, species and ecosystem diversity – biogeographical classification of India – value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values – Biodiversity at global, national and local levels – India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ conservation of biodiversity. Field study of common plants, insects, birds
Field study of simple ecosystems – pond, river, hill slopes, etc.

UNIT II ENVIRONMENTAL POLLUTION 10

Definition – causes, effects and control measures of: (a) Air pollution (Atmospheric chemistry- Chemical composition of the atmosphere; Chemical and photochemical reactions in the atmosphere - formation of smog, PAN, acid rain, oxygen and ozone chemistry;- Mitigation procedures- Control of particulate and gaseous emission, Control of SO_2, NO_X, CO and HC) (b) Water pollution : Physical and chemical properties of terrestrial and marine water and their environmental significance; Water quality parameters – physical, chemical and biological; absorption of heavy metals - Water treatment processes. (c) Soil pollution - soil waste management: causes, effects and control measures of municipal solid wastes – (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards–role of an individual in prevention of pollution – pollution case studies – Field study of local polluted site – Urban / Rural / Industrial / Agricultural.

UNIT III NATURAL RESOURCES 10

Forest resources: Use and over-exploitation, deforestation, case studies- timber extraction, mining, dams and their effects on forests and tribal people – Water resources: Use and overutilization of surface and ground water, dams-benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies – Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. Energy Conversion processes – Biogas – production and uses, anaerobic digestion; case studies – Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and

desertification – role of an individual in conservation of natural resources – Equitable use of resources for sustainable lifestyles. Introduction to Environmental Biochemistry: Proteins –Biochemical degradation of pollutants, Bioconversion of pollutants.
Field study of local area to document environmental assets – river/forest/grassland/hill/mountain.

UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT 7

From unsustainable to sustainable development – urban problems related to energy – water conservation, rain water harvesting, watershed management – resettlement and rehabilitation of people; its problems and concerns, case studies – role of non-governmental organization- environmental ethics: Issues and possible solutions – 12 Principles of green chemistry- nuclear accidents and holocaust, case studies. – wasteland reclamation – consumerism and waste products – environment production act – Air act – Water act – Wildlife protection act – Forest conservation act – The Biomedical Waste (Management and Handling) Rules; 1998 and amendments- scheme of labeling of environmentally friendly products (Ecomark). enforcement machinery involved in environmental legislation- central and state pollution control boards- disaster management: floods, earthquake, cyclone and landslides. Public awareness.

UNIT V HUMAN POPULATION AND THE ENVIRONMENT 6

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

TOTAL: 45 PERIODS

OUTCOMES:

Environmental Pollution or problems cannot be solved by mere laws. Public participation is an important aspect which serves the environmental Protection. One will obtain knowledge on the following after completing the course.

- Public awareness of environment at infant stage.
- Ignorance and incomplete knowledge has lead to misconceptions.
- Development and improvement in standard of living has lead to serious environmental disasters.

TEXT BOOKS :

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

REFERENCES:

1. R.K. Trivedi, “Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standard”, Vol. I and II, Enviro Media.
2. Cunningham, W.P. Cooper, T.H. Gorhani, ‘Environmental Encyclopedia’,Jaico Publ.,House, Mumbai, 2001.
3. Dharmendra S. Sengar, ‘Environmental law’, Prentice hall of India PVT LTD, New Delhi, 2007.
4. Rajagopalan, R, ‘Environmental Studies-From Crisis to Cure’, Oxford University Press (2005)

BM6611 **DIGITAL SIGNAL PROCESSING LABORATORY** **L T P C**
0 0 3 2

OBJECTIVES:

The student should be made to:

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

LIST OF EXPERIMENTS:

MATLAB / EQUIVALENT SOFTWARE PACKAGE

1. Generation of sequences (functional & random) & correlation
2. Linear and Circular Convolutions
3. Spectrum Analysis using DFT
4. FIR filter design
5. IIR filter design
6. Multirate Filters
7. Equalization

DSP PROCESSOR BASED IMPLEMENTATION

8. Study of architecture of Digital Signal Processor
9. MAC operation using various addressing modes
10. Linear Convolution
11. Circular Convolution
12. FFT Implementation
13. Waveform generation
14. IIR and FIR Implementation
15. Finite Word Length Effect

TOTAL: 45 PERIODS

OUTCOMES:

Students will be able to

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

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

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

List of software required:

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

CRO (20MHz) -15 Nos

BM6612 DIAGNOSTIC AND THERAPEUTIC EQUIPMENT LABORATORY

L	T	P	C
0	0	3	2

OBJECTIVES:

- To provide practice on recording and analysis of different Bio potentials
- Study the function of different Therapeutic equipments.

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 Lab View

TOTAL: 45 PERIODS

LAB REQUIREMENTS FOR 30 STUDENTS

Multioutput power supply (+15v, -15v, +30V variable, +5V , 2A) 2 Nos.
Short wave Diathermy 1 No.
Ultrasound diathermy 1 No.
Single parameter biotelemetry system 1 No.
Electrical Safety Analyser 1 No.
Spirometry with associated analysis system 1 No.
ECG Simulator 1 No.
Medical stimulator 1 No
Surgical diathermy with analyzer 1 No
Audiometer 1No
Lab View.

OUTCOMES:

- The learner is able to analyze the Bio medical signals, to check the safety of any medical equipments and to have the knowledge about therapeutic equipments.

BM6701 PATTERN RECOGNITION AND NEURAL NETWORKS

L	T	P	C
3	0	0	3

OBJECTIVES:

- The course will introduce the student to the fundamentals of pattern recognition and its application.
- The course will discuss several supervised and unsupervised algorithms suitable for pattern classification. Particular emphasis will be given to computational methods such as linear discriminant functions and nearest neighbor rule.
- The course also covers basic neural network architectures and learning algorithms, for applications in pattern recognition, image processing, and computer vision.
- The major focus of this course will be on the use of Pattern and Neural Classifiers for classification applications.

UNIT I INTRODUCTION AND SUPERVISED LEARNING 9

Overview of Pattern recognition, Types of Pattern recognition, Parametric and Nonparametric approach, Bayesian classifier, Discriminant function, non parametric density estimation, histograms, kernels, window estimators, k- nearest neighbor classifier, estimation of error rates.

UNIT II UNSUPERVISED LEARNING AND CLUSTERING ANALYSIS 9

Unsupervised learning- Hierarchial clustering- Single-linkage Algorithm, Complete – linkage Algorithm, Average-linkage algorithm and Ward's method. Partitional clustering- Forgy's Algorithm, k-means algorithm and Isodata Algorithm

UNIT III INTRODUCTION AND SIMPLE NEURAL NET 9

Elementary neurophysiology and biological neural network- Artificial neural network-Architecture, biases and thresholds, Hebb net, Perceptron, Adaline and Madaline.

UNIT IV BACK PROPAGATION AND ASSOCIATIVE MEMORY 9

Back propagation network, generalized delta rule, Bidirectional Associative memory Hopfield Network

UNIT V NEURAL NETWORKS BASED ON COMPETITION 9

Kohonen Self organizing map, Learning Vector Quantisation, Counter Propagation network.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Explain the fundamentals of pattern recognition and neural networks.
- Design and apply different pattern recognition techniques to the applications of interest.

TEXT BOOKS:

1. Duda R.O. Hart P.G, "Pattern Classification and scene analysis", Wiley Edition 2000 (Units I & II).
2. Hagan, Demuth and Beale, "Neural network design", Vikas Publishing House Pvt Ltd., New Delhi, 2002 (Units III, IV & V).

REFERENCES:

1. Freeman J.A., and Skapura B.M, "Neural Networks, Algorithms, Applications and Programming Techniques", Addison - Wesley, 2003.
2. Earl Gose, Richard Johnsonbaugh Steve Jost, "Pattern Recognition and Image Analysis", Prentice Hall of India Pvt Ltd., New Delhi, 1999.
3. Robert Schalkoff, "Pattern recognition, Statistical, Structural and neural approaches" John Wiley and Sons (Asia) Pvt Ltd., Singapore, 2005.
4. Laurene Fausett, "Fundamentals of neural networks- Architectures, algorithms and applications", Prentice Hall, 1994.

BM6702 **MEDICAL INFORMATICS** **L T P C**
3 0 0 3

OBJECTIVES:

The student should be made to:

- Learn ICT applications in medicine with an introduction to health informatics.
- Understand the theories and practices adopted in Hospital Information Systems in the light of medical standards, medical data formats and recent trends in Hospital Information Systems.

UNIT I MEDICAL INFORMATICS 9

Introduction – Medical Informatics – Bioinformatics – Health Informatics - Structure of Medical Informatics –Functional capabilities of Hospital Information System - On-line services and Off – line services - Dialogue with the computer

UNIT II MEDICAL STANDARDS 9

Evolution of Medical Standards – IEEE 11073 - HL7 – DICOM – IRMA - LOINC – HIPPA –Electronics Patient Records – Healthcare Standard Organizations – JCAHO (Joint Commission on Accreditation of Healthcare Organization) - JCIA (Joint Commission International Accreditation) - Evidence Based Medicine - Bioethics.

UNIT III MEDICAL DATA STORAGE AND AUTOMATION 9

Representation of Data, Data modeling Techniques, Relational Hierarchical and network Approach, Normalization techniques for Data handling - Plug-in Data Acquisition and Control Boards – Data Acquisition using Serial Interface – Medical Data formats – Signal, Image and Video Formats – Medical Databases - Automation in clinical laboratories - Intelligent Laboratory Information System – PACS.

UNIT IV HEALTH INFORMATICS 9

Bioinformatics Databases, Bio-information technologies, Semantic web and Bioinformatics, Genome projects, Clinical informatics, Nursing informatics, Public health informatics, Education and Training

UNIT V RECENT TRENDS IN MEDICAL INFORMATICS 9

Medical Expert Systems, Virtual reality applications in medicine, Virtual Environment – Surgical simulation - Radiation therapy and planning – Telemedicine – virtual Hospitals - Smart Medical Homes – Personalized e-health services – Biometrics - GRID and Cloud Computing in Medicine.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Discuss about health informatics and different ICT applications in medicine.
- Explain the function of Hospital Information Systems
- Analyze medical standards

TEXT BOOKS:

1. R.D.Lele, “Computers in medicine progress in medical informatics”, Tata McGraw Hill Publishing Ltd, 2005 (Units I, III & IV).
2. Mohan Bansal, “Medical informatics”, Tata McGraw Hill Publishing Ltd, 2003 (Units II, IV & V).

REFERENCES:

1. Orpita Bosu and Simminder Kaur Thukral, “Bioinformatics Databases, Tools and Algorithms”, Oxford University press, 2007.
2. Yi Ping Phoebe Chen, “Bioinformatics Technologies”, Springer International Edition, New Delhi, 2007.

BM6703 **MEDICAL OPTICS** **L T P C**
3 0 0 3

OBJECTIVES:
To Study about:
- The optical properties of the tissues and the applications of laser in diagnosis and therapy.

UNIT I OPTICAL PROPERTIES OF THE TISSUES 9
Refraction, Scattering, Absorption, Light transport inside the tissue, Tissue properties, Laser Characteristics as applied to medicine and biology-Laser tissue Interaction-Chemical-Thermal-Electromechanical – Photoabalative processes.

UNIT II INSTRUMENTATION IN PHOTONICS 9
Instrumentation for absorption, Scattering and emission measurements, excitation light sources – high pressure arc lamp, LEDs, Lasers, Optical filters, - optical detectors – Time resolved and phase resolved detectors.

UNIT III SURGICAL APPLICATIONS OF LASERS 9
Lasers in ophthalmology- Dermatology –Dentistry-Urology-Otolaryngology - Tissue welding.

UNIT IV NON THERMAL DIAGNOSTIC APPLICATIONS 9
Optical coherence tomography, Elastography, Laser Induced Fluorescence (LIF)-Imaging, FLIM Raman Spectroscopy and Imaging, FLIM – Holographic and speckle application of lasers in biology and medicine.

UNIT V THERAPEUTIC APPLICATIONS 9
Phototherapy, Photodynamic therapy (PDT) - Principle and mechanism - Oncological and nononcological applications of PDT - Biostimulation effect – applications-Laser Safety Procedures.

TOTAL: 45 PERIODS

OUTCOMES:
At the end of the course, the student should be able to:
- Demonstrate knowledge of the fundamentals of optical properties of tissues
- Describe surgical applications of laser.
- Describe photonics and its therapeutic applications.

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

IT6005 **DIGITAL IMAGE PROCESSING** **L T P C**
3 0 0 3

OBJECTIVES:
The student should be made to:
- Learn digital image fundamentals.
- Be exposed to simple image processing techniques.
- Be familiar with image compression and segmentation techniques.
- Learn to represent image in form of features.

UNIT I DIGITAL IMAGE FUNDAMENTALS 8

Introduction – Origin – Steps in Digital Image Processing – Components – Elements of Visual Perception – Image Sensing and Acquisition – Image Sampling and Quantization – Relationships between pixels - color models.

UNIT II IMAGE ENHANCEMENT 10

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

UNIT III IMAGE RESTORATION AND SEGMENTATION 9

Noise models – Mean Filters – Order Statistics – Adaptive filters – Band reject Filters – Band pass Filters – Notch Filters – Optimum Notch Filtering – Inverse Filtering – Wiener filtering **Segmentation:** Detection of Discontinuities–Edge Linking and Boundary detection – Region based segmentation- Morphological processing- erosion and dilation.

UNIT IV WAVELETS AND IMAGE COMPRESSION 9

Wavelets – Subband coding - Multiresolution expansions - **Compression:** Fundamentals – Image Compression models – Error Free Compression – Variable Length Coding – Bit-Plane Coding – Lossless Predictive Coding – Lossy Compression – Lossy Predictive Coding – Compression Standards.

UNIT V IMAGE REPRESENTATION AND RECOGNITION 9

Boundary representation – Chain Code – Polygonal approximation, signature, boundary segments – Boundary description – Shape number – Fourier Descriptor, moments- Regional Descriptors – Topological feature, Texture - Patterns and Pattern classes - Recognition based on matching.

TOTAL: 45 PERIODS

OUTCOMES:

Upon successful completion of this course, students will be able to:

- Discuss digital image fundamentals.
- Apply image enhancement and restoration techniques.
- Use image compression and segmentation Techniques.
- Represent features of images.

TEXT BOOK:

1. Rafael C. Gonzales, Richard E. Woods, “Digital Image Processing”, Third Edition, Pearson Education, 2010.

REFERENCES:

1. Rafael C. Gonzalez, Richard E. Woods, Steven L. Eddins, “Digital Image Processing Using MATLAB”, Third Edition Tata McGraw Hill Pvt. Ltd., 2011.
2. Anil Jain K. “Fundamentals of Digital Image Processing”, PHI Learning Pvt. Ltd., 2011.
3. Willliam K Pratt, “Digital Image Processing”, John Willey, 2002.
4. Malay K. Pakhira, “Digital Image Processing and Pattern Recognition”, First Edition, PHI Learning Pvt. Ltd., 2011.
5. http://eeweb.poly.edu/~onur/lectures/lectures.html.
6. http://www.caen.uiowa.edu/~dip/LECTURE/lecture.html

BM6712	DIGITAL IMAGE PROCESSING LABORATORY	L T P C 0 0 3 2

OBJECTIVES:

- To practice the basic image processing techniques.
- To understand the functions of transforms.
- To know the effect of quantization.
- To explore the applications of image processing.

LIST OF EXPERIMENTS

Simulation using MATLAB (Image processing Tool Box) or equivalent software

1. Image sampling and quantization
2. Analysis of spatial and intensity resolution of images.
3. Intensity transformation of images.
4. DFT analysis of images
5. Transforms (Walsh, Hadamard, DCT, Haar)
6. Histogram Processing
7. Image Enhancement-Spatial filtering
8. Image Enhancement- Filtering in frequency domain
9. Image segmentation – Edge detection, line detection and point detection
10. Basic Morphological operations.
11. Basic Thresholding functions
12. Analysis of images with different color models.

MINI PROJECTS:

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

TOTAL: 45 PERIODS

OUTCOMES:

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

- Perform filtering operations in the image
- Use transforms and analyse the characteristics of the image.
- Write program to analyse the texture of the image
- Implement project on simple image processing applications.
- Apply image processing technique to solve real world problems

Equipments for a batch of 30 students (2 students per experiment):

PCs with related accessories- 15

MATLAB (licensed) or any equivalent software with Image processing tool box

Image processing software tools

REFERENCE:

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

BM6801 REHABILITATION ENGINEERING L T P C
3 0 0 3

OBJECTIVES:

The student should be made to:

- Study the principles of rehabilitation.
- Know new rehabilitation concepts for future development and applications.
- Learn therapeutic Exercise Techniques.
- Understand orthopedic prosthetics and orthotics in rehabilitation.

UNIT I INTRODUCTION TO REHABILITATION & REHABILITATION TEAM: **9**

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, The Role of Psychiatrist, Occupational therapist, Physical therapist, Recreation therapist, Prosthetist - Orthotist, Speech pathologist, Rehabilitation nurse, Social worker, Corrective therapist, Psychologist, Music therapist, Dance therapist & Biomedical engineer.

UNIT II PRINCIPLES OF REHABILITATION: 9

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: 9

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

UNIT IV PRINCIPLES IN MANAGEMENT OF COMMUNICATION: 9

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

UNIT V ORTHOTIC & PROSTHETIC DEVICES: 9

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.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Explain the needs of rehabilitations and its future development
- Describe therapeutic exercise techniques, Orthopedic Prosthetics, Orthotics

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.

BM6811 PROJECT WORK L T P C
0 0 12 6

OBJECTIVES:

- 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.

The students in a group of 3 to 4 works on a topic 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.

TOTAL: 180 PERIODS

OUTCOMES:

- On Completion of the project work students will be in a position to take up any challenging practical problems and find solution by formulating proper methodology.

BM6001 BIOFLUIDS AND DYNAMICS L T P C
3 0 0 3

OBJECTIVES:

To provide the students:

- An understanding on the physiology and anatomy of studied systems,
- A capability to analyse cardiac, respiratory, soft tissue and orthopedic mechanics

UNIT I BIO-FLUID MECHANICS 10

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: 10

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 9

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 8

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.

OUTCOMES:

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

- Discuss on Cardiovascular and pulmanory system in human body
- Explain blood properties ,especially the anatomy and physiology of blood vessels

TEXT BOOK:

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

REFERENCES:

1. David A. Rubenstein, Weiyin, Mary D. Frame, “Biofluid Mechanics- An Introduction to fluid 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.

BM6002 BIOMETRIC SYSTEMS L T P C
3 0 0 3

OBJECTIVES:

- To understand the technologies of fingerprint, iris, face and speech recognition
- To understand the general principles of design of biometric systems and the underlying trade-offs.
- To recognize personal privacy and security implications of biometrics based identification technology.
- To identify issues in the realistic evaluation of biometrics based systems.

UNIT I INTRODUCTION TO BIOMETRICS 9

Introduction and back ground – biometric technologies – passive biometrics – active biometrics - Biometric systems – 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 9

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 9

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 9

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 9

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

TOTAL: 45PERIODS

OUTCOMES:

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

- Demonstrate knowledge engineering principles underlying biometric systems.
- Analyze design basic biometric system applications.

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.

BM6003 **VIRTUAL REALITY** **L T P C**
3 0 0 3

OBJECTIVES:

The student should be made to:

- Explore the potential of a virtual world for delivering application
- Determine possible instructional designs
- Understand the limitations
- Understand the barriers, solutions, and costs associated, including required training

UNIT I INTRODUCTION **10**

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 **9**

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

UNIT III HUMAN FACTORS **8**

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 **10**

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

UNIT V APPLICATIONS **8**

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

TOTAL: 45 PERIODS

OUTCOMES:

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

- Design a system or process to meet given specifications with realistic engineering constraints.
- Function as a member of an engineering design team.
- Utilize technical resources
- Write technical documents and give technical oral presentations related to design mini project results.

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

BM6004 COMPUTER ORGANISATION L T P C
3 0 0 3

OBJECTIVES:

- To make students understand the basic structure and operation of digital computer.
- To Familiarize the students with arithmetic and logic unit and implementation of fixed point and floating-point arithmetic operations.
- To expose the students to two types of control unit techniques and the concept of pipelining.
- To familiarize the students with hierarchical memory system including cache memories and virtual memory.
- To expose the students with different ways of communicating with I/O devices and standard I/O interfaces.

UNIT I DIGITAL DATA REPRESENTATION 9

Introduction to number systems- number base conversions –signed number representation, fixed and floating point representations, character representation - Computer arithmetic - Addition and Subtraction – Multiplication Algorithms – Division Algorithms – Floating-Point Arithmetic Operations – Decimal Arithmetic Unit – Decimal Arithmetic Operations. Logical and combinational circuits: logical operations using gates- logic expression minimization –combinational circuits and flip-flops- classifications of semiconductor memories and memory organization.

UNIT II BASIC COMPUTER ORGANIZATION AND DESIGN 9

Stored program organization (von Neumann architecture), Register Transfer language-Arithmetic Logic-Shift Micro operations, Instruction code timing and control, Instruction cycle Interrupt design of basic computer- Instruction sets and types, addressing modes, stack organization.

UNIT III PROCESSOR AND CONTROL UNIT 9

Processor basics, CPU organization, data representation, data path design, fixed point arithmetic, ALU, floating point arithmetic, control design - basic concepts, hardwired control, micro programmed control, pipeline control.

UNIT IV MEMORY AND I/O SYSTEMS 9

Memory technology, memory systems, virtual memory, high speed memories, interleaved memories, caches, design methods, associative memories, input/output system, programmed I/O, DMA and interrupts, I/O processors.

UNIT V PARALLEL PROCESSING & ARCHITECTURE 9

Parallelism in uniprocessor system**,** parallel computer structures, architectural classification schemes, pipelining, instruction and arithmetic pipelining, principles of designing pipelined processors, vector processing requirements. Architecture: RISC machines, design principles, RISC versus CISC, examples, RISC architecture, fault tolerant computers, static and dynamic dataflow design.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Design arithmetic and logic unit.
- Implement fixed point and floating-point arithmetic units.
- Compare and contrast the memory systems.
- Compare and contrast the different ways of communicating with I/O devices.
- Compare and contrast parallel processing architectures.

TEXT BOOKS:

1. John P.Hayes, "Computer architecture and Organisation', Third Edition, Tata McGraw-Hill, 1998.
2. M. Morris Mano, "Computer System Architecture", 3rd Edition, Prentice-Hall of India, 2004.

REFERENCES:

1. V.Carl Hamacher, Zvonko G. Varanesic and Safat G. Zaky, "Computer Organisation", V edition, McGraw-Hill Inc, 1996.
2. William Stallings "Computer Organization and Architecture", Seventh Edition , Pearson Education, 2006.
3. Vincent P. Heuring, Harry F. Jordan, "Computer System Architecture", Second Edition, Pearson Education, 2005.
4. Ian Mc Loughlin, "Computer Architecture an Embedded Approach", Tata McGraw Hill Edition, 2012.
5. Govindarajalu, "Computer Architecture and Organization, Design Principles and Applications", first edition, Tata McGraw Hill, New Delhi, 2005.
6. Heuring V.P. and Jordan H.F, "Computer Systems Design and Architecture", second edition, Addison Wesley, New Delhi, 2002.
7. http://nptel.ac.in/.

MD6702 PHYSIOLOGICAL MODELING L T P C
3 0 0 3

OBJECTIVES:

The student should be made to:

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

UNIT I SYSTEM CONCEPT 9

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 8

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 10

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 10

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 8

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

TOTAL: 45 PERIODS

OUTCOMES:

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

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

TEXT BOOKS

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

REFERENCES:

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

BM6005 BIO INFORMATICS L T P C
3 0 0 3

OBJECTIVES:

The student should be made to:

- Expose to the need for Bioinformatics tools
- Be familiar with the modeling techniques
- Learn microarray analysis
- Expose to Pattern Matching and Visualization

UNIT I INTRODUCTION 9

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 9

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 9

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

TOTAL: 45 PERIODS

OUTCOMES:

Upon Completion of the course, the students will be able to

- Develop models for biological data
- Apply pattern matching techniques to bioinformatics data – protein data genomic data.
- Apply micro array technology for genomic expression study

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

GE6757 TOTAL QUALITY MANAGEMENT L T P C
3 0 0 3

OBJECTIVES:

- To facilitate the understanding of Quality Management principles and process.

UNIT I INTRODUCTION 9

Introduction - Need for quality - Evolution of quality - Definitions of quality - Dimensions of product and service quality - Basic concepts of TQM - TQM Framework - Contributions of Deming, Juran and Crosby - Barriers to TQM - Quality statements - Customer focus - Customer orientation, Customer satisfaction, Customer complaints, Customer retention - Costs of quality.

UNIT II TQM PRINCIPLES 9

Leadership - Strategic quality planning, Quality Councils - Employee involvement - Motivation, Empowerment, Team and Teamwork, Quality circles Recognition and Reward, Performance appraisal - Continuous process improvement - PDCA cycle, 5S, Kaizen - Supplier partnership - Partnering, Supplier selection, Supplier Rating.

UNIT III TQM TOOLS AND TECHNIQUES I 9

The seven traditional tools of quality - New management tools - Six sigma: Concepts, Methodology, applications to manufacturing, service sector including IT - Bench marking - Reason to bench mark, Bench marking process - FMEA - Stages, Types.

UNIT IV TQM TOOLS AND TECHNIQUES II 9

Control Charts - Process Capability - Concepts of Six Sigma - Quality Function Development (QFD) - Taguchi quality loss function - TPM - Concepts, improvement needs - Performance measures.

UNIT V QUALITY SYSTEMS 9

Need for ISO 9000 - ISO 9001-2008 Quality System - Elements, Documentation, Quality Auditing - QS 9000 - ISO 14000 - Concepts, Requirements and Benefits - TQM Implementation in manufacturing and service sectors..

TOTAL: 45 PERIODS

OUTCOMES :

- The student would be able to apply the tools and techniques of quality management to manufacturing and services processes.

TEXT BOOK:

1. Dale H. Besterfiled, et at., "Total quality Management", Pearson Education Asia, Third Edition, Indian Reprint 2006.

REFERENCES:

1. James R. Evans and William M. Lindsay, "The Management and Control of Quality", 8th Edition, First Indian Edition, Cengage Learning, 2012.
2. Suganthi.L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd., 2006.
3. Janakiraman. B and Gopal .R.K., "Total Quality Management - Text and Cases", Prentice Hall (India) Pvt. Ltd., 2006.

MD6010 TELEHEALTH TECHNOLOGY L T P C
3 0 0 3

OBJECTIVES:

The student should be made to:

- Learn the key principles for telemedicine and health.
- Understand telemedical technology.
- Know telemedical standards, mobile telemedicine and it applications.

UNIT I TELEMEDICINE AND HEALTH 9

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 II TELEMEDICAL TECHNOLOGY 9

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 9

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 9

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 9

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.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Apply multimedia technologies in telemedicine.
- Explain Protocols behind encryption techniques for secure transmission of data.
- Apply telehealth in healthcare.

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.

BM6006 NANO ELECTRONICS L T P C
3 0 0 3

OBJECTIVE:

- To introduce quantum mechanics concepts, approximations and statistical mechanics for understanding nano systems

UNIT I INTRODUCTION TO QUANTUM MECHANICS 9

Particles, waves, probability amplitudes, schrodinger equation, wavepackets solutions, operators, expectation values, eigenfuntions, piecewise constant potentials.

UNIT II SIMPLE HARMONIC OSCILLATORS AND APPROXIMATIONS 9

SHM Operators, SHM wavepacket solutions, Quantum LC circuit, WKB approximations, variational methods.

UNIT III SYSTEMS WITH TWO AND MANY DEGREES OF FREEDOM 9

Two level systems with static and dynamic coupling, problems in more than one dimensions, electromagnetic field quantization, density of states.

UNIT IV STATISTICAL MECHANICS 9

Basic concepts, microscopic, quantum systems in equilibrium, statistical models applied to metals and semiconductors

UNIT V APPLICATIONS 9

Hydrogen and Helium atoms, electronic states, Atomic force microscope, Nuclear Magnetic Resonance, carbon nanotube properties and applications

TOTAL: 45 PERIODS

OUTCOMES:

The learner is able to:

- Explain quantum mechanics concepts, approximations and statistical mechanics for understanding nano systems

TEXT BOOKS:

1. Hagelstein, Peter L., Stephen D. Senturia, and Terry P. Orlando, “Introduction to Applied Quantum and Statistical Physics”, New York, NY: Wiley, 2004.
2. Rainer Waser, “Nanoelectronics and Information Technology”, Wiley 2005.
3. Michael A. Nielsen and Isaac L. Chuang, “Quantum Computation and Quantum Information”, Cambridge University Press, 2000.

REFERENCES:

1. Neil Gershenfeld, “The Physics of Information Technology”, Cambridge University Press, 2000.
2. Adrian Ionesu and Kaustav Banerjee eds. “Emerging Nanoelectronics: Life with and after CMOS” Vol I, II, and III, Kluwer Academic, 2005

EC6703 EMBEDDED AND REAL TIME SYSTEMS L T P C
3 0 0 3

OBJECTIVES:

The student should be made to:

- Learn the architecture and programming of ARM processor.
- Be familiar with the embedded computing platform design and analysis.
- Be exposed to the basic concepts of real time Operating system.
- Learn the system design techniques and networks for embedded systems

.

UNIT I INTRODUCTION TO EMBEDDED COMPUTING AND ARM PROCESSORS 9

Complex systems and micro processors– Embedded system design process –Design example: Model train controller- Instruction sets preliminaries - ARM Processor – CPU: programming input and output- supervisor mode, exceptions and traps – Co-processors- Memory system mechanisms – CPU performance- CPU power consumption.

UNIT II EMBEDDED COMPUTING PLATFORM DESIGN 9

The CPU Bus-Memory devices and systems–Designing with computing platforms – consumer electronics architecture – platform-level performance analysis - Components for embedded programs- Models of programs- Assembly, linking and loading – compilation techniques- Program level performance analysis – Software performance optimization – Program level energy and power analysis and optimization – Analysis and optimization of program size- Program validation and testing.

UNIT III PROCESSES AND OPERATING SYSTEMS 9

Introduction – Multiple tasks and multiple processes – Multirate systems- Preemptive real-time operating systems- Priority based scheduling- Interprocess communication mechanisms – Evaluating operating system performance- power optimization strategies for processes – Example Real time operating systems-POSIX-Windows CE.

UNIT V SYSTEM DESIGN TECHNIQUES AND NETWORKS 9

Design methodologies- Design flows - Requirement Analysis – Specifications-System analysis and architecture design – Quality Assurance techniques- Distributed embedded systems – MPSoCs and shared memory multiprocessors.

UNIT V CASE STUDY 9

Data compressor - Alarm Clock - Audio player - Software modem-Digital still camera - Telephone answering machine-Engine control unit – Video accelerator.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Describe the architecture and programming of ARM processor.
- Outline the concepts of embedded systems
- Explain the basic concepts of real time Operating system design.
- Use the system design techniques to develop software for embedded systems
- Differentiate between the general purpose operating system and the real time operating system
- Model real-time applications using embedded-system concepts

TEXT BOOK:

1. Marilyn Wolf, “Computers as Components - Principles of Embedded Computing System Design”, Third Edition “Morgan Kaufmann Publisher (An imprint from Elsevier), 2012.

REFERENCES:

1. Jonathan W.Valvano, “Embedded Microcomputer Systems Real Time Interfacing”, Third Edition Cengage Learning, 2012.
2. David. E. Simon, “An Embedded Software Primer”, 1st Edition, Fifth Impression, Addison-Wesley Professional, 2007.
3. Raymond J.A. Buhr, Donald L.Bailey, “An Introduction to Real-Time Systems- From Design to Networking with C/C++”, Prentice Hall,1999.
4. C.M. Krishna, Kang G. Shin, “Real-Time Systems”, International Editions, Mc Graw Hill 1997
5. K.V.K.K.Prasad, “Embedded Real-Time Systems: Concepts, Design & Programming”, Dream Tech Press, 2005.
6. Sriram V Iyer, Pankaj Gupta, “Embedded Real Time Systems Programming”, Tata McGraw Hill, 2004.

CS6551 COMPUTER NETWORKS L T P C

3 0 0 3

OBJECTIVES:

The student should be made to:

- Understand the division of network functionalities into layers.
- Be familiar with the components required to build different types of networks
- Be exposed to the required functionality at each layer
- Learn the flow control and congestion control algorithms

UNIT I FUNDAMENTALS & LINK LAYER 9

Building a network – Requirements - Layering and protocols - Internet Architecture – Network software – Performance ; Link layer Services - Framing - Error Detection - Flow control

UNIT II MEDIA ACCESS & INTERNETWORKING 9

Media access control - Ethernet (802.3) - Wireless LANs – 802.11 – Bluetooth - Switching and bridging – Basic Internetworking (IP, CIDR, ARP, DHCP,ICMP)

UNIT III ROUTING 9

Routing (RIP, OSPF, metrics) – Switch basics – Global Internet (Areas, BGP, IPv6), Multicast – addresses – multicast routing (DVMRP, PIM)

UNIT IV TRANSPORT LAYER 9

Overview of Transport layer - UDP - Reliable byte stream (TCP) - Connection management - Flow control - Retransmission – TCP Congestion control - Congestion avoidance (DECbit, RED) – QoS – Application requirements

UNIT V APPLICATION LAYER 9

Traditional applications -Electronic Mail (SMTP, POP3, IMAP, MIME) – HTTP – Web Services – DNS - SNMP

TOTAL: 45 PERIODS

OUTCOMES:

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

- Identify the components required to build different types of networks
- Choose the required functionality at each layer for given application
- Identify solution for each functionality at each layer
- Trace the flow of information from one node to another node in the network

TEXT BOOK:

1. Larry L. Peterson, Bruce S. Davie, “Computer Networks: A systems approach”, Fifth Edition, Morgan Kaufmann Publishers, 2011.

REFERENCES:

1. James F. Kurose, Keith W. Ross, “Computer Networking - A Top-Down Approach Featuring the Internet”, Fifth Edition, Pearson Education, 2009.
2. Nader. F. Mir, “Computer and Communication Networks”, Pearson Prentice Hall Publishers, 2010.
3. Ying-Dar Lin, Ren-Hung Hwang, Fred Baker, “Computer Networks: An Open Source Approach”, McGraw Hill Publisher, 2011.
4. Behrouz A. Forouzan, “Data communication and Networking”, Fourth Edition, Tata McGraw – Hill, 2011.

EC6601 VLSI DESIGN L T P C

3 0 0 3

OBJECTIVES:

- In this course, the MOS circuit realization of the various building blocks that is common to any microprocessor or digital VLSI circuit is studied.
- Architectural choices and performance tradeoffs involved in designing and realizing the circuits in CMOS technology are discussed.
- The main focus in this course is on the transistor circuit level design and realization for digital operation and the issues involved as well as the topics covered are quite distinct from those encountered in courses on CMOS Analog IC design.

UNIT I MOS TRANSISTOR PRINCIPLE 9

NMOS and PMOS transistors, Process parameters for MOS and CMOS, Electrical properties of CMOS circuits and device modeling, Scaling principles and fundamental limits, CMOS inverter scaling, propagation delays, Stick diagram, Layout diagrams

UNIT II COMBINATIONAL LOGIC CIRCUITS 9

Examples of Combinational Logic Design, Elmore's constant, Pass transistor Logic, Transmission gates, static and dynamic CMOS design, Power dissipation – Low power design principles

UNIT III SEQUENTIAL LOGIC CIRCUITS 9

Static and Dynamic Latches and Registers, Timing issues, pipelines, clock strategies, Memory architecture and memory control circuits, Low power memory circuits, Synchronous and Asynchronous design

UNIT IV DESIGNING ARITHEMETIC BUILDING BLOCKS 9

Data path circuits, Architectures for ripple carry adders, carry look ahead adders, High speed adders, accumulators, Multipliers, dividers, Barrel shifters, speed and area tradeoff

UNIT V IMPLEMENTATION STRATEGIES 9

Full custom and Semi custom design, Standard cell design and cell libraries, FPGA building block architectures, FPGA interconnect routing procedures.

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of the course, students should

- Explain the basic CMOS circuits and the CMOS process technology.
- Discuss the techniques of chip design using programmable devices.
- Model the digital system using Hardware Description Language.

TEXT BOOKS:

1. Jan Rabaey, Anantha Chandrakasan, B.Nikolic, "Digital Integrated Circuits: A Design Perspective". Second Edition, Prentice Hall of India, 2003.
2. M.J. Smith, "Application specific integrated Circuits", Addisson Wesley, 1997

REFERENCES:

1. N.Weste, K.Eshraghian, "Principles of CMOS VLSI Design", Second Edition, Addision Wesley 1993
2. R.Jacob Baker, Harry W.LI., David E.Boyee, "CMOS Circuit Design, Layout and Simulation", Prentice Hall of India, 2005
3. A.Pucknell, Kamran Eshraghian, "BASIC VLSI Design", Third Edition, Prentice Hall of India, 2007.

BM6007 INTERNET AND JAVA PROGRAMMING L T P C

3 0 0 3

OBJECTIVES:

The student should be made to:

- Understand internet concepts,
- Learn client and server programming .
- Understand of the essentials of java for developing internet applications

UNIT I BASIC NETWORK AND WEB CONCEPTS 8

Internet standards-TCP and UDP protocols-URLs-MIME-CGI- Internet applications: FTP, Telnet, Email, Chat. World Wide Web: Overview of HTTP, HTTP request-response, generation of dynamic web pages, cookies

UNIT II CLIENT SIDE PROGRAMMING 8

HTML-forms-frames-tables-web page design-JavaScript introduction-control structures-functions-arrays-objects-simple web applications.

UNIT III DYNAMIC HTML 8

Dynamic HTML-introduction-object model and collections-event model- Cascading Style Sheet (CSS): the need for CSS, introduction to CSS, basic syntax and structure, using CSS, manipulating text, padding, lists, Positioning using CSS.

UNIT IV JAVA PROGRAMMING 12

Object Oriented Programming Concepts, The java programming environment, Fundamental Programming structures, Objects and Classes, Inheritance, Interfaces, Exceptions, I/O Packages-Multithreading , Applets, AWT-Event handling, RMI

UNIT V SERVER SIDE PROGRAMMING 9

Servlets-Deployment of simple Servlets- -HTTP GET and POST requests-session tracking-cookies-JDBC-simple web applications-multi-tier applications.

TOTAL:45 PERIODS

OUTCOMES:

Upon Completion of the course, the students will be able to

- Explain basic concepts of internet
- Discuss the need for client and server side programming
- Write java programs
- Develop internet applications using Java.

TEXT BOOKS:

1. Deitel, Deitel and Nieto, “Internet and World Wide Web-How to program”, Pearson Education Publishers, 2000
2. Steven Holzner et. al, “Java 2 Programming” , Black Book, Dreamtech Press, 2006.

REFERENCES:

1. Herbert Schildt, Java2: The Complete Reference, , Fifth edition, Tata McGraw-Hill, 2002.
2. Cay S.Hortsmann, Gary Cornwell, “Core Java 2”, Vol I, 7 edition, Pearson Education, 2005.
3. Steven Holzner, “HTML Black Book” Coriolis Group Books, 2000.
4. Java Script the definitive guide by David Flanagan Thomno A.Powell, “The Complete Reference HTML and XHTML”, fourth edition, Tata McGraw Hill, 2003.
5. Kathy Sierra, Bert Bates, “Head First Java, 2nd Edition “, Publisher: O'Reilly Media 2005

BM 6008 **NEURAL ENGINEERING** **L T P C**
3 0 0 3

OBJECTIVES:

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

UNIT I BASICS OF NEURON STRUCTURE AND FUNCTIONS 9

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

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 IV NEUROPHYSIOLOGY & NEURORADIOLOGY 9

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 III NEURONAL DISEASES AND DISORDERS 9

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

Regeneration of the nervous system. Nerve graft; Neural tissue engineering; Drug delivery system in CNS. Cognitive & neurobehavioral rehabilitation.

TOTAL : 45 PERIODS

OUTCOMES:

Upon Completion of the course, the students will be able to

- Explain the structure of human nervous system
- Apply neural tissue engineering for rehabilitation
- Regenerate nervous system

TEXT BOOKS:

1. Mathews G.G. “Neurobiology”, 2nd edition, Blackwell Science, UK, 2000.
2. Malcom Carpenter, “Neuroanatomy”, Mc Graw Hill 4th Edition.1991.

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, 1984.

BM6009 **BIO MEMS** **L T P C**
3 0 0 3

OBJECTIVES:

The student should be made to:

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

UNIT I MEMS MATERIALS AND FABRICATION 9

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

UNIT II MECHANICAL AND THERMAL SENSORS AND ACTUATORS 9

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

UNIT III ELECTROSTATIC AND PIEZOELECTRIC SENSORS AND ACTUATORS 9

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

UNIT IV MICROFLUIDIC SYSTEMS 9

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

UNIT V APPLICATIONS OF BIOMEMS 9

CAD for MEMs, Drug delivery, micro total analysis systems (MicroTAS) detection and measurement methods, microsystem approaches to polymerase chain reaction (PCR),DNA sensor, MEMS based drug delivery

TOTAL: 45 PERIODS

OUTCOMES:

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

- Discuss various MEMS fabrication techniques.
- Explain different types of sensors and actuators and their principles of operation at the micro Scale level.
- Apply MEMS in different field of medicine.

TEXT BOOKS:

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

REFERENCES:

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

BM6010 ASSIST DEVICES L T P C
3 0 0 3

OBJECTIVES:

The student should be made to:

- Study various mechanical techniques that will help failing heart.
- Learn the functioning of the unit which does the clearance of urea from the blood
- Understand the tests to assess the hearing loss and development of electronic devices to compensate for the loss.
- Know the various orthodic devices and prosthetic devices to overcome orthopaedic problems.
- Understand electrical stimulation techniques used in clinical applications.

UNIT I CARDIAC ASSIST DEVICES 9

Principle of External counter pulsation techniques, intra aortic balloon pump, Auxillary ventricle and schematic for temporary bypass of left ventricle, prosthetic heart valves.

UNIT II HEMODIALYSERS 9

Artificial kidney, Dialysis action, hemodialyser unit, membrane dialysis, portable dialyser monitoring and functional parameters.

UNIT III HEARING AIDS 9

Common tests – audiograms, airconduction, bone conduction, masking techniques, SISI, Hearing aids – principles, drawbacks in the conventional unit, DSP based hearing aids.

UNIT IV PROSTHETIC AND ORTHODIC DEVICES 9

Hand and arm replacement – different types of models, externally powered limb prosthesis, feedback in orthodic system, functional electrical stimulation, sensory assist devices.

UNIT V RECENT TRENDS 9

Transcutaneous electrical nerve stimulator, bio-feedback.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Explain the functioning and usage of electromechanical units which will restore normal functional ability of particular organ that is defective temporarily or permanently.

TEXT BOOKS:

1. Levine S.N. (ed), "Advances in Bio-medical Engineering and Medical physics", Vol. I, II, IV, inter university publications, New York, 1968 (Unit I, IV, V).
2. Kolff W.J, "Artificial Organs", John Wiley and sons, New York, 1976. (Unit II).
3. Albert M.Cook and Webster J.G, "Therapeutic Medical Devices", Prentice Hall Inc., New Jersey,1982 (Unit III).

REFERENCE:

1. D.S. Sunder, "Rehabilitation Medicine", 3rd Edition, Jaypee Medical Publication, 2010.

CS6003 AD HOC AND SENSOR NETWORKS L T P C
3 0 0 3

OBJECTIVES:

The student should be made to:

- Understand the design issues in ad hoc and sensor networks.
- Learn the different types of MAC protocols.
- Be familiar with different types of adhoc routing protocols.
- Be expose to the TCP issues in adhoc networks.
- Learn the architecture and protocols of wireless sensor networks.

UNIT I INTRODUCTION 9

Fundamentals of Wireless Communication Technology – The Electromagnetic Spectrum – Radio propagation Mechanisms – Characteristics of the Wireless Channel -mobile ad hoc networks (MANETs) and wireless sensor networks (WSNs) :concepts and architectures. Applications of Ad Hoc and Sensor networks. Design Challenges in Ad hoc and Sensor Networks.

UNIT II MAC PROTOCOLS FOR AD HOC WIRELESS NETWORKS 9

Issues in designing a MAC Protocol- Classification of MAC Protocols- Contention based protocols-Contention based protocols with Reservation Mechanisms- Contention based protocols with Scheduling Mechanisms – Multi channel MAC-IEEE 802.11

UNIT III ROUTING PROTOCOLS AND TRANSPORT LAYER IN AD HOC WIRELESS NETWORKS 9

Issues in designing a routing and Transport Layer protocol for Ad hoc networks- proactive routing, reactive routing (on-demand), hybrid routing- Classification of Transport Layer solutions-TCP over Ad hoc wireless Networks.

UNIT IV WIRELESS SENSOR NETWORKS (WSNS) AND MAC PROTOCOLS 9

Single node architecture: hardware and software components of a sensor node - WSN Network architecture: typical network architectures-data relaying and aggregation strategies -MAC layer protocols: self-organizing, Hybrid TDMA/FDMA and CSMA based MAC- IEEE 802.15.4.

UNIT V WSN ROUTING, LOCALIZATION & QOS 9

Issues in WSN routing – OLSR- Localization – Indoor and Sensor Network Localization-absolute and relative localization, triangulation-QOS in WSN-Energy Efficient Design-Synchronization-Transport Layer issues.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Explain the concepts, network architectures and applications of ad hoc and wireless sensor networks
- Analyze the protocol design issues of ad hoc and sensor networks
- Design routing protocols for ad hoc and wireless sensor networks with respect to some protocol design issues
- Evaluate the QoS related performance measurements of ad hoc and sensor networks

TEXT BOOK:

1. C. Siva Ram Murthy, and B. S. Manoj, "Ad Hoc Wireless Networks: Architectures and Protocols ", Prentice Hall Professional Technical Reference, 2008.

.

REFERENCES:

1. Carlos De Morais Cordeiro, Dharma Prakash Agrawal "Ad Hoc & Sensor Networks: Theory and Applications", World Scientific Publishing Company, 2006.
2. Feng Zhao and Leonides Guibas, "Wireless Sensor Networks", Elsevier Publication - 2002.
3. Holger Karl and Andreas Willig "Protocols and Architectures for Wireless Sensor Networks", Wiley, 2005
4. Kazem Sohraby, Daniel Minoli, & Taieb Znati, "Wireless Sensor Networks-Technology, Protocols, and Applications", John Wiley, 2007.
5. Anna Hac, "Wireless Sensor Network Designs", John Wiley, 2003.

MD6008 FIBER OPTICS AND LASERS IN MEDICINE L T P C
3 0 0 3

OBJECTIVES:

The student should be made to:

- Be familiar with objective property of tissues
- Be exposed to Optical Holography

UNIT I OPTICAL PROPERTIES OF THE TISSUES 9

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

UNIT II INSTRUMENTATION IN PHOTONICS 9

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 9

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

UNIT IV OPTICAL HOLOGRAPHY 9

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

UNIT V SPECIAL TECHNIQUES 9

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

TOTAL: 45 PERIODS

OUTCOMES:

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

- Apply lasers in different areas of medicine.
- Explain the special techniques of Lasers.
- Use the Photonics instrumentation.

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.

BM6011 COMPUTER HARDWARE AND INTERFACING L T P C
3 0 0 3

OBJECTIVES:

The student should be made to:

- Learn advanced 8086 family of processors, motherboards, PC based data acquisition and troubleshooting of PCs.

UNIT I INTEL ADVANCED PROCESSORS 9

80186, 80286, 80386, 80486 -Architecture, Memory management.

UNIT II PENTIUM PROCESSORS 9

Pentium Architecture- Memory Management- Pentium Pro microprocessors – Pentium II, Pentium III , Pentium 4 – Special features and software changes.

UNIT III PC HARDWARE OVERVIEW 9

Functional units & Interconnection, New generation motherboards 286 to Pentium 4 Bus interface – ISA – EISA- VESA- PCI- PCIX, Memory and I/O port addresses, Peripheral interfaces and controller.

UNIT IV PC BASED DATA ACQUISTION 9

Plug in data acquisition and control boards and programming- ADC, DAC, Digital I/O board and Timing Board, Serial port and parallel port programming. Data acquisition and programming using serial interfaces- PC and microcontroller serial ports, USB and IEEE 1394.

UNIT V TROUBLESHOOTING, MAINTAINING & REPAIRING 9

Memory troubleshooting, Monitor troubleshooting, Motherboard troubleshooting,Port troubleshooting, Sound Boards and Video adapters troubleshooting, USB troubleshooting.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Explain 8086 family of processors, motherboards, PC based data acquisition and troubleshooting of PCs

TEXT BOOKS:

1. B. Govindarajalu, "IBM PC and clones Hardware, Trouble Shooting and Maintenance", Second Edition, Tata McGraw Hill, New Delhi, 2005.
2. Stephen J. Bigelow, "Troubleshooting, Maintaining & Repairing", 5th Edition, Tata McGraw Hill 2001.

REFERENCE:

1. N.Mathivanan, "PC–Based Instrumentation Concepts and Practice", Prentice Hall of India, New Delhi, 2007

CS6012 SOFT COMPUTING L T P C

3 0 0 3

OBJECTIVES

The student should be made to:

- Learn the various soft computing frame works
- Be familiar with design of various neural networks
- Be exposed to fuzzy logic
- Learn genetic programming
- Be exposed to hybrid systems

UNIT I INTRODUCTION 9

Artificial neural network: Introduction, characteristics- learning methods – taxonomy – Evolution of neural networks- basic models - important technologies - applications.

Fuzzy logic: Introduction - crisp sets- fuzzy sets - crisp relations and fuzzy relations: cartesian product of relation - classical relation, fuzzy relations, tolerance and equivalence relations, non-iterative fuzzy sets. Genetic algorithm- Introduction - biological background - traditional optimization and search techniques - Genetic basic concepts.

UNIT II NEURAL NETWORKS 9

McCulloch-Pitts neuron - linear separability - hebb network - supervised learning network: perceptron networks - adaptive linear neuron, multiple adaptive linear neuron, BPN, RBF, TDNN- associative memory network: auto-associative memory network, hetero-associative memory network, BAM, hopfield networks, iterative autoassociative memory network & iterative associative memory network – unsupervised learning networks: Kohonen self organizing feature maps, LVQ – CP networks, ART network.

UNIT III FUZZY LOGIC 9

Membership functions: features, fuzzification, methods of membership value assignments- Defuzzification: lambda cuts - methods - fuzzy arithmetic and fuzzy measures: fuzzy arithmetic - extension principle - fuzzy measures - measures of fuzziness -fuzzy integrals - fuzzy rule base and approximate reasoning : truth values and tables, fuzzy propositions, formation of rules-decomposition of rules, aggregation of fuzzy rules, fuzzy reasoning-fuzzy inference systems-overview of fuzzy expert system-fuzzy decision making.

UNIT IV GENETIC ALGORITHM 9

Genetic algorithm and search space - general genetic algorithm – operators - Generational cycle - stopping condition – constraints - classification - genetic programming – multilevel optimization – real life problem- advances in GA

UNIT V HYBRID SOFT COMPUTING TECHNIQUES & APPLICATIONS 9

Neuro-fuzzy hybrid systems - genetic neuro hybrid systems - genetic fuzzy hybrid and fuzzy genetic hybrid systems - simplified fuzzy ARTMAP - Applications: A fusion approach of multispectral images with SAR, optimization of traveling salesman problem using genetic algorithm approach, soft computing based hybrid fuzzy controllers.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Apply various soft computing frame works
- Design of various neural networks
- Use fuzzy logic
- Apply genetic programming
- Discuss hybrid soft computing

TEXT BOOKS:

1. J.S.R.Jang, C.T. Sun and E.Mizutani, “Neuro-Fuzzy and Soft Computing”, PHI / Pearson Education 2004.
2. S.N.Sivanandam and S.N.Deepa, "Principles of Soft Computing", Wiley India Pvt Ltd, 2011.

REFERENCES:

1. S.Rajasekaran and G.A.Vijayalakshmi Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithm: Synthesis & Applications", Prentice-Hall of India Pvt. Ltd., 2006.
2. George J. Klir, Ute St. Clair, Bo Yuan, “Fuzzy Set Theory: Foundations and Applications” Prentice Hall, 1997.
3. David E. Goldberg, “Genetic Algorithm in Search Optimization and Machine Learning” Pearson Education India, 2013.
4. James A. Freeman, David M. Skapura, “ Neural networks Algorithms, Applications, and Programming Techniques, Pearson Education India, 1991.
5. Simon Haykin, “Neural Networks Comprehensive Foundation” Second Edition, Pearson Education, 2005.

GE6075 PROFESSIONAL ETHICS IN ENGINEERING L T P C
3 0 0 3

OBJECTIVE:

- To enable the students to create an awareness on Engineering Ethics and Human Values, to instill Moral and Social Values and Loyalty and to appreciate the rights of others.

UNIT I HUMAN VALUES 10

Morals, values and Ethics – Integrity – Work ethic – Service learning – Civic virtue – Respect for others – Living peacefully – Caring – Sharing – Honesty – Courage – Valuing time – Cooperation – Commitment – Empathy – Self confidence – Character – Spirituality – Introduction to Yoga and meditation for professional excellence and stress management.

UNIT II ENGINEERING ETHICS 9

Senses of 'Engineering Ethics' – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy – Models of professional roles - Theories about right action – Self-interest – Customs and Religion – Uses of Ethical Theories

UNIT III ENGINEERING AS SOCIAL EXPERIMENTATION 9

Engineering as Experimentation – Engineers as responsible Experimenters – Codes of Ethics – A Balanced Outlook on Law.

UNIT IV SAFETY, RESPONSIBILITIES AND RIGHTS 9

Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk - Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination

UNIT V GLOBAL ISSUES 8

Multinational Corporations – Environmental Ethics – Computer Ethics – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Moral Leadership –Code of Conduct – Corporate Social Responsibility

TOTAL: 45 PERIODS

OUTCOMES :

Upon completion of the course, the student should be able to apply ethics in society, discuss the ethical issues related to engineering and realize the responsibilities and rights in the society

TEXTBOOKS:

1. Mike W. Martin and Roland Schinzinger, "Ethics in Engineering", Tata McGraw Hill, New Delhi, 2003.
2. Govindarajan M, Natarajan S, Senthil Kumar V. S, "Engineering Ethics", Prentice Hall of India, New Delhi, 2004.

REFERENCES:

1. Charles B. Fleddermann, "Engineering Ethics", Pearson Prentice Hall, New Jersey, 2004.
2. Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, "Engineering Ethics – Concepts and Cases", Cengage Learning, 2009
3. John R Boatright, "Ethics and the Conduct of Business", Pearson Education, New Delhi, 2003
4. Edmund G Seebauer and Robert L Barry, "Fundametals of Ethics for Scientists and Engineers", Oxford University Press, Oxford, 2001
5. Laura P. Hartman and Joe Desjardins, "Business Ethics: Decision Making for Personal Integrity and Social Responsibility" Mc Graw Hill education, India Pvt. Ltd.,New Delhi 2013.
6. World Community Service Centre, ' Value Education', Vethathiri publications, Erode, 2011

Web sources:

1. www.onlineethics.org
2. www.nspe.org
3. www.globalethics.org
4. www.ethics.org

MD6007 **BODY AREA NETWORKS** **L T P C**
3 0 0 3

OBJECTIVES:

The student should be made to:

- Learn about body area networks' and different hardwares related to it
- Provide knowledge in the applications of Body Area Networks.

UNIT I INTRODUCTION **9**

Definition, BAN and Healthcare, Technical Challenges- Sensor design, biocompatibility, Energy Supply, optimal node placement, number of nodes, System security and reliability, BSN Architecture – Introduction

UNIT II HARDWARE FOR BAN **9**

Processor-Low Power MCUs, Mobile Computing MCUs ,Integrated processor with radio transceiver, Memory ,Antenna-PCB antenna, Wire antenna, Ceramic antenna, External antenna, Sensor Interface, Power sources- Batteries and fuel cells for sensor nodes.

UNIT III WIRELESS COMMUNICATION AND NETWORK **9**

RF communication in Body, Antenna design and testing, Propagation, Base Station-Network topology-Stand –Alone BAN, Wireless personal Area Network Technologies-IEEE 802.15.1,IEEE P802.15.13, IEEE 802.15.14, Zigbee

UNIT IV COEXISTENCE ISSUES WITH BAN **9**

Interferences – Intrinsic - Extrinsic, Effect on transmission, Counter measures- on physical layer and data link layer, Regulatory issues-Medical Device regulation in USA and Asia, Security and Self protection-Bacterial attacks, Virus infection ,Secured protocols, Self protection.

UNIT V APPLICATIONS OF BAN **9**

Monitoring patients with chronic disease, Hospital patients, Elderly patients, Cardiac arrhymias monitoring, Multi patient monitoring systems, Multichannel Neural recording, Gait analysis, Sports Medicine, Electronic pill

TOTAL: 45 PERIODS

OUTCOMES:

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

- Explain about working of Body Area Network
- Discuss the applications of BAN.

TEXT BOOK:

1. Annalisa Bonfiglio, Danilo De Rossi ,"Wearable Monitoring Systems", Springer, 2011.(Unit I, II, III & V).
2. Sandeep K.S. Gupta,Tridib Mukherjee,Krishna Kumar Venkatasubramanian, "Body Area Networks Safety, Security, and Sustainability," Cambridge University Press, 2013. (Unit IV).

REFERENCES:

1. Zhang, Yuan-Ting, "Wearable Medical Sensors and Systems",Springer, 2013.
2. Guang-Zhong Yang(Ed.), "Body Sensor Networks, "Springer, 2006.
3. Mehmet R. Yuce,Jamil Y.Khan, "Wireless Body Area Networks Technology, Implementation , and applications",Pan Stanford Publishing Pte.Ltd,Singapore, 2012.

ME6002 REFRIGERATION AND AIR CONDITIONING L T P C
3 0 0 3

OBJECTIVES:

- To understand the underlying principles of operations in different Refrigeration & Air conditioning systems and components.
- To provide knowledge on design aspects of Refrigeration & Air conditioning systems

UNIT I INTRODUCTION 5

Introduction to Refrigeration - Unit of Refrigeration and C.O.P.– Ideal cycles- Refrigerants Desirable properties – Classification - Nomenclature - ODP & GWP.

UNIT II VAPOUR COMPRESSION REFRIGERATION SYSTEM 10

Vapor compression cycle : p-h and T-s diagrams - deviations from theoretical cycle – subcooling and super heating- effects of condenser and evaporator pressure on COP- multipressure system - low temperature refrigeration - Cascade systems – problems. Equipments: Type of Compressors, Condensers, Expansion devices, Evaporators.

UNIT III OTHER REFRIGERATION SYSTEMS 8

Working principles of Vapour absorption systems and adsorption cooling systems – Steam jet refrigeration- Ejector refrigeration systems- Thermoelectric refrigeration- Air refrigeration - Magnetic - Vortex and Pulse tube refrigeration systems.

UNIT IV PSYCHROMETRIC PROPERTIES AND PROCESSES 10

Properties of moist Air-Gibbs Dalton law, Specific humidity, Dew point temperature, Degree of saturation, Relative humidity, Enthalpy, Humid specific heat, Wet bulb temperature Thermodynamic wet bulb temperature, Psychrometric chart; Psychrometric of air-conditioning processes, mixing of air streams.

UNIT V AIR CONDITIONING SYSTEMS AND LOAD ESTIMATION 12

Air conditioning loads: Outside and inside design conditions; Heat transfer through structure, Solar radiation, Electrical appliances, Infiltration and ventilation, internal heat load; Apparatus selection; fresh air load, human comfort & IAQ principles, effective temperature & chart, calculation of summer & winter air conditioning load; Classifications, Layout of plants; Air distribution system; Filters; Air Conditioning Systems with Controls: Temperature, Pressure and Humidity sensors, Actuators & Safety controls.

TOTAL: 45 PERIODS

OUTCOME:

Upon completion of this course, the students can able to demonstrate the operations in different Refrigeration & Air conditioning systems and also able to design Refrigeration & Air conditioning systems .

TEXT BOOK:

1. Arora, C.P., Refrigeration and Air Conditioning, McGraw Hill, 3rd edition, New Delhi, 2010.

REFERENCES:

1. Roy J. Dossat, Principles of Refrigeration, 4th edition, Pearson Education Asia, 2009.
2. Stoecker, W.F. and Jones J. W., Refrigeration and Air Conditioning, McGraw Hill, New Delhi, 1986.
3. ASHRAE Hand book, Fundamentals 2010
4. Jones W.P., Air conditioning engineering, 5th edition, Elsevier Butterworth-Heinemann, 2001

EC6007 **SPEECH PROCESSING** **L T P C**
3 0 0 3

OBJECTIVES:

- To introduce speech production and related parameters of speech.
- To show the computation and use of techniques such as short time Fourier transform, linear predictive coefficients and other coefficients in the analysis of speech.
- To understand different speech modeling procedures such as Markov and their implementation issues.

UNIT I BASIC CONCEPTS **10**

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 **10**

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 **8**

Hidden Markov Models: Markov Processes, HMMs – Evaluation, Optimal State Sequence – Viterbi Search, Baum-Welch Parameter Re-estimation, Implementation issues.

UNIT IV SPEECH RECOGNITION **8**

Large Vocabulary Continuous Speech Recognition: Architecture of a large vocabulary continuous speech recognition system – acoustics and language models – n-grams, context dependent sub-word units; Applications and present status.

UNIT V SPEECH SYNTHESIS **9**

Text-to-Speech Synthesis: Concatenative and waveform synthesis methods, sub-word units for TTS, intelligibility and naturalness – role of prosody, Applications and present status.

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of the course, students will be able to

- Model speech production system and describe the fundamentals of speech.
- Extract and compare different speech parameters.
- Choose an appropriate statistical speech model for a given application.
- Design a speech recognition system.
- Use different speech synthesis techniques.

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.

GE6078 INTELLECTUAL PROPERTY RIGHTS L T P C
3 0 0 3

OBJECTIVES:
The student should be made to:
- Learn how to value intangible assets, taking into account their commercial potential and legal status.
- Explore the legal & business issues surrounding marketing of new products related to technology.

UNIT I INTRODUCTION 5
Introduction – Invention and Creativity – Intellectual Property (IP) – Importance – Protection of IPR – Basic types of property (i) Movable Property (ii) Immovable Property and (iii) Intellectual Property.

UNIT II PATENTS, COPYRIGHTS AND TRADEMARKS 10
IP – Patents – Copyrights and related rights – Trade Marks and rights arising from Trademark registration – Definitions – Industrial Designs and Integrated circuits – Protection of Geographical Indications at national and International levels – Application Procedures.

UNIT III INTERNATIONAL STANDARDISATION 10
International convention relating to Intellectual Property – Establishment of WIPO – Mission and Activities – History – General Agreement on Trade and Tariff (GATT).

UNIT IV INDIAN STRATEGIES 10
Indian Position Vs WTO and Strategies – Indian IPR legislations – commitments to WTO-Patent Ordinance and the Bill – Draft of a national Intellectual Property Policy – Present against unfair competition.

UNIT V CASE STUDIES 10
Case Studies on – Patents (Basumati rice, turmeric, Neem, etc.) – Copyright and related rights – Trade Marks – Industrial design and Integrated circuits – Geographic indications – Protection against unfair competition.

TOTAL: 45 PERIODS

OUTCOMES:
Upon completion of the course, students will be able to:
- Review an intellectual property portfolio and comprehend the extent of their protection.
- Develop a business plan that advances the value of their intellectual property portfolio
- Develop a strategy of marketing their intellectual property and understand some negotiation basics.
- Explain some of the limits of their intellectual property rights and comprehend some basic legal pitfalls.

TEXT BOOK:

1. Subbaram N.R. “Handbook of Indian Patent Law and Practice “, S. Viswanathan, Printers and Publishers Pvt. Ltd.,1998.

REFERENCES:

1. Eli Whitney, United States Patent Number: 72X, Cotton Gin, March 14, 1794.
2. Derwent IP Matters, “Using the Internet for non-patent prior art searches”, July 2000.
3. www.iptoday.com

WEBSITE:

www.ipmatters.net/features/000707_ gibbs.html.

MF6009 RAPID PROTOTYPING L T P C
3 0 0 3

OBJECTIVE:

Generating a good understanding of RP history, its development and applications.. To expose the students to different types of Rapid prototyping processes, materials used in RP systems and reverse engineering.

UNIT I INTRODUCTION 8

History – Development of RP systems – Applications in Product Development, Reverse Engineering, Rapid Tooling, Rapid Manufacturing- Principle – Fundamental – File format – Other translators – medical applications of RP - On demand manufacturing – Direct material deposition - Shape Deposition Manufacturing.

UNIT II LIQUID BASED AND SOLID BASED RAPID PROTOTYPING SYSTEMS 10

Classification – Liquid based system - Stereolithography Apparatus (SLA), details of SL process, products, Advantages, Limitations, Applications and Uses. Solid based system - Fused Deposition Modeling, principle, process, products, advantages, applications and uses - Laminated Object Manufacturing

UNIT III POWDER BASED RAPID PROTOTYPING SYSTEMS 10

Selective Laser Sintering – principles of SLS process, principle of sinter bonding process, Laser sintering materials, products, advantages, limitations, applications and uses. Three Dimensional Printing – process, major applications, research and development. Direct shell production casting – key strengths, process, applications and uses, case studies, research and development. Laser Sintering System, e-manufacturing using Laser sintering, customized plastic parts, customized metal parts, e-manufacturing - Laser Engineered Net Shaping (LENS).

UNIT IV MATERIALS FOR RAPID PROTOTYPING SYSTEMS 10

Nature of material – type of material – polymers, metals, ceramics and composites- liquid based materials, photo polymer development – solid based materials, powder based materials - case study.

UNIT V REVERSE ENGINEERING and NEW TECHNOLOGIES 7

Introduction, measuring device- contact type and non-contact type, CAD model creation from point clouds-preprocessing, point clouds to surface model creation, medical data processing - types of medical imaging, software for making medical models, medical materials, other applications - Case study.

TOTAL: 45 PERIODS

OUTCOMES:

- To provide knowledge on different types of Rapid Prototyping systems and its applications in various fields

TEXT BOOKS:

1. Rafiq I. Noorani, Rapid Prototyping – Principles and Applications, Wiley & Sons, 2006.
2. Chua C.K, Leong K.F and Lim C.S, Rapid Prototyping: Principles and Applications, second edition, World Scientific, 2003.

REFERENCES:

1. N.HOPKINSON, R.J.M, HAUGE, P M, DICKENS, "Rapid Manufacturing – An Industrial revolution for the digital age", Wiley, 2006
2. IAN GIBSON, "Advanced Manufacturing Technology for Medical applications: Reverse Engineering, Software conversion and Rapid Prototyping", Wiley, 2006
3. Paul F.Jacobs, Rapid Prototyping and Manufacturing, "Fundamentals of Stereo lithography", McGraw Hill 1993.
4. D.T.Pham and S.S. Dimov, "Rapid Manufacturing", Springer Verlog 2001.

BM6012 WEARABLE SYSTEMS L T P C
3 0 0 3

OBJECTIVES:

The student should be made to:

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

UNIT I SENSORS 9

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 9

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 9

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 9

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 9

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

OUTCOMES:

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

- Explain need of wireless health systems and the application of wearable systems

TEXT BOOKS:

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