

Course Scheme for B. Tech Biomedical Engineering

III Semester

Course Code	Course Title	L	T	P	External Marks	Internal Marks	Total
AM-201	Mathematics-III	4	1	-	60	40	100
BM-201	Fundamentals of Biomedical Engineering	3	1	-	60	40	100
BM-203	Human Anatomy & Physiology	4	0	-	60	40	100
BM-205	Biochemistry**	4	0	-	60	40	100
BM-207	Electronic Devices & Circuits*	3	1	-	60	40	100
BM-209	Sensors and Transducers	3	1		60	40	100
BM-211	Lab I- Biochemistry Lab	-	-	3	20	30	50
BM-213	Lab II- Anatomy & Physiology Lab	-	-	2	20	30	50
BM-215	Lab III- Electronic Devices & Circuits Lab	-	-	2	20	30	50
	Workshop Training	-	-	-	40	60	100
	Grand Total	21	4	7	460	390	850

Contact Hours: 32

IV Semester

Course Code	Course Title	L	T	P	External Marks	Internal Marks	Total
EE-201	Network Analysis and Synthesis	3	2	-	60	40	100
BM-202	Analog & Digital Electronics	3	1	-	60	40	100
BM-204	Physical Biochemistry	4	0	-	60	40	100
CS-303	Computer Network	3	1	-	60	40	100
EC-206	Signals & Systems	3	1	-	60	40	100
BM-206	Biomedical Instrumentation	3	1	-	60	40	100
BM-208	Lab IV- Analog and Digital Electronics Lab	-	-	2	20	30	50
BM-210	Lab V-Computer Network Lab	-	-	2	20	30	50
BM-212	Lab VI- Biomedical Instrumentation Lab	-	-	2	20	30	50
	General Fitness	-	-	-	-	100	100
	Grand Total	19	6	6	420	430	850

Contact Hours: 31

* Earlier BM-205

** Earlier BM-207

V Semester

Course Code	Course Title	L	T	P	External Marks	Internal Marks	Total
BM-301	Clinical Engineering	3	1	-	60	40	100
BM-303	Numerical Methods & Computer Programming	3	1	-	60	40	100
BM-305	Medical Imaging Technologies	3	1	-	60	40	100
BM-307	Bio-Control Systems	3	1	-	60	40	100
BM-309	Tissue Engineering	4	0	-	60	40	100
BM-311	Biomechanics	3	1	-	60	40	100
BM-313	Lab-VII Tissue Engineering Lab	-	-	2	20	30	50
BM-315	Lab-VIII Numerical Methods & Computer Programming Lab	-	-	2	20	30	50
BM-317	Lab-IX Biomechanics Lab	-	-	2	20	30	50
	Industrial Training	-	-	-	40	60	100
	Grand Total	19	5	6	460	390	850

Contact Hours: 30

VI Semester

Course Code	Course Title	L	T	P	External Marks	Internal Marks	Total
BM-302	Genetic Engineering.	3	1	-	60	40	100
BM-304	Microprocessors, Micro Controllers & Embedded System	3	1	-	60	40	100
BM-306	Biomedical Equipments	3	1	-	60	40	100
BM-308	Biomaterials	3	1	-	60	40	100
BM-310	Communication Engineering	3	1	-	60	40	100
CE-216	Environmental Sciences	3	1	-	60	40	100
BM-312	Lab-X Bioinstrumentation & Biomaterial Lab	-	-	2	20	30	50
BM-314	Lab-XI Microprocessors & Microcontroller Lab	-	-	2	20	30	50
BM-316	Lab-XII Genetic Engineering Lab	-	-	2	20	30	50
	General Fitness	-	-	-	-	100	100
	Grand Total	18	6	6	480	370	850

Contact Hours: 30

VII / VIII Semester

Course Code	Course Title	L	T	P	External Marks	Internal Marks	Total
BM-401/ 402	Rehabilitation Engineering	3	1	-	60	40	100
BM-403/404	Biomedical Signal Processing	3	1	-	60	40	100
BM-405/406	Medical Imaging & Image Processing	3	1	-	60	40	100
BM-407/408	Nuclear Medicine and Radiation Safety	3	1	-	60	40	100
	Open Elective	3	1	-	60	40	100
	Departmental Elective	3	1	-	60	40	100
BM-409/410	Project	-	-	6	80	120	200
EC-316	Lab-IVX Digital Signal Processing Lab (using MATLAB)	-	-	2	20	30	50
BM-411/412	Lab-XV Medical Image Processing Lab	-	-	2	20	30	50
	General Fitness	-	-	-	-	100	100
	TOTAL	18	6	10	480	520	1000

Contact Hours: 34

Open Elective

- i) DE-1.3 Human Resources and Management
- ii) CS-326 Operation Research
- iii) BM-413/414 Neural Networks and Fuzzy logics
- iv) CS-312 Computers and Society

Departmental Elective

- i) BM-415/416 Computers in Medicine
- ii) BM-419/420 Hospital Management
- iii) BM-421/422 Physiological Modelling
- iv) BM-423/424 Medical Informatics
- v) BM-425/426 Fiber Optics and Lasers in Medicine

7th & 8th Semester

Subject	Marks Internal	Marks External	Marks
Industrial Training of six months	500	500	1000

Total 1000

AM 201 MATHEMATICS-III

Internal Marks: 40
External Marks: 60
Total Marks: 100

L T P
4 1 0

1. Fourier Series

Periodic functions, Euler's formula. Even and odd functions, half range expansions, Fourier series of different wave forms.

2. Laplace Transforms

Laplace transforms, transform of derivatives and integrals, Laplace transform of unit step function, impulse function, periodic functions, applications to solution of ordinary linear differential equations with constant coefficients, and simultaneous differential equations.

3. Special Functions

Legendre polynomial, Bessel's equation, Bessel functions of the first and second kind. Recurrence relations, Equations reducible to Bessel's equation, Error function and its properties.

4. Partial Differential Equations

Formation of partial differential equations, Linear partial differential equations, homogeneous partial differential equations with constant coefficients Applications: Wave equation and Heat conduction equation in one dimension. Two dimensional Laplace equation, solution by the method of separation of variables. Laplacian in polar coordinates.

5. Functions of Complex Variable

Limits, continuity, derivative of complex functions, analytic function, Cauchy-Riemann equation, conjugate functions, harmonic functions; Conformal Mapping: Mapping of a complex function, conformal mapping, standard transforms, mapping of standard elementary transformations, complex potential, applications to fluid flow problems; Complex Integration: Line integrals in the complex plane, Cauchy's theorem, Cauchy's integral formula and derivatives of analytic function. Taylor's and Laurent's expansions, singular points, poles, residue, complex integration using the method of residues, evaluation of real integrals by contour integration.

Recommended Books

1. Kreyszing Erwin :Advanced Engineering Mathematics, Wiley Eastern, New Delhi
2. BS Grewal :Higher Engineering Mathematics, Khanna Publishers, N Delhi.,1996.
3. NK Jain :Numerical Solutions of Differential Equations, Prentice Hall, Delhi., 2005
4. Sharma & Gupta :Differential Equations; Krishna Prakashan Media (P) Ltd., Meerut.

BM-201 FUNDAMENTALS OF BIOENGINEERING

Internal Marks : 40
External Marks : 60
Total Marks : 100

L T P
3 1 0

1. Introduction to Biomedical Engineering

What is Bioengineering? Biomedical Engineering, Chemical Biotechnology, Modern Healthcare Systems, Role played by Biomedical Engineers, Status of Biomedical Engineering.

2. Moral and Ethical Issues

Morality and Ethics, Two moral Norms, Redefining Death, Taking Control, Human Experimentation, Informed Consent; Ethical issues in Feasibility studies, Emergency use, Treatment use; Role of Biomedical engineers in FDA Process.

4. Cell Biology

Introduction of anatomy, histology and Cell physiology, Cell, Structure and functions of subcellular organelles: cell-membrane, plasma-membrane, cytoplasm, smooth and rough endoplasmic reticulum, mitochondria, Golgi complex, lysosomes, cytoskeleton and cell motility. Nucleus and chromosomes, Cell Division-Mitosis and Meiosis.

5. Tissues

Epithelial tissues and Glands. Connective tissue- Types of Connective tissue, Muscular Tissue. Nervous tissue: different types of neurons, Synapse, Neuromuscular Junction, Neurotransmitters, Astrocytes, nerve fibers and glial cells.

6. Immunology

Natural Immunity, Acquired Immunity, Immune responses, Complement System for Antibodies, Adjuvants and Immunosuppressants, Structure of Immunoglobulins, Production of Ab's, Interferons, Vaccines, T cell receptors and CD3 Complex, Autoimmunity and Autoimmune Diseases, Production of Monoclonal Ab's, Hybridoma Techniques, Antibody Engineering.

7. Bio-electricity

Origin of Bioelectricity; Surface Potentials, Trans-membrane Potential, Role of Na^+ - K^+ pump and leak channel, Polarization and Depolarization, Transmission of Nerve Impulse, measurement of surface potentials.

8. Bio-magnetism

Introduction to Bio-magnetism, Generation and nature of bio-magnetic fields, Ferro magnetic particles in body, Magnetic fields of skin, muscles, eyes and other internal organs, Neuro-magnetic field, measurement of magnetic field generated by living organism, magneto-encephalography, magneto-cardiography.

Recommended Books

1. Seebauer EG and Barry RL :Fundamentals of Ethics for Scientists and Engineering, Oxford Press.
2. Enderle, Blanchard, Bronzino :Introduction to Biomedical Engineering, 2nd ed. Acad. Press, 2005.
3. Guyton AF :Textbook of Medical Physiology, Saunders, 10th ed.,2005.
4. Hoboie, RK :Intermediate Physics in Biology and Medicine,

BM-203 HUMAN ANATOMY AND PHYSIOLOGY

Internal Marks : 40
External Marks : 60
Total Marks : 100

L T P
4 0 0

Elementary Anatomy and Physiology of following systems:

1. **Skeletal System:** Development of bones, types of bones, Micro-anatomical and gross structure of bones, Osteology of human skeleton and various movement of joints.
2. **Muscular System:** Structure and types of muscles in human body, important muscles and their group action. Molecular organization of Contractile System, Sliding Mechanism of muscle Contraction, Regulation and Energetics of Contraction, Excitation- Contraction Coupling Innervation of muscles, Neuromuscular Transmission, Mechanism of muscular contraction.
3. **Circulatory System:** Blood volume, composition and function of blood, Haemopoiesis, blood coagulation, blood groups, body fluids. Structure of heart and blood vessels, Systemic circulation, pulmonary circulation, Portal circulation, and coronary circulation. Heart sound and E.C.G., Nervous control of heart and blood vessels, regulation of blood pressure. Lymphatic System: Lymph vessels, Lymph nodes and Lymphoid organs, their structure and functions.
4. **Digestive System:** Gastrointestinal tract and associated glands (Salivary Glands, Liver, Pancreas etc). Digestion of food in mouth, stomach and small intestines, gastro-intestinal tract movements and absorption. Function of liver and liver function tests and metabolism.
5. **Respiratory System:** Functional anatomy of respiratory system, Trachea, Lungs including other air passages. Mechanism of breathing and exchange of gases in lungs. Regulation of respiration, Oxygen and Carbon dioxide transport, anoxia, dyspnoea, cyanosis, artificial respiration and pulmonary function tests.
6. **Urinary System,** Structure and function of kidney, urater and Urinary bladder, Structure and functions of skin.
7. **Endocrine System:** Endocrine glands (Thyroid, Parathyroid, Adrenal, Hypothalamus and Pituitary glands) and their functions. Regulation of endocrine secretion.
8. **Reproductive System:** Male and female reproductive organ System.
9. **Special sense organs:** Eye, Ear, Nose Taste buds, Skin and its appendages, Subcutaneous sense organs.
10. **Nervous System:** Anatomical structures of cerebral cortex, spinal ganglion and autonomic ganglion, Neuron and its function, spinal cord and reflex action, sensory end organs and sensory path ways, cerebral cortex and motor path ways. Maintenance of posture and locomotion. Autonomic Nervous System, Brain, Spinal cord and peripheral nerves.

Recommended Books

1. Rastogi, S.C. : Experimental Physiology,. New Age
2. T Singh H.D. :Textbook of Human Physiology, S.Chand.
3. Subramunyam :Textbook of Human Physiology, S.Chand
4. Ranganathan, T.S:Textbook of Human Anatomy, S.Chand
5. Ross and Wilson : Anatomy and Physiology in Health and Illness
6. Sembulingam and Sembulingam: Essentials of Medical Physiology, Jaypee, IInd ed, 2000.

BM- 205 BIOCHEMISTRY

Internal Marks : 40
External Marks : 60
Total Marks : 100

L T P
4 0 0

- 1. Water**
Physical Properties and Hydrogen Bonding of water, Structure of Liquid water, Other properties of Hydrogen Bonds, Solvent Properties of Water, Hydrophobic Interactions, Effect of Solutes on water properties, Ionization of Water, Ion Product of Water.
- 2. Acid Base Homeostasis**
Acids, bases, measurement of pH, glass electrodes, role of kidney and lungs in acid-base balance, Biochemical measurement of acid-base status of patients, Disorders of acid-base balance, Blood gas analyzer.
- 3. Bio-Molecules**
Structure and functions of macromolecules, Chemistry and properties of amino acids, proteins, carbohydrates, lipids, nucleic acids and vitamins.
- 4. Chemical Bonds**
Covalent bonds, ionic bonds, co-ordinate bonds, hydrogen bonds, Vander-waal forces, hydrophobic interactions, diode interactions.
- 5. Proteins**
Primary, secondary, tertiary and quaternary structures, protein analysis, methods and purification of proteins. Enzymes as Catalysts, Structure and functions, Factors affecting activities of enzymes, Isolation methods.
- 6. Lipid Metabolism**
Oxidation of fatty acids, synthesis of fatty acids (fatty acid synthesis complex system), ketone bodies, Disorders of lipid metabolism.
- 7. Carbohydrate Metabolism**
Glycolysis, Glycogenolysis, Glycogenesis and their regulation, Citric acid cycle.
- 8. Amino acid Metabolism**
Oxidative degradation and synthesis of amino acids, estimation of amino acids.
- 9. Nucleic Acid Metabolism**
Biosynthesis of purines and pyrimidines, its regulation & catabolism, Genetic Disorders.
- 10. Biological Oxidation**
Organization of respiratory chain, Anaerobic and aerobic respiration, Redox Potentials and Oxidative Phosphorylation-mechanism and its inhibitors.

Recommended Books

1. Rama Rao, A : Text book of Biochemistry for Medical Students, UB publication, 7th ed. 1994.
2. Zubay, G. : Biochemistry, W.C. Brown Publishers, Oxford England, 1993.
3. Stryer, L. : Biochemistry, W.H. Freeman and Company, New York, 1995.
4. Lehninger, A.L. : Principles of Biochemistry, worth publishers, New York, 1994.

BM-207 ELECTRONIC DEVICES AND CIRCUITS

Internal Marks : 40
External Marks : 60
Total Marks : 100

L T P
3 1 0

1. Diode Circuits

PN junction diode, concept of band structure, potential barrier, diode as a circuit element, half wave, full wave and bridge rectifier and determination of rms, average value, ripple factor and regulation, capacitor input, inductor input, RC and RL filter circuits, special propose diode; LED, LCD and Photo- diodes.

2. Bipolar junction Transistors

pnp & npn, transistor construction and characteristics in CB, CE and CC modes. Determination of h parameters from Transistor characteristics. h parameter equivalent circuit of transistor. Conversion of h Parameter from CB to CE and CC configuration. Graphical analysis of transistors as an amplifier, special purpose transistors, UJT (construction and characteristics only), photo- transistors

3. Field Effect Transistors

Construction and characteristics of Junction Field effect transistor (JFET), MOSFET (both depletion and enhancement type), CMOSFET's, parameters and equivalent circuit of an FET, biasing of FETs, FET as an amplifier in CS configuration.

4. Transistor Biasing and Stabilization

Operating point, bias stability, various Biasing circuits, stabilization against I_{CO} , V_{BE} and beta. Bias compensation methods and thermal runaway.

5. Small Signal Low Frequency Transistor

Analysis of transistor amplifier using h-parameters in CB, CE and CC configuration. Comparison of three configurations in term A_1 , A_{21} , R_1 , R_0 . Frequency response of amplifier. Effect of an emitter bypass capacitor, coupling capacitor, emitter resistance and shunt capacitors on frequency response of amplifier. Analysis of emitter follower using Miller's theorem

6. Oscillators

Condition of Oscillators , Different types of oscillators: RC Phase shift , Wein Bridge, Hartley, calpitt & Crystal Oscillators, Derivation of expression for frequency and amplitude of these oscillators

7. Introduction to Operational Amplifiers

Block diagram of a typical Op-Amp, Schematic symbol, integrated circuits and their types, IC package types, Pin Identification and temperature range, Interpretation of data sheets, Overview of typical set of data sheets, Characteristics and performance parameters of and Op-Amp, Ideal Op-Amp, Equivalent circuit of an Op-Amp, Ideal voltage transfer curve, Open loop configurations : Differential, Inverting & Non Inverting. Practical Op-Amp: Input offset voltage, Input bias current, Input offset current, total output offset voltage, Thermal drift, Effect of variation in power supply voltages on offset voltage, Change in Input offset voltage and Input offset current with time, Temperature and supply voltage sensitive parameters, Noise, Common Mode configuration and common mode rejection Ratio.

Recommended Books

1. Salivaahanan, S :Electronics Devices & Circuits, TMH.
2. Millman :Electronics Devices & Circuits, Jacob, TMH.
3. Gupta, J.B :Electronics Devices & Circuits, Kataria.
4. Boystad :Electronics Devices & Circuits, New Age.
5. David Bel :Electronics Devices & Circuits, AHI.

BM-209 SENSORS AND TRANSDUCERS

Internal Marks : 40
External Marks : 60
Total Marks : 100

L T P
3 1 0

1. **Measurement**
Fundamentals of Medical Instrumentation: Types of Medical Instruments Recording and Monitoring Instruments: Fundamentals of Medical Instrumentation, Bioelectric signals (ECG, EMG, ECG, EOG & ERG) and their characteristics.
2. **Bio-electrodes**
Electrode-tissue interface, Electrode-electrolyte interface, Polarizable and non polarizable electrodes, Electrode Potential, Electrode equivalent Circuits, Contact impedance, Effects of high contact impedance. Biomedical recorders; Recording Systems: Different types of electrodes: Surface electrodes, Micro electrodes, Needle electrodes, Ag-AgCl electrode, ECG electrodes, EMG electrodes, EEG electrodes, pH electrodes and their uses.
3. **Physiological Transducers**
Biological sensors in human Body, Physiological monitoring, Need for sensor system in diagnosis, accuracy, Precision and errors, Signal and Noise.
4. **Piezoelectric force and Ultrasound Transducers**
Piezoelectric phenomenon and materials, Output voltage expression of piezo-crystal, Piezoelectric Pressure Transducer, Piezoelectric Microphone, Piezoelectric acceleration transducer, Force plate. Piezoelectric Ultrasonic Transducer: Construction, design, Electrical excitation, beam pattern, Piezoelectric semiconductor.
5. **Strain Gauges**
Theory of resistance strain gauges, Type and construction of metal wire and metal foil strain gauges, Strain Gauge materials, Deposited metal strain gauges, semiconductor strain gauges, Signal conditioning circuits, Temperature compensation, Bridge balancing Circuits.
6. **Temperature Transducers and Probes**
Resistance Temperature Detectors (RTD)- RTD construction and characteristics, RTD bridge circuits. Thermistors, Thermocouples. Thermistor probes, Thermocouple Probes
7. **Displacement Transducers**
Displacement and force transducers, LVDT, Capacitive Displacement Transducers, Capacitive angular displacement transducer-coupled Core type and Non-contact types. Strain gauge displacement transducers, Potentiometric Displacement transducers. Digital output displacement transducers.
8. **Diaphragm Transducers**
Diaphragm basics, Diaphragm types strain gauge transducers, capacitive transducers, Inductive and Potentiometric transducers.
9. **Nuclear Radiation Transducers**
Ionization Transducer-GM counter, Scintillation transducer- Scintillation counter.

10. Biochemical, Optical and Enzyme Sensors:

Blood gas sensors, Polarographic Clark PO₂ sensor, Transcutaneous PO₂ sensor, Photometric blood oxygen saturation sensor- non invasive optical pulse oxymetry. Blood pH electrode/ sensor, PCO₂ sensor, Enzyme based Glucose sensor, Microbial NO₂ biosensor, DNA/RNA based biosensors.

11. Biosensors

Working Principle of Biosensors, Immobilization of Biological sensing Element, Types of Biosensors, Applications of Biosensors.

Recommended Books

1. H T Kashipara :Biomedical Transducers, Mahajan Publishing House, Ahmedabad.
2. Cobbold, R.S.C :Transducers for Biomedical Measurements: Principles and Applications–Wiley, New York

BM-211 BIOCHEMISTRY LAB

Internal Marks : 30
External Marks : 20
Total Marks : 50

L T P
0 0 3

1. Preparation of solutions of different molarities and Normalities.
2. Preparation of buffers of different range and checking of pH.
3. Estimation of protein by Lowry's method.
4. Isoelectric point of casein.
5. Blood chemistry- separation of serum, preparations of plasma and estimation of blood glucose, urea and cholesterol. (Without using kit)
6. Estimation of Bilirubin.
7. Liver function tests- SGOT, SGPT.
8. Effect of pH, Temperature and concentration on the activity of Alkaline Phosphatase.
9. Verification of Lambert-Beer's Law.
10. Saponification Value of fat.
11. Estimation of carbohydrate by the Anthrone method .
12. Quantitative estimation of amino acids using Ninhydrin reaction.
13. Polyacrylamide Gel Electrophoresis (PAGE).
14. SDS Electrophoresis and Molecular weight Determination

BM-213 ANATOMY AND PHYSIOLOGY LAB

Internal Marks : 30

External Marks : 20

Total Marks : 50

L T P

0 0 2

- 1 Use of Simple Microscope, its components and maintenance
- 2 Identification of organs and histological preparation of slides- Fixing, embedding, sectioning and staining
- 3 Preparation of peripheral blood smear & determination of Differential leucocyte count (DLC)
- 4 Determination of RBC count and Total Leucocyte Count (TLC)
- 5 Determine Heart Rate via palpation of the Radial artery
- 6 Determine blood pressure using a manual sphygmomanometer
- 7 ECG electrode, its placement and skin preparation
- 8 Testing of hearing function using Tuning Fork
- 9 Identification of histological specimen of Tissues and organs (D slides/ Charts) of Digestive system, respiratory system, Circulatory system, endocrine system, nervous system, muscular system and excretory system.
- 10 Functional aspects of joints

BM-215 ELECTRONIC DEVICES AND CIRCUITS LAB

Internal Marks: 30

External Marks:20

Total Marks: 50

L T P

0 0 2

1. Study of Half wave, full wave & Bridge rectifiers.
2. Study of simple capacitive, T & S filters
3. Study of Zener regulator.
4. To plot the input and output characteristics of CE configuration.
5. To plot the input and output characteristics of CB configuration.
6. Determination of h-parameters of a transistors using output characteristics.
7. Design of transistor biasing circuits.
8. Study of frequency response of RC coupled amplifier.
9. Study of an emitter follower circuit.
10. To plot JFET characteristics in CS configuration.
11. Study of parameters of practical op-amp.
12. Use of different amplifier configurations and the corresponding frequency responses for an RC-coupled amplifier with BJT / FET.

EE-201 NETWORK ANALYSIS AND SYNTHESIS

Internal Marks : 40

L T P

External Marks : 60

3 2 0

Total Marks : 100

1. **Circuit Concepts & Circuits Elements**

Independent and dependent sources, signals and wave forms; periodic and singularity voltages, step, ramp, impulse, Doublet. Loop currents and loop equations, node voltage and node equations, Network Theorems, Superposition, Thevenin's Norton's Maximum Power Transfer, Reciprocity.

2. **Time and Frequency Domain Analysis**

Representation of basic circuits in terms of generalized freq. & their response, Laplace transform of shifted functions, transient and steady response. Time domain behavior from poles and zeros, Convolution Theorem.

3. **Network Synthesis**

Network functions, Impedance & Admittance function, Transfer functions, Relationship between transfer and impulse response, poles and zeros and restrictions, Network function for two terminal pair network. Sinusoidal network in terms of poles and zeros, Real liability condition for impedance synthesis of RL & RC circuits, Foster and Cauer forms.

4. **Filter Synthesis**

Classification of filters, characteristics impedance and propagation constant of pure reactive network, Ladder network, T Section, IT Section, terminating half section. Pass bands and stop bands. Design of constant-K, m-derived filters, Composite filters.

Recommended Books

1. Van Valkenberg : Network Analysis & Synthesis
2. Sudhakar Sham Mohan : Network Analysis and Synthesis
3. Lyer, IVS : Network Synthesis by
4. JA Administer : Electric Circuits
5. Chakraborty : Circuit Theory

BM-202 ANALOG AND DIGITAL ELECTRONICS

Internal Marks: 40

External Marks: 60

Total Marks: 100

L T P

3 1 0

Part A

1. Large Signal Amplifiers

Class A direct coupled with resistive load, Transformer coupled with resistive load, design theory, power amplifier design, harmonic distortion, power output, variation of output power with load, thermal runaway, output transformer saturation, push-pull amplifiers, operation of class-A push-pull amplifier, class-B push-pull amplifier, crossover distortion, class AB push-pull amplifier, transistor phase inverter, conversion efficiency of class B amplifiers, design of Class-B push-pull amplifier, complementary-symmetry amplifier.

2. Multistage Amplifiers

Coupling of transistor amplifiers, frequency response of coupled amplifiers, cascading of RC coupled amplifiers and their analysis. Tuned Amplifiers: single tuned, double tuned and stagger tuned amplifiers and their analysis.

3. Feedback in Amplifiers

Types of feedback, effect of negative feedback on gain, bandwidth, stability, distortion and frequency response etc. Voltage series, current series, voltage shunt, current shunt feedback circuits and their analysis.

Part B

4. Introduction to IC

Advantages of IC's, General classification of IC's (Linear/Digital IC's, Monolithic/Hybrid IC's), Basic IC fabrication steps

5. Sequential Circuits

Introduction, flip flop SR, JK, D, T edge triggered and deeded flip-flop, Registers. Type of Registers, circuit diagram, timing wave form and operation counters, counter design with state equation and state diagrams.

6. D/A and A/D Converters

Introduction, Weighted register D/A converter, binary ladder D/A converter, steady state accuracy test, D/A accuracy and resolution, parallel A/D converter, Counter type A/D converter Successive approximation A/D converter. Single and dual slope A/D converter A/D accuracy and resolution, Voltage of frequency conversion, Voltage of time conversion. Analog multiplexes and demultiplexes

Recommended Books

Millman and Halkias	: Electronic Devices & Circuits, TMH.
Boylestad	: Electronic Devices & Circuits Theory, PH.
Allen Mottorshead	: Electronic Devices & Circuits, PHI.
Malvino	: Digital principle and applications, TMH.
R.P.Jain	: Modern digital electronics, PIH.
Malvino	: Digital electronics principle, THM

BM-204 PHYSICAL BIOCHEMISTRY

Internal Marks : 40

External Marks : 60

Total Marks : 100

L T P

4 0 0

1. Transport phenomena

Active & Passive Transport, Fick's laws of diffusion, diffusion equation, Applications to biochemistry: Donnan Membrane Equilibrium

2. Chromatography

Theory, operations and applications of Partition, Adsorption, Ion Exchange and Affinity Chromatography. Thin layer and Column Chromatography, GLC and HPLC, DNA Cellulose Chromatography.

3. Sedimentation

Theory of velocity sedimentation, preparative and analytical Ultracentrifugation, factors affecting sedimentation velocity, sedimentation coefficient, Determination of Molecular weight by Sedimentation equilibrium, Density gradient, Applications of density gradient.

4. Electrophoresis

Theory, operations and applications, Electrophoresis on paper, cellulose acetate and gel. 2-D gel electrophoresis, Agarose gel electrophoresis, Electrophoretic transfers- Southern, Northern & Western, Isoelectric focussing, Combined electrophoresis and chromatography-Finger printing, Pulse field electrophoresis.

5. Chemical Kinetics

Theories of Chemical kinetics. Differential and Integrated rate laws, Mechanisms of chemical and biochemical reactions, Enzyme kinetics, Transition state theory; Diffusion-limited processes: Kinetics methods in biochemistry.

6. Absorption Spectroscopy

Theory of light absorption, Absorption by bio-molecules Instrument Used for measurement of light / UV light; Structural analysis of DNA and Proteins using absorption of light, CD and ORD, Infrared spectroscopy.

7. Diffraction Techniques

X-ray Diffraction, Electron Diffraction, Neutron Diffraction, Crystal structures, Space symmetry groups, Structural determination of Bio-macromolecules.

8. Thermodynamics

Laws of Thermodynamics, Thermodynamics of Solutions, Gibbs-Duhem's Equation, Thermodynamics in Biology.

9. Bioenergetics

Catabolism and Anabolism, Multienzyme systems, ATP Cycle, Free energy, Standard Free energy change of chemical Reactions, Production of energy in biological systems, Reservoirs of high energy phosphate bonds, free energy coupling processes, ADP and Pyrophosphate.

10. Cell Signaling

Mechanism of hormone action, Signal Transduction -Role of cAMP, cGMP, Ca²⁺, Inositol Triphosphate, Diacyl Glycerol, Ca²⁺-Homeostasis.

Recommended Books

1. David Frifelder :Physical Biochemistry, Wiley, New York, 1998.
2. Cantor and Schimmel :Biophysical Chemistry Vol I & III, 1985.
3. T.E. Crieshton :Proteins – Structure and Molecular Principles.
4. A.G. Marshal :Biophysical Chemistry, Wiley New York, 1985.
5. Terrance G. Cooper :The Tools of Biochemistry
6. Puri, Sharma and Pathania :Biophysical Biochemistry

CS-303 COMPUTER NETWORKS

External Marks: 60
Internal Marks: 40
Total Marks: 100

L T P
3 1 0

1. Introduction

Basic concepts of analog and digital signals, data transmission concepts, Analog and digital data transmission, transmission impairments.

2. Transmission media

Guided and Un-guided Media, Performance, Shannon Capacity. Media Computerisation.

3. Encoding and modulating

Digital-to-Digital conversion, Analog and Digital conversion, Digital to Analog conversion, Analog to Analog conversion.

4. Digital Data Communication

Digital data transmission, DTE – DCE Interface, EIA-449, EIA-530, X.21, Modems, Cable Modems.

5. Multiplexing and Switching

FDM, WDM, TDM, Multiplexing application – telephone systems, DSL, Par Circuit switching Packet Switching & Message switching virtual circuits.

6. Spread Spectrum

Concept, Frequency hopping spread spectrum, direct sequence spread spectrum, code-division Multiple Access.

7. Error detection and Correction

Types of Errors, Detection, VRC, LRC, CRC, Checksum, Error Correction.

8. Protocol Architecture

Protocols, standards, OSI, TCP/IP Protocol Architecture.

Recommended Books

1. Behrouz A Ferouzan : Data Communications and Networking , 2nd ed., TMH
2. William Stallings : Data and Computer Communication, 7th ed., Pearson Edu.
3. Ulyers D Black : Data Communication and Distributed Networks –3rd Edition PHI.
4. Andrew S. Tanenbaum : Computer Networks, PHI

EE-206 SIGNALS AND SYSTEMS

Internal Marks : 40
External Marks: 60
Total Marks : 100

L T P
3 1 0

1. System and Signal Analysis

Classification of signals and systems, signal representation using fourier series, complex exponential fourier series, fourier series representation of periodic signals periodic signal representation using fourier transform, fourier transform of periodic power signals, power spectral density, system response impulse, step and time domain response analysis, transfer function and frequency, Domain analysis effect of Transfer function on spectral densities, Stationary of non-Transients.

2. Random Signal Theory

Introduction to probabilities Definition, probability of Random events, Joint and conditional probability, probability Mass function statistical averages. Probability density functions and statistical averages. Examples of P.D. function, transformation of random variables random processes, stationary, true averages and Fygodic.

3. Signal Transmission Through Linear Networks

Convolution theorem, its graphical interpretation. Conditional function with a unit Impulse function. The sampling theorem low pass and band pass network, matched filter, input output relations with random inputs, envelope detector, equivalent noise band width Noise. Introduction to thermal noise, shot noise partial noise, low frequency or flicker, Gaussian Noise, burst noise, avalanche noise bipolar transistor noise, F.E.T. noise, Equivalent input noise signal to noise ration, noise factor, amplifier input noise in terms of F-Noise factor or amplifiers, Noise temperature, Noise equivalent Bandwidth, Noise fig. Experimental determination of noise figure, Pulse response & Digital No. and elimination.

Recommended Books

1. Simon Haykin :Communication Signal and Systems
2. Oppenheim and Willsky : Signal and Systems

BM-206 BIOMEDICAL INSTRUMENTATION

Internal Marks : 40
External Marks : 60
Total Marks : 100

L T P
3 1 0

- 1. Patient Monitoring and diagnostic Systems**
Digital Pulse Monitor, Digital Heart Rate Monitor, Diagnostic Aids Electronic Stethoscope, ECG, EEG, Electromyograph, Biomonitors.
- 2. Blood Flow meters**
Electromagnetic Blood flow meter, Ultrasonic Blood flow meters, NMR Blood flow meters, Laser Doppler Blood flow meters.
- 3. Blood Gas Analyzers**
Blood PO₂ Measurement, Measurement of blood PCO₂ blood pH measurement, Complete blood gas Analyzer, Oximetry.
- 4. Blood Cell Counters**
Methods of cell counting- Coulter Counters, Automatic recognition and Differential counting of cells
- 5. Clinical Laboratory Instruments**
Spectroscopy, Absorption spectroscopy, Photoelectric calorimeter, Spectrophotometer, Flame Photometer, Auto-analyzers.
- 6. Cardiac Measurement**
Indicator dilution methods, Measurement of continuous Cardiac output, Impedance technique, Cardiac Arrhythmias, Ambulatory monitoring Instruments, Phonocardiogram, Plethysmography.
- 7. Pulmonary Function Analyzers**
Pulmonary Function measurement, Spirometry, Pulmonary function analyzers, Respiratory gas Analyzers.
- 8. Audiometers and Hearing Aids**
Basic Audiometer, Pure tone audiometer, Audiometer system Bekesy, Evoked response Audiometer system.
- 9. Biomedical Telemetry**
Wireless Telemetry, Single channel telemetry, Multichannel telemetry, Multipatient telemetry, Transmission of Physiological signal over telephone lines, Telemetry systems for ECG, Temperature data, Obstetrical telemetry, Implantable telemetry systems for ECG, Temperature, Blood Pressure and blood flow.
- 10. Miscellaneous** : Ophthalmoscope, Tonometer, Glaucometer, Ergometer.

Recommended Books

1. John G. Webster :Medical Instrumentation,John Wiley and sons, 3rd ed., 2004.
2. Carr J.J. & Brown : Biomedical Instrumentation & Measurement, Pearson Edu.,
3. Cromwell et al :Biomedical Instrument,Pearson edu., N. Delhi, 2nd ed, 2003
4. R.S. Khandpur : Handbook of Biomedical Instrumentation, TMH, N. Delhi 2nd ed. 2003.
5. Sujay Guha :Medical Electronics and Instrumentation, University Publication

BM-208 ANALOG AND DIGITAL ELECTRONICS LAB

Internal Marks: 30
External Marks: 20
Total Marks : 50

L T P
0 0 2

1. To study the characteristics of a Class- A amplifier.
2. To study the characteristics of Class- B amplifier.
3. To study the characteristics of Class-C amplifier.
4. To study the characteristics of Class- AB amplifier.
5. To study the characteristics of Class- B push-pull amplifier.
6. To study the characteristics of complementary symmetry amplifier.
7. (a) Verification of the truth table of the Multiplexer 74150.
b) Verification of the truth table of the De-Multiplexer 74154.
8. Study and verification of the operations of ALU 74181 with regards to addition / subtraction / comparison.
- 9.(a) Design and test of an S-R flip-flop using TOR/NAND gates.
(b) Verify the truth table of a J-K flip-flop (7476)
(c) Verify the truth table of a D flip-flop (7474) and study its operation in the toggle and asynchronous modes.

CS- 315 COMPUTER NETWORKS LAB

External Marks: 20
Internal Marks: 30
Total Marks: 50

L T P
0 0 2

1. Conversion of Analog to digital signals.
2. Conversion of digital to analog signals.
3. Conversion of Analog to Analog signals.
4. Conversion of digital to digital signals.
5. Implementation of multiplexers.
6. To study FDM modulation techniques.
7. To study TDM modulation techniques
8. To study WDM modulation techniques
9. To study various transmission media like twisted pairs, co-axial cables, optical fibers etc.

BM-212 BIOMEDICAL INSTRUMENTATION LAB

External Marks: 20

Internal Marks: 30

Total Marks: 50

L T P

0 0 2

1. Use of simple microscope, Calculation of magnification, Illustrations of parts, functions and maintenance.
2. Identification of different types of pH electrodes
3. Use of various types of transducers and their maintenance.
4. To measure pressure, temperature, distance, volume using transducers
5. Measurement of skin contact impedance and techniques to reduce it
6. Recording of 12 lead ECG using portable ECG machine and determination of various intervals and periods.
7. Calculation of Cardiac axis through ECG
8. Study the working of spirometer and determining lung volumes and capacities
9. Measurement of leakage current with the help of safety factor.
10. To study the components of spectrophotometers and colorimeters
11. Study the working of Electronic Stethoscopes, Digital Thermometers, E.C.G. Audio meters, Hearing aids, Bio-monitors , pH meters and their maintenance.

BM-301 CLINICAL ENGINEERING

Internal Marks : 40
External Marks : 60
Total Marks : 100

L T P
3 1 0

1. Basis of Common Diseases and Clinical Investigations

Disease Codes from WHO, Diabetes, Hypertension, Rheumatic heart disease, Ischemic heart disease, Asthma, Alzheimer's and Parkinson Disease, Functions of Hospital clinical chemistry laboratory- Various tests performed, Equipments- Automatic clinical analyzer, principle and functions.

2. Cardiac Diseases

Cardiac cycle, valves and their function – Conducting systems, normal and abnormal ECG's, Analysis and Interpretation of ECG from technology point of view, Cardiac pacing, Diagnostic indications, temporary and permanent pacing. Cardiovascular measurements: Heart rate monitor, Prosthetic devices, cardiac catheterization, heart lung machine, Fibrillation- Atrial and ventricular; Cardiac assist devices, principle and application of Echo Cardiography, Treadmill, Ergo meter, equipments used for open heart surgery.

3. Nephrology

Diagnostic applications of Radionuclides in renal medicine. Principles of dialysis, Haemodialysis and other types of Dialysis. Components of dialyzers, controls and monitoring services of dialysers.

4. Anesthesia

Applications in anesthesia, intensive care, medical gas supply system , intravenous drug delivery system, principle of equipment used in pain therapy, principle of OT tables and lights, photo therapy, surgical diathermy.

5. Ophthalmology

Genesis of Electroretinogram (ERG), Basis of ERG diagnosis, Genesis of Electro oculogram (EOG). Vision testing Equipments – Sneller's chart, Keratometer, Refractometer. Slit lamp Biomicroscope and camera, fundus camera, Ophthalmoscope, Retinoscope, Tonometer, perimeter, ultrasound, scanner, electromagnet, organ laser, contact lenses, intraocular lenses, operating microscope, Vitrectomy Instrument.

6. Management of Medical Equipments

Risk factors, Strategies, Safety and applications.

Recommended Books

1. R.M. Kenedi :A textbook of Biomedical Engineering, Maxmillan ed., 1980
2. R Shalak and Shu Chen :Handbook of Bioengineering
3. Stranss and Welt :Diseases of Kidney, 3rd ed, Vol II.,1979.
4. Salomon and Paper :Clinical Nephrology – the kidney diseases,1995.
5. A.C. Burton :Cardiovascular Physiology , Biophysics, 2nd ed. 1972.
6. J.G. Webster :Biomedical Instrumentation- Application and Design
7. Otto Glasser :Medical Physics, 1978
8. Carr JJ and Brown J M :An Introduction to Biomedical Equipment Technology. 4th ed.

BM-303 NUMERICAL METHODS AND COMPUTER PROGRAMMING

Internal Marks : 40
External Marks : 60
Total Marks : 100

L T P
3 1 0

1. **Overview of C++ language**
 - 1.1 Data types, variables, constants, arithmetic expressions and assignment statements.
 - 1.2 Program control statements, console I/O.
 - 1.3 Arrays, functions and pointers. Structures, unions, enumerated data types.
 - 1.4 The C-preprocessor, C standard Lib and header files.

2. **Errors in Numerical Computation**

Sources of errors in numerical computation.
Round-off error.
Truncation error.
Inherent error.
Stability of numerical algorithms.

3. **Transcendental and Polynomial Equations**

Bisection method.
3.1 Secant method.
3.2 Regula-Falsi method.
3.3 Newton-Raphson method.
3.4 Rate of convergence of iterative methods.
3.5 System of nonlinear equations.

4. **Systems of Linear Equations and Inverse of a Matrix**
 - 4.1 Gauss-elimination method.
 - 4.2 Gauss-Jordan method.
 - 4.3 LU decomposition method.
 - 4.4 Cholesky method for symmetric and positive definite systems.
 - 4.5 Gauss-Jacobi iteration method.
 - 4.6 Gauss-Seidel iteration method.
 - 4.7 Rate of convergence of iterative methods.

5. **Interpolation and Approximation**

Lagrange interpolation.
5.1 Errors of interpolation.
5.2 Divided differences.
5.3 Newton's divided difference interpolation.
5.4 Finite differences.
5.5 Newton's forward and backward differences interpolation.
5.6 Least squares approximation.

6. **Numerical Differentiation**

Methods based on interpolation.
6.1 Methods based on finite differences.
6.2 Methods based on undetermined coefficients.
6.3 Choice of optimal step size.
6.4 Richardson extrapolation methods.

7. Numerical Integration

7.1 Newton Cotes methods (Trapezoidal rule, Simpson's rule).

7.2 Composite integration methods.

7.3 Derivation of methods using the method of undetermined parameters.

7.4 Romberg integration.

7.5 Gaussian methods (Gauss-Legendre methods, Gauss-Chebyshev methods, Gauss-Laguerre methods, Gauss-Hermite methods).

8. Numerical Solution of First Order Ordinary Differential Equations

Taylor's series method.

8.1 Euler method.

8.2 Runge-Kutta methods (Second and fourth order).

Recommended Books

1. E. Balagurusamy :Programming in ANSI C, TMH, 1992.
2. Jain, Iyengar and. Jain :Numerical Methods for Scientific and Engineering Computation, IVth ed., New Age, 2003.
- Jain, Iyengar and. Jain :Numerical Methods : Problems and Solutions, New Age International Publishers, 1994.
- Ralston and Rabinowitz :A First Course in Numerical Analysis" TMH 2nd edition, 1978.
- Atkinson :Elementary Numerical Analysis, John Wiley.
- Gerald, Wheatley :Applied Numerical Analysis, Addison-Wesley.
- Sastry, :Introductory Methods of Numerical Analysis, Prentice Hall of India.
- Kreyszig :Advanced Engineering Mathematics, 8th Edition, John Wiley
- Akai :Applied Numerical Methods, John Wiley.

BM-305 MEDICAL IMAGING TECHNOLOGIES

Internal Marks : 40
External Marks : 60
Total Marks : 100

L T P
3 1 0

1. X-ray Machine & Digital Radiography

X-ray equipment (soft and hard X-rays), engineering principles of x-ray system, Radiation protection, Scattered radiation and its importance to radio graphical image, quality & safety specifications of X-ray equipment.

2. Transmission Lines

Circuit representation of parallel plane transmission lines. Parallel plane transmission line with losses. Low loss RF and UHF transmission lines. Distortionless condition. Transmission line charts – Impedance matching.

3. Ultrasonic Imaging System

Ultrasonic wave motion, wave characteristics, intensity, and ultrasound properties in body (velocity, attenuation, reflection, refraction and absorption). Use of ultrasound in biological field. Basic principles of radio-diagnosis, image formation, image analysis. Ultrasound transducer, measurement of image system, application of scan, m-mode and b-scan, scan scattering and propagation of ultrasound in biological and material with applications to imaging and tissues, sector scan, mechanical sector transducers, linear scan using multi element linear array scanner, annular array system. Theory and construction of array transducer for imaging, Doppler ultrasound systems and their applications to the study of blood flow. Doppler imaging, Practical interpretation of ultrasound.

4. X-ray Computed Tomography & MRI Systems

Tomographic imaging principle, computerized X-ray Tomography; Principle and applications of Applied Positron Tomography; Magnetic resonance (NMR) Spectroscopy, MRI Machines, functional MRI and spectroscopy; Medical Thermography – Thermographics equipment and their application

Recommended Books

1. R.S. Khandpur : Handbook of Biomedical Engineering
2. Christensens : Text Book of Radiology
3. Barry N. Fimberg :Applied Clinical Engineering
4. Garzole R.C :Digital Image Processing

BM-307 BIO-CONTROL SYSTEMS

Internal Marks : 40
External Marks : 60
Total Marks : 100

L T P
4 1 0

1. Introduction to state variable analysis of control systems:

Introduction to state variable concept, definition of state variables, matrix representation of state equation, state transition equation, properties of transition matrix, relationship b/w state equations and higher order differential equations, state equation and transfer function, characteristics equation, Eigen values and Eigen vectors.

2. Transformation to phase variables

Canonical forms of state variables, controllability canonical form, observability canonical form Jordan canonical form controllability and observability of linear system, relationship among controllability, Observability and transfer function.

3. Introduction to Biological Control system:

Introduction, dynamic systems and their control, mode and block diagrams, the pupil control systems, general structure of control system, the dynamic response characteristics of the pupil control system, open and close loop systems instability, automatic aperture control.

4. Mathematical modeling of the system

Thermo regulation, thermoregulation of cold bloodedness, warm bloodedness, the anatomy of thermoregulation, lumping and partial differential equations, examples: mathematical model of the controlled process of the body.

5. Modeling the body as compartments

Behavior in simple compartmental systems, pharmacy kine model, urea distribution model, multi compartmental system. Dissolution of drugs in solid form, distribution and accessibility of body waters and tissue compartments, basis for zero order and first order chemical kinetics behavior in biological system.

6. Biological Receptors:

Introduction, receptor characteristics, transfer function, models of receptors, receptor and perceived intensity. Respiratory model and systems, cardiovascular control system, skeletal muscle servomechanisms

Recommended Books

1. A.H. Patel :A manual of medical laboratory technology
2. Kent and Olsen :Control Systems, TMH, 2003.
3. Michael CK Khoo :Physiological Control Systems: Analysis, Simulation and Estimation.

BM-309 TISSUE ENGINEERING

Internal Marks : 40
External Marks : 60
Total Marks : 100

L T P
4 0 0

- 1. Biological Considerations**
Cell Differentiation, Cell Aggregation, Cell Motility Cellular Communications.-Soluble Growth factors and Insoluble Factors
- 2. Physical Considerations**
Organisation of Tissues into Functional Subunits, Estimating Tissue Function from Spec Sheets, Mass Transfer in 3-D Configurations, Tissue Microenvironment, Biomaterials
- 3. Stem Cell lines**
Stem cells, Maturational Lineage Biology Pluripotent Stem cell lines; Types of stem cells-Pluripotent haemopoietic stem cells, Marrow stromal cells, Neural Stem cells, Totipotent Embryonic Stem cells, Therapeutic cloning, Stem cell Therapy and cloning.
- 4. Organ/Embryo Culture**
Explanation Techniques, Organ Culture, Whole Embryo Culture; *In vitro* Fertilization; Embryo Transfer Technology
- 5. Tissue Engineering and Scaffolds**
Materials for Tissue Engineering- Synthetic and Natural, Recognition sites, Tissue Engineering of skin, Bone grafts, Nerve Grafts, Bioartificial organs, features of designing a tissue engineering scaffold, biodegradable and non-biodegradable scaffolds, Biomimetic scaffolds
- 6. Scaling up**
Key Design challenges, Implementation of Tissue Engineered Products

Recommended Books

1. Griffith and Smith :Animal Biotechnology, Vol I & II
2. Freshney :Animal Cell Culture
3. P.K.Gupta :Biotechnology and Genomics, Rastogi Publications 2nd ed 2005
4. Bernhard Palsson & Sangeeta Bhatia :Tissue Engineering; Pearson Prentice Hall,2004.

BM-311 BIOMECHANICS

Internal Marks : 40
External Marks : 60
Total Marks : 100

L T P
4 0 0

1. Introduction to Fluid Mechanism

Basic laws governing conservation of mass, Newton's Law, Hooke's Law, momentum and energy, laminar flow, Newtonian and Non-Newtonian Fluid, Viscoelastic fluid, Couette flow and Hagen-Poiseuille equation, turbulent flow.

2. Flow Dynamical Study of Circulating System

Heart and blood vessels, Ventricular pressure, volume, ECG time based cyclic variation. Determination of ventricular wall diastolic, systolic modules verses stress properties and their physiological connotation, Intra-ventricular blood

3. Flow Analysis of Velocity and Pressure Gradient

Arterial impedance relating pulse pressure and flow rate, mechanism and transport in microcirculation, microcirculatory flow, Transcapillary fluid movements in systemic circulation, physiological factors controlling blood pressure, Heart valves.

4. Soft Tissue Mechanics

Pseudo-elasticity, Nonlinear stress- strain relationship, Structural and functional properties of skin, ligaments and tendon, Muscle in terms of its elastic and contractile element parameters

5. Lung Mechanics

Lung structure and function, methods of determining lung pressure and volume, airway resistance and conductance.

6. Orthopaedic Mechanics

Mechanical properties of Cartilage, Diffusion properties of articular cartilage, Mechanical properties of bone, Kinetics and kinematics of joint, Lubrication of joints, Analysis of force in orthopaedic implants

7. Cochlear Mechanics

Passive Models, Active Models, Vestibular Mechanics, Otolith Distributed Parameter model, Non- Dimensionalisation of the Motion Equation, Otolith Transfer Function and Frequency Response, Semicircular Canal Distributed Parameter model and its Frequency Response.

Recommended Books

1. Y.C. Fung : Biomechanics –Circulation, Springer Verlag, 1997.
2. Susan J. Hall : Basic Biomechanics 1, TMH, 2002.
3. Ozkay & Margareta Nordin: Fundamentals of Biomechanics, Springer Verlag, 1999.
4. Y.C. Fung :Biomechanics-Mechanical Properties of Living tissues, Springer Verlag, 1981
5. Dawson and Right :Introduction to biomechanics of joints and joint replacement, Mechanical Engg. Publication Ltd. 1989.
6. Jacob Kline :Handbook of Biomedical Engineering, Academic Press Inc. 1988

BM-313 TISSUE ENGINEERING LAB

Internal marks : 30
External marks : 20
Total marks : 50

L T P
0 0 2

1. Counting of cells using Haemocytometer
2. Viability test using Trypan Blue Exclusion method
3. Isolation of Lymphocyte
4. Preparation of media and glassware
5. Establishment of Primary cell culture from lymphocyte
6. Trypsinisation of monolayer
7. Cell culture in static phase
8. Cell culture in spinner flasks
9. Metabolic study of cell culture

BM-315 NUMERICAL METHODS AND COMPUTER PROGRAMMING LAB

Internal marks : 30
External marks : 20
Total marks : 50

L T P
0 0 2

1. To develop computer program to determine roots of a given equation using method of
 - a. Bisection method.
 - b. Secant method.
 - c. Regula-Falsi method.
 - d. Newton Raphson method
2. To develop computer programs for solution of system of simultaneous linear equations using:
Gauss Elimination Technique, without and with specified boundary conditions, for full as well as bounded symmetric and unsymmetrical matrices
3. Numerical integration by Trapezoidal and Simpson's rule.
4. Gauss-Siedel iteration method
5. Solution of ordinary differential equations by
 - (i) Euler Method
 - (ii) Runge-Kutta Method
 - (iii) Taylor Series Methods
6. Various matrix operation-and their use as sub-routines

BM-317 BIOMECHANICS LAB

Internal marks : 30
External marks : 20
Total marks : 50

L T P
0 0 2

1. To study the flow through a variable area duct and to verify Bernoulli's energy equation.
2. To determine the Coefficient of Discharge for an obstruction flow meter.
3. To study the transition from laminar flow to turbulent flow and to ascertain the lower critical Reynold's number.
4. To prove that blood is a Non-Newtonian fluid.
5. Determine the Reynold's Number of Blood.
6. To study the technique of blood flow analysis by Colour Doppler
7. E.M.G.
8. Spirometry
9. To study the effect of various physiological parameters (posture, exercise) on B.P., Pulse & Respiration.
10. Treadmill and Ergometer

BM-302 GENETIC ENGINEERING

Internal Marks : 40

External Marks : 60

Total Marks : 100

L T P

3 0 0

1 Molecular tools and their applications

Milestones in Genetic Engineering, Restriction enzymes, modification enzymes, DNA and RNA markers.

2 Gene Cloning Vectors

Plasmids, bacteriophages, phagemids, cosmids, Artificial chromosomes. Restriction Mapping of DNA fragments and Map Construction, Nucleic Acid Sequencing. cDNA, SI mapping. RNase protection assay. Reporter assays.

3 Expression Strategies for Heterologous Genes

Vector Engineering and codon optimization, host engineering. In vitro transcription and translation, expression in bacteria, expression in Yeast, expression in insects and insect cells, expression in mammalian cells, expression in plants.

4 Processing of Recombinant Proteins

Purification and refolding, characterization of recombinant proteins, stabilization proteins. Phage Display

5 Transgenic and Gene Knockout Technologies

Targeted gene replacement synthesis and Cloning, mRNA, enrichment, reverse transcription, DNA primers, linkers, adaptors and their chemical synthesis, Library construction and screening. Alternative strategies of gene cloning: Cloning interacting genes-Two and three hybrid systems, cloning differentially expressed genes. DNA chips and cDNA microarrays.

6 Polymerase Chain Reaction

Basic principles, Different forms of PCR eg multiplexes, RT PCR, e PCR etc., Applications of PCR in detecting genetic disorders.

7 Transposon Tagging

Role of gene tagging in gene analysis. T-DNA and transposon tagging, Identification and isolation of genes through R-DNA or transposon. Site-directed Mutagenesis and Protein Engineering.

8 Gene Regulation

DNA Transfection, Northern blot, primer extension, Chromosome engineering.

9 Gene Therapy

Vector engineering, Strategies of gene delivery, Gene replacement / augmentation, gene correct, gene editing, Gene regulation and silencing, Nanotechnology and its applications to Medicine.

Recommended Books

1. Walker and Gingold: Molecular Biology and Biotechnology, Royal Society of Chemistry, London, 1991
2. Watson. J. et. al. : Molecular Biology of Gene, 4th ed, 1994, Benjamin / Cummings, California, USA.
3. Alberts, B. et. al. : Molecular Biology of Cell, Garland Publishers Inc., 1994.
4. Watson, J.D. et al. : Recombinant DNA, Scientific American Books, New York., 1993.
5. Old and Primorose : Principles of Gene Manipulation , Blackwell, U.K, 1994.
6. Date, J.N. : Methods in Gene Technology , Jai Press Ltd. London, England., 1994,

BM-304 MICROPROCESSOR, MICROCONTROLLER AND EMBEDDED SYSTEMS

Internal Marks : 40
External Marks : 60
Total Marks : 100

L T P
3 0 0

1. Introduction to Microprocessor

Overview of Microprocessor Structure and its operation. Microprocessor evolution and its types. 8085 Microprocessor : 8085 MPU, Memory Interfacing, Memory mapped I/O and peripheral mapped. I/O 8085 Micro processor Programming model. Introduction to 8085 instructions programming techniques, counters and time delays, stack and subroutines, interrupts of 8085. 8086 Microprocessor : 8086 internal architecture, 8086 system configuration and timing, minimum and maximum mode, memory segmentation, address modes. Microprocessor system peripheral and interface: Introduction to interfacing, 8155, 8255, 8279, 8254, DMA controller, programmable interrupt controller, USART interfacing with 8085 MPU.

2 8051 Micro Controller

Comparison of Micro processor and Micro controller, micro controller and embedded processors Serial Communication: 8051 connection to RS 232, 8051 serial communication programming. Real World Interfacing: LCD, ADC and sensors, stepper motor, keyboard, DAC and external memory.

3 Introduction to an embedded system and FPGA Kit

Introduction to latest micro controllers such as ARM processors, its design and applications.

Recommended Books

1. Ali Mazidi :The 8051 Micro Controller and embedded Systems
2. David e Simon, Pearson Education : An embedded software primer
3. Frank Vahid and Tony Givargus :Embedded system design
4. Gaonkar :Microprocessor Architecture, Programming and Application with 8085
5. B. Ram. :Introduction to Micro processor
6. D.V. Hall :Micro processor Interfacing, Programming and hardware

BM-306 BIOMEDICAL EQUIPMENTS

Internal Marks : 40
External Marks : 60
Total Marks : 100

L T P
3 0 0

1. Bio-Medical Stimulators and De-stimulators

Principles, Varieties and applications, Shortwave diapulse, microwave, ultrasonic therapy; circuit description, application and dosage control. Electrotherapy: diagnosis, Nerve and Muscle stimulators, Pain relievers, Ultrasonic stimulators, Electro surgical stimulators and analyzers, Functional electrical stimulators and De-stimulators, spinal cord stimulator and cerebral stimulator

2. Diagnostics and Therapeutic Equipments

Principles and description of electronic and optical assembly, Principles and description of Endoscopes, Fiber optic endoscopes, Laproscope, Cystoscopes, Principles and description of Dialysis equipment – infusion pumps haemodialysers, Principles and description of Spirometry – Plathysmorgraphy.

3. Therapeutic Equipments for Cardiology

Defibrillators - basic principles, comparative study, energy requirement, synchronous operations, implantable defibrillators. Heart Lung machines – basic principles, catheters (Varieties & Use) Oxygenators.

4. Therapeutic Equipments (For ICU)

Ventilators – Anesthesia ventilators and critical care ventilators, oxygen and CO₂ analyzers, Pulse Monitors, ECG analyzers, Pulse Meters. Holter Monitors, Arrhythmia Monitors and analyzers.

5. LASER Technology

Basic concept about LASER, LASER coherence, its principle of operation, Properties, gain medium, pumping mechanism and resonator design, Types of LASER: pulsed ruby laser, ND YAG laser, argon laser and CO₂ laser. Applications of laser in medicine: control of gastric hemorrhage by photocoagulation, retinal detachment.

6. Diathermy equipment

Electrosurgical Equipments and Techniques. Electrotomy, fulguration, coagulation, desiccation, Electrosurgery units, spark gap valve, solid-state generator. Construction, Principle, Working of surgical diathermy and its safety aspects.

7. Neonatal Instrumentation

Incubator: Physiological heat balance, heat production and heat loss methods. Apnea detection. Photo therapy devices.

Recommended Books

1. R.S. Khandpur :Handbook of Biomedical Engineering
2. R.S. Khandpur :Introduction of Analytical Instruments
- 3 Carr and Brown :Introduction to Bio-medical Equipment Technology
- 4 Webster, JG :Biomedical Instrumentation : J.G. Webster

BM-308 BIOMATERIALS

Internal Marks : 40
External Marks : 60
Total Marks : 100

L T P
3 0 0

- 1. Introduction of different types of Biomaterials**
Polymers; Plastics; Metallic and Ceramic Biomaterial; Carbon and Polymer materials
Absorbable and porous biomaterials, with example; Surface chemistry of biomaterials, thermal and chemical phenomenon, piezoelectric effect.
- 2. Mechanical Properties and Tests**
For elasticity, plasticity, inelasticity, deformation and fracture.
- 3. Polymer and Plastics**
Classification, thermal properties, factors influencing polymer properties. Polymer compatibility, polymer degradation, resorbable polymers, tissue adhesives, dialysis membrane, sutures. Conducting polymers, Biodegradable polymers.
- 4. Metallic**
Properties and use to titanium alloys stainless steel, cobalt based alloys.
- 5. Carbon and Ceramic Biomaterials**
Carbon, Alumina, Surface reactive ceramics, degradable ceramics and composites.
- 6. Synthetic and Polymeric Biomaterials**
Polymers in Biomedical use, Polyethylene, Polypropylene, silicones rubber, acrylic implants, Hydrogels, Polyurethanes, Polyamides.
- 7. Biopolymers**
Collagens, Elastin, Mucopolysaccharides, Proteoglycans, Cellulose, Chitin etc.
- 8. Orthopedic Implants**
Alveolar bone replacements. Orthopedic implants – types of orthopedic function devices, permanent joint replacements, hip joint, bone cement, Biological testing of biomaterials.
- 9. Cardiovascular Implants and Extracorporeal Devices**
Blood clotting, Blood Rheology, Heart, Aorta, Valves, Lungs, Vascular Implants, Cardiac Pacemaker, Blood Substitutes, Kidney Function.
- 10. Prosthetic Devices**
Artificial limbs, hand and foot, dental prosthesis.
- 11. Sensory Devices:**
Intraocular Lens and hearing aids

Recommended Books

1. Sujata Bhat :Biomaterials, Narosa Publishing House, 2002
2. John G. Webber :Encyclopedia of Medical Devices and Instruments, Vol I-IV
3. David F. Williams :Biocompatibility of clinical implants materials, Vol. I
5. Cook AM and Webster J :Therapeutic Medical Devices
6. J.B. Park :Biomaterials – An Introduction , CRC Press, 1995

BM-310 COMMUNICATION ENGINEERING

Internal Marks : 40
External Marks : 60
Total Marks : 100

L T P
3 0 0

1. Spectral Analysis and Random Process

Spectral characteristics of periodic and aperiodic signal – Spectra of common signals related to communication – cross correlation – autocorrelation and power / energy density spectra – random signals and process – modelling noises.

2. Analog Modulation Systems

Basic principles of AM, FM, and PM – Spectra – power consideration – receivers characteristics and deduction of AM, FM, and PM and Systems performance – Threshold effects reduction.

3. Base Band Data Communication

Sampling and quantization – PCM, ADPCM, DM, ADM, Base band pulse shaping – binary data formats – base band transmission – ISI – correlative coding – optimum SNR – matched filter detection.

4. Digital Modulation

Digital modulation – coherent binary modulation techniques – coherent quadrature modulation techniques – non-coherent binary modulation – M-array modulation – performance of digital modulation systems based on probability of error – band width – ISI.

5. Spread Spectrum and Error Correction Techniques 9

Fundamental concepts – Direct sequence spread spectrums and frequency hopping spread spectrum – Block Codes – cyclic codes.

Recommended books

1. Bernald Sklan : Digital Communication Pearson Education, 2nd edition 2001.
2. Taub & Schilling : Principles of Communication, TMH, 1990.
3. Simon Haykins : Digital Communication, John Wiley, 2001.
4. B.P.Lathi : Analog and Digital Communication Systems, PHI, 1992.
5. Proakis : Digital Communication TMH, 1992.
6. A.B.Carlson : Communication Systems , TMH, 1992.
7. K. Sam Shanmugam : Digital and Analog Communication Systems , John Wiley, 1985.

CE-216 ENVIRONMENTAL SCIENCES

Internal Marks : 40
External Marks : 60
Total Marks : 100

L T P
3 0 0

Unit 1 :The Multidisciplinary nature of environmental studies

Definition, scope and importance
Need for public awareness.

Unit 2 :Natural Resources :Renewable and non-renewable resources :

Natural resources and associated problems.

- a) Forest resources :Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forests and tribal people.
- b) Water resources :Use and over-Utilization of surface and ground Water, floods, drought, conflicts and water, dams-benefits and problems.
- c) Mineral resources :Use and exploitation, environmental effects of extracting and using mineral resources, case studies.
- d) Food resources :World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies.
- e) Energy resources :Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. Case studies.
- f) 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.

Unit 3 :Ecosystems

- Concept of an ecosystem.
- Structure and function of an ecosystem.
- Producers, consumers and decomposers.
- Structure and function of an ecosystem.
- Producers, consumers and decomposers.
- Energy flow in the ecosystem.
- Ecological succession.
- Food chains, food webs and ecological pyramids.
- Introduction, types, characteristic features, structure and function of the following ecosystem :-
 - a. Forest ecosystem
 - b. Grassland ecosystem
 - c. Desert ecosystem
 - d. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Unit 4 : Biodiversity and its conservation

- Introduction – 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 conservation of biodiversity.

Unit 5 :`Environmental Pollution

Definition Causes ,effects and control measures of :-

- Air pollution
 - Water pollution
 - Soil pollution
 - Marine pollution
 - Noise pollution
 - Thermal pollution
 - Nuclear hazards
- Solid waste Management :Causes, effects and control measures of urban and industrial wastes.
 - Role of an individual in prevention of pollution.
 - Pollution case studies.
 - Disaster management :floods, earthquake, cyclone and landslides.

Unit 6 :Social Issues and the Environment

- 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.
- Environmental ethics :Issues and possible solutions.
- Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case studies.
- Wasteland reclamation.
- Consumerism and waste products.
- Environment Protection Act.
- Air (Prevention and Control of Pollution) Act.
- Water (Prevention and control of Pollution) Act
- Wildlife Protection Act
- Forest Conservation Act
- Issues involved in enforcement of environmental legislation.
- Public awareness.

Unit 7 : Human Population and the Environment

- Population growth, variation among nations.
- Population explosion – Family Welfare Programme.
- Environment and human health.
- Human Rights.
- Value Education.
- HIV /AIDS
- Women and Child Welfare.
- Role of Information Technology in Environment and human health.

- Case Studies.

Unit 8 : Field work

- Visit to a local area to document environmental and river forest grassland hill mountain.
- Visit to a local polluted site – Urban //Rural /Industrial /Agricultural
- Study of common plants, insects, birds.
- Study of simple ecosystems-pond, river, hill slopes, etc.(Field work Equal to 5 lecture hours)

**BM-312 BIOINSTRUMENTATION AND BIOMATERIAL
LAB**

Internal Marks : 30
External Marks : 20
Total Marks : 50

L T P
0 0 2

1. Nerve and muscle stimulator
2. Ultrasonic Stimulator
3. Electro-surgical stimulator
4. Functional electrical stimulator
5. To study the working of Spirometry, Plathysmogram
6. ECG Monitor
7. Pace maker (external and implantable, power source of implantable pacemaker leads and electrodes)
8. Demonstration of coronary care devices-coronary stents.
9. Dithermy equipment (Operation and Demonstration)
10. To study the properties of Titanium alloys/ stainless steel alloys/Cobalt alloys
11. To find the elastic strength & compression strength of bone
12. Determine the Young's Modulus of your hair strand
13. Materials used in dental prostheses and their strength.

Visit to Hospital / Medical Institute /Manufacturer's Workshop for Exposure

**BM-314 MICROPROCESSOR AND MICROCONTROLLER
LAB**

Internal Marks : 30
External Marks : 20
Total Marks : 50

L T P
0 0 2

1. Study of 8085 Microprocessor Kit.
2. Write a program to add two 8-bit number using 8085.
3. Write a program to add & subtract two 16-bit number using 8085 .
4. Write a program to subtract two 16-bit number using 8085 .
5. Write a program to multiply two 8 bit numbers by repetitive addition method using 8085.
6. Study 8086 Microprocessor kit
7. Write a program to control the operation of stepper motor using 8085/8086 microprocessors and 8255 PPI.
8. Write a program for finding square of a number using look-up table and verify.
9. Write a program to control the temperature using 8085/8086 microprocessors and 8255 PPI.
10. Write a program to control speed of DC motor using 8085/8086 microprocessors and 8255 PPI
11. Study of 8051/8031 Micro controller kits.
12. Write a program to add two numbers lying at two memory locations and display the result.
13. Write a program for multiplication of two numbers lying at memory location and display the result.
14. Write a program to check a number for being ODD or EVEN and show the result on display.
15. Study of Interrupt structure of 8051/8031 micro controllers.
16. Study of Interrupt structure of 8051/8031 micro controllers.
17. Write a program of Flashing LED connected to port 1 of the Micro Controller.
18. Write a program to generate a Ramp waveform using DAC with micro controller.
19. Write a program to interface the ADC.
20. Interfacing of high power devices to Micro-controller port-lines, LED, relays and LCD display.

BM-316 GENETIC ENGINEERING LAB

Internal Marks : 30
External Marks : 20
Total Marks : 50

L T P
0 0 2

1. Isolation of plasmid DNA and its visualization through electrophoresis.
2. Southern blotting
3. Transformation of cells
4. Identification of transformed cells
5. Isolation and analysis of RNA
6. Detection of MTB

BM-401/402 REHABILITATION ENGINEERING

Internal Marks : 40

External Marks : 60

Total Marks : 100

L T P

3 1 0

1. Introduction to Rehabilitation Medicine
2. Delivery of Rehabilitation Care: The Rehabilitation Team
3. Therapeutic Exercise Techniques
4. Sociolegal Aspects of Rehabilitation
5. Principles in Management of Communication Impairment
6. Behavioral and Learning Problems in the Disabled
7. Orthotics, Amputation and Prosthetics
8. Mobility Aids
9. Architectural Barriers
10. Vocational Rehabilitation
11. Rehabilitation of Pain, Paralysis, Congenital Malformations, Cerebral Palsy, Poliomyelitis, Brain Injury, Stroke, Peripheral Nerve Injuries
12. Role of Surgery in Rehabilitation
13. Rehabilitation of Paraplegia, Quadriplegia, Neurological, Cardio respiratory and Hematological Conditions
14. Rehabilitation of Burns, Arthritis, Fractures and Pain Syndromes

Recommended Books:

Sydney Litich :Therapeutic Exercise

Sydney Litich :Massage , Manipulation & Traction

William :Rehabilitation techniques, E. Prentice

Sunder S. :Text book of Rehabilitation, 2nd ed. Jaypee, 2002

Bronzino :The Biomedical Engineering Handbook,2nd ed. CRC,2000

BM-403/404 BIOMEDICAL SIGNAL PROCESSING

Internal Marks : 40
External Marks : 60
Total Marks : 100

L T P
3 1 0

1. Concepts

Signals and Signal Processing Characterization and Classification of Signals, Typical Signal Processing Operations, Examples of Typical Signals, Typical Signal Processing Applications.

2. Digital Filters

Structures : block diagram representation, signal flow-graph representation, equivalent structures, basic FIR digital filters, structures, state-space structures, all pass filters, tunable FIR digital filters, cascaded realization of FIR filters, parallel all pass realization of FIR Transfer functions, digital sine-cosine generator, computational complexity of digital filter structures. Design preliminary consideration, impulse invariance method of FIR filter design, bilinear transform method of FIR filter design of digital FIR notch filters, low pass FIR digital filter design examples, special Transformations of FIR filter design, Fourier Series, FIR Filters, FIR Filter, Design Based on Frequency Sampling Approach, Computer-Aided Design of Digital Filters.

3. Digital Signal Processors

Overview of Motorola DSP 563XXX family of digital signal processors architectures of DSP 56307 assembly language instructions and programming typical software applications.

4. Implementation, Applications

Implementation considerations : basic issues software implementation computation of the discrete fourier transform, the quantization process and errors, analysis of coefficient quantization effects analysis of coefficient quantization effects in FIR Filters representative applications : dial-tone multi frequency signal detection, analysis using short discrete fourier transform, musical sound processing, digital fm stereo generation, discrete-time analytic signal generation, voice privacy system, subband coding of speech and audio signals.

5. Neurological Signal Processing

Modeling of EEG signals, detection of alpha, beta, gamma rays Cardiology Signal processing – arrhythmia detection algorithms.

Recommended Books:

1. Sanjit K. Mitra : Digital Signal Processing A Computer Based Approach
2. Richard G Lyons : Understanding Digital Signal Processing
3. Proakis & Dimitris Manolakis : DSP Principles, Algorithms, and Applications

**BM-405/406 MEDICAL IMAGING AND IMAGE
PROCESSING**

Internal Marks : 40
External Marks : 60
Total Marks : 100

L T P
3 1 0

1. Digital Imaging Processing System

Image acquisition storage, processing, communication display. Visual perception: Structure of Human Eye, Image formation in human eye, brightness and contrast, adaptation and discrimination, Blocks-Law-and-critical fusion frequency, photographic film characteristics.

2. Image Mode

Uniform and non-uniform sampling, quantisation. Image enhancement : Image smoothing, point operators, contrast manipulation, histogram modification, noise clipping, image sharpening, spatial operators, frequency domain method, low pass and high pass filtering.

3. Image Transforms

DFT, Properties of 2nd Fourier Transforms, Sine and Cosine Transforms, Hadamass Transforms, Image Restoration : Degradation Model, Aprior knowledge required in restoration, inverse filtering, Weiner filtering, Interactive restoration. Image Segmentation : Detection of discontinuity, point line and edge detection and boundary detection, Thresholding, Image interpretation. Biomedical Application: Computer Tomography, Emission Tomography, CAT, Radon Transform, CAT, MRI Images, Processing of Radiograph, Angiogram, Sonography including Doppler, Projection Theorem, Back Projection.

Recommended Books:

1. R.C. Gonsatz :Digital Image Processing, R.E. Woods
2. Anil K Jain :Fundamentals of Image Processing
3. William Pratt :Digital Image Processing, John Wiley.

**BM-407/408 NUCLEAR MEDICINE AND RADIATION
SAFETY**

Internal Marks : 40
External Marks : 60
Total Marks : 100

L T P
3 1 0

1. Atomic Physics

Traditional definition of atom, periodic system of elements, mechanical properties of atom, Emission of light and its frequencies. Electromagnetic spectra.

Principles of Nuclear Physics, Natural radioactivity, Alpha, Beta and Gamma emission, Decay series, types of radiation and their applications, Units of radioactivity, Artificially produced isotopes and its application, accelerators; Radionuclides used in Medicine and technology.

2. Measurements of Radioactivity

Principle of radiation detectors, GM-Counters, Scintillation Counters, dot scanners, Nuclear angiogram, Radiation therapy.

3. Interaction of radiation with living cells

Interaction of radiation with matter, Linear Energy Transfer, Target theory, single hit and multi-hit target theory, Cellular effects of radiation damage, Direct and Indirect effects, DNA damage, Macromolecular synthesis, Chromosomal damage, Maximum permissible dose and dose limits for different organs..

4. Somatic Effects of Radiation

Radiosensitivity protocol of different tissues in human, LD 50/30 doses, effect of radiation on skin, blood forming organs, lenses of eye, embryo and Endocrinal glands.

5. Genetic effects of Radiation

Threshold of linear dose effect, relationship, factors affecting frequency of radiation induced mutation, Gene controlled hereditary diseases, biological effect of microwave and RF wave. Variation in Dielectric constant and specific conductivity of tissues. Penetration and propagation of Signal effects in various vital organs, Radiation Protection.

6. Radiation Safety

Radiation Protection Techniques, Safety Limits, Radiation Monitoring.

Recommended Books:

1. R..S Khandpur :Handbook of Biomedical Instrumentation, TMH, New Delhi, 1997.
2. Steve Webb :The Physics of Medical Imaging, Adam Hilger, Philadelphia, 1988.
3. Hendee and Ritenour : Medical Imaging Physics, 3rd ed., Mosby Year Book, St. Louis, 1992.
4. Casey : Biophysics
5. Chandra R : Introductory physics of Nuclear Medicine

**EC-316 DIGITAL SIGNAL PROCESSING
(using MATLAB)**

Internal Marks : 30
External Marks : 20
Total Marks : 50

L T P
0 0 2

Perform the following exercises using MATLAB™

1. To develop elementary signal function modules (m-files) for unit sample, unit step, exponential and unit ramp sequences.
2. To develop program modules based on operation on sequences like signal shifting, signal folding, signal addition and signal multiplication.
3. To develop program for discrete convolution and correlation.
4. To develop program for finding response of the LTI system described by the difference equation.
5. To develop program for computing inverse Z-transform.
6. To develop program for finding magnitude and phase response of LTI system described by system function $H(z)$.
7. To develop program for computing DFT and IDFT.
8. To develop program for computing circular convolution.
9. To develop program for conversion of direct form realization to cascade form realization.
10. To develop program for cascade realization of IIR and FIR filters.
11. To develop program for designing FIR filter.
12. To develop program for designing IIR Filter.

Recommended Books

1. Ingle V.K., Proakis :DSP using Matlab, Vikas Publication.

**BM-411/412 MEDICAL IMAGE PROCESSING
LAB**

Internal Marks : 30
External Marks : 20
Total Marks : 50

L T P
0 0 2

- 1 Study of ultrasonic transducers and displays.
- 2 Study of pacemaker.
- 3 Multichannel biotelemetry.
- 4 Shortwave and ultrasonic diathermy.
- 5 Multi-channel data acquisition system.
- 6 Simulation of biosignals.
- 7 Analysis of ECG signals.
- 8 Analysis of EEG signals.
- 9 Leakage current and electrical safety measurements.
- 10 Mini Project.

DE-1.3 HUMAN RESOURCE MANAGEMENT

Internal Marks : 40
External Marks : 60
Total Marks : 100

L T P
3 1 0

1. Introduction

Introduction to Human Resource Management and its definition, functions of Human Resource Management & its relation to other managerial functions. Nature, Scope and Importance of Human Resource Management in Industry, Role & position of Personnel function in the organization.

2. Procurement and Placement

Need for Human Resource Planning; Process of Human Resource Planning; Methods of Recruitment; Psychological tests and interviewing; Meaning and Importance of Placement and Induction, Employment Exchanges (Compulsory Notification of vacancies) Act 1959, The Contract Labour (Regulation & Abolition) Act 1970.

3. Training & Development

Difference between training and Development; Principles of Training; Employee development; Promotion-Merit verses seniority Performance Appraisal, Career Development and Planning.

4. Job analysis & Design

Job Analysis: Job Description & Job Description, Job Specification.

5. Job Satisfaction

Job satisfaction and its importance; Motivation, Factors affecting motivation, introduction to Motivation Theory; Workers ' Participation, Quality of work life.

6. The Compensation Function

Basic concepts in wage administration, company's wage policy, Job Evaluation, Issues in wage administration, Bonus & Incentives, Payment of Wages Act-1936, Minimum wages Act-1961

7. Integration:

Human Relations and Industrial Relations; Difference between Human Relations and Industrial Relations, Factors required for good Human Relation Policy in Industry; Employee Employer relationship Causes and Effects of Industrial disputes; Employees Grievances & their Redressal, Administration of Discipline, Communication in organization, Absenteeism, Labour Turnover, Changing face of the Indian work force and their environment, Importance of collective Bargaining; Role of trader unions in maintaining cordial Industrial Relations.

8. Maintenance

Fringe & retirement terminal benefits, administration of welfare amenities, Meaning and Importance of Employee Safety, Accidents-Causes & their Prevention, Safety Previsions under the Factories Act 1948; Welfare of Employees and its Importance, Social security, Family Pension Scheme, ESI act 1948, Workmen's Gratuity Act 1972, Future challenges for Human Resource Management.

Recommended Text Books

1. N. Bhagotiwala ;Human Resource Management, T.N.Chhabra, Dhanpat Rai & Co.
2. Lowin B. Flippo :Principles of personnel Management , TMH
3. R.C. Saxena - Labour Problems and social welfare, K.Math & Co.

CS-326 OPERATION RESEARCH

Internal Marks : 40
External Marks : 60
Total Marks : 100

L T P
3 1 0

1. OBJECTIVES

Importance of need to take intelligent decisions is to be emphasized. Using OR major focus should be on how to model various situations in industries and solve them.

2. COURSE CONTENTS:

Introduction to OR modeling approach and various real life situations. [5%] Linear programming problems and Applications, Various components of LP problem formulation. Solving Linear Programming problem using simultaneous equations and Graphical Method Simplex method & extensions :

Sensitivity analysis

Duality theory Revised

Simplex Dual Simplex

3. Transportation and Assignment Problems. [30%]

Network Analysis including PERT-CPM Concepts of network the shortest path minimum spanning tree problem maximum flow problem minimum cost flow problems The network simplex method Project planning & control with PERT & CPM [20%] Integer programming concepts, formulation solution and applications [10%]

Game Theory [10%] Queuing Theory & Applications [10%] Linear Goal Programming methods and applications [5%] Simulation [10%]

Recommended Books

1. D.S Hira. : Operation Research
2. D.S Sharma. : Operation Research
3. Hillier & Lieberman :Introduction to OR, TMH, Int. Series 1995
4. Ravindran :Introduction to OR, John Wiley & Sons, 1993
5. R.Kapoor :Computer Assisted Decision Models, TMH, 1991

BM-413/414 NEURAL NETWORKS AND FUZZY LOGICS

Internal Marks : 40
External Marks : 60
Total Marks : 100

L T P
3 1 0

- 1. Adaptive Linear Combiner**
Elementary Neurophysiology and Biological neural network- Artificial neural network, Adeline and Madeline.
- 2. Back Propagations and Associate Memory**
The perceptron, linear separability, Basic learning laws : Hebb's rule, Delta rule, Widrow & Hoff LMS learning rule, correlation learning rule, instar and outstar learning rules. Back propagation Network, generalized delta rule, Bidirectional associate Memory, Hopfield memory architecture.
- 3. Boltzmann's Machines and Counter Propagation Network**
Simulated Annealing, Boltzman completion network, Boltzman input output network, counter propagation network.
- 4. Self Organizing Maps and Adaptive Resonance Theory**
Self organizing map, feature map classifier, adaptive resonance theory network, ART1, ART2.
- 5. Spatiotemporal Networks and Neocognitron**
Architecture of Spatiotemporal networks, Sequential competitive avalanche field, Neocognitron Architecture and data processing.
- 6. Applications of neural nets such as pattern Recognition**
Optimization, associative memories, vector quantization, control, Applications in speech and decision making.
- 7. Fuzzy Logic**
Basic concepts of Fuzzy Logic, Fuzzy vs Crisp set, Linguistic variables, membership functions, operations of fuzzy sets, fuzzy IF-THEN rules, variable inference, techniques, defuzzification techniques, basic fuzzy inference algorithm, Applications of fuzzy logic, Fuzzy system design, Implementation of fuzzy system, Useful tools supporting design.

Recommended Books

1. Freeman & David. Skapura :Neural networks, Algorithms applications and programming techniques, , Addison Wesley, 1991. ISE Reprint, 1999.
2. David M. Skapura :Building Neural Networks, Addison Wesley, 1996.
3. Bose :Neural Network Fundamentals with graphs, algorithms and applications TMH, 1995.
4. Riza Berkin & Trubatch :Fuzzy Systems Design Principles, Building Fuzzy IF-THEN Rule Bases
5. Vegna Narayanan :Artificial Neural Networks
6. Bart Kosko :Neural Networks & Fuzzy Logic
7. Simon Haykin :Neural Networks

CS - 312 COMPUTERS AND SOCIETY

Internal Marks : 40
External Marks : 60
Total Marks : 100

L T P
3 1 0

PREREQUISITES : RDBMS-I & Computer Networks-I.

OBJECTIVES:

To study the impact of the large scale introduction of computers on the cultural social and political environment of a country.

To discuss ethical and moral issues of concern to computer scientists and engineers.

COURSE CONTENTS:

A survey of a variety of computer application. [15%]

Impact of introduction of computers and its impact on privacy and security [15%]

Networking of computers and its impact on privacy and security [15%]

Information integrity [10%]

Ethical issues arising out of creation of computer viruses trojan horses etc. [10%]

Intellectual property rights in relation to computer v hardware and software.[15%]

Data banks and their impact on society. [10%]

The role of computer in education. [10%]

Recommended Books

1. Weizenbaum, J. : Computer Power and Human Reason: from judgement to Calculation. W. H. Freeman, San Francisco, 1976.
2. Dunlop and Kling : Computerization and Controversy: Value Conflicts and Social Choices, Boston Academic Press, 1991

BM-415/416 COMPUTERS IN MEDICINE

Internal Marks : 40
External Marks : 60
Total Marks : 100

L T P
3 1 0

- 1. Overview of Computer Hardware PC-AT**
8086 architecture, system connections, Instruction set & programming, Microcontrollers, Motherboard and its logic, RS232-C and IEEE bus standards, CRT controllers, FDC, HDC and Post sequence, PC based video card, modems and networking.
- 2. System Design**
Multichannel Computerised ECG, EMG and EEG data acquisition, storage and retrieval, transmission of signal and images.
- 3. Computers in Patient Monitoring**
Physiological monitoring, automated ICU, computerised arrhythmia monitoring, Information flow in a clinical lab, computerised concepts, Interfacing to HIS.
- 4. Computers in Medical Systems Modeling**
Radiotherapy, Drug design, Drug delivery system, Physiological system modeling and Simulation.
- 5. Computers in Medical Research**
Role of expert systems, Pattern recognition techniques in medical image classification, ANN concepts.

Recommended Books:

1. R.D.Lele :Computers in Medicine, TMH, New Delhi, 1999.
2. Douglas V.Hall :Microprocessors and Interfacing: Programming and hardware, TMH, Singapore, 1999.
3. Minappa and Saiyada : Personnel Management , TMH New Delhi
4. Mamoria :Personnel Management., Himalaya Publishing House, Bombay
5. N. Bhagotiwala :Economics of Labour and Industrial Relations, Sahitya Bhawan, Agra.

BM-419/420 HOSPITAL MANAGEMENT

Internal Marks : 40
External Marks : 60
Total Marks : 100

L T P
3 1 0

- 1. Need and Scopes of Clinical Engineering**
Clinical engineering program, educational responsibilities, role to be performed by them in hospital, staff structure in hospital.
- 2. National Health Policies**
Need for evolving health policy, health organization in state, health financing system, health education, health insurance, health legislation.
- 3. Training and Management of Technical Staff in Hospital**
Difference between hospital and industrial organization, levels of training, steps of training, development training program, evaluation of training, wages and salary, employee appraisal method.
- 4. Standards and codes in Health Care**
Necessity for standardization, FDA, Joint Commission of Accreditation of hospitals, ICRP and other standard organization, methods to monitor the standards.
- 5. Computer in Medicine**
Computer application in ICU, X-Ray department, laboratory administration, patient data, medical records, communication, simulation.

Recommended Books

1. Webster and Cook: Clinical Engineering Principle and Practice, Prentice Hall Inc., New Jersey, 1979.
2. Goyal R.C : Handbook of hospital personal management, Prentice Hall of India, 1996

BM-421/422 PHYSIOLOGICAL MODELLING

Internal Marks : 40
External Marks : 60
Total Marks : 100

L T P
3 1 0

1. Introduction

System concept, system properties, piece-wise Linear approximation, electrical analog for compliance, thermal storage, pulse response of first order systems, response of resistant and compliance system.

2. Transfer Functions

Transfer functions and its use, engineering concept in coupled system, example of Transformed signals.

3. Impedance Concept

Circuits for the transfer function with impedance concept, prediction of performance, periodic signals.

4. Feedback Systems

Characteristics of physiological feedback systems, uses and testing of system stability.

5. Simulation of Biological Systems

Simulation of thermal regulation, pressure and flow control in circulation, oculo motor system, endocrinal system, functioning of receptors.

Recommended Books

1. Manfredo and Milsum : Bio-medical engineering system, TMH (New York),1969.
2. William B.Blessner : A System approach to Bio-medical timore, 1970.
3. Douglas S.Reggs : Control theory and physiological feedback mechanism, The William & Williams Co.

BM-423/424 MEDICAL INFORMATICS

Internal Marks : 40
External Marks : 60
Total Marks : 100

L T P
3 0 0

1. **Introduction to Medical Informatics**
2. **Medical Data, Information and Knowledge**
Medical data, Medical information, Knowledge and Models, Information and Communication, Uncertainty of Medical Data, Systems, Medical Computer Systems- Systematization of Computer Applications
3. **Databases**
Database Management, Classification of Medical Data and Information, Examples of Classification Systems.
4. **Health Care Information Systems**
Electronic Patient Record, Electronic referral-Consulting system, Primary Care Systems, Clinical Departmental Information Systems, Clinical Support Systems, Nursing Information Systems
5. **Information Safety and**
Information Safety and Security in Health Care Information Systems, Evaluation of Health Information Systems and Technology
6. **Medical Decisions- Support Systems**
Rationales for Computer- aided Decision making, Decision making, Decision Models- Quantitative Models, Qualitative Models, Knowledge Based Systems- Characteristic features of Knowledge Based Systems, Knowledge Representation , Artificial Intelligence Methods

Recommended Books

1. Van Bommel and Musen : Handbook of Medical Informatics. Bohn Stafleu Van Loghum, Houston, 1997 .
2. Enrico Coiera : Guide to Medical Informatics, the Internet and Telemedicine, Chapman & Hall, Medical, London,1997.
3. Bronzino JD : The Biomedical Engineering Handbook, IEEE Press, 2000.

**BM-425/426 FIBER OPTICS AND LASERS IN
MEDICINE**

Internal Marks : 40

External Marks : 60

Total Marks : 100

L T P

3 0 0

1. Introduction to Fiber Optics

Basic fiber link, Applications, Principles of light : Introduction, EM spectrum, Light as wave, Light as a Particle, Speed of light, Internal and External Reflections, Snell's Law, Optical Fiber, Numerical Aperture.

2. Optic Fiber and its Properties

Basic Fiber Construction, Propagation of Light, Modes of Operation, Refractive Index Profile, Types of Fibers, Dispersion, Data rate and Bandwidth, Attenuation Losses.

3. Connectors, Splices and Couplers

Splices: Mechanical, fusion, Protection of splice. Connectors : SMA, STC, Bionic etc coupling : Passive, Stan, TEE types. Optical Sources and Photo Detectors : Creation of Photons, LED, ILD. Photodetectors : PIN photodiode, Avalanche Photodiode, Photodiode parameters, Detector Noise, Speed of Response, SNR.

4. Modulation Scheme for Fiber Optics Transmission

Digital Modulation, Analog Modulation, Schemes, Multiplexing.

5. Laser Systems

Types of Lasers, Solid state Lasers, Gas Lasers, Dye Lasers. Lasers used in Medical Practice: Ruby Laser, CO2 Laser, Nd-YAG laser ad related solid state laser.

6. Laser-Tissue Interaction

Spectral Band Designations, Energy and Power, Irradiant and Radiant Exposure, fluence, Thermal diffusion Fibers and contact tip, Types of Tissue-Laser Interaction: Photocoagulation, photochemical ablation, Photo-disruption, Photochemical Interaction.

7. Laser Application in Medical Therapy

Applications in General Surgery, Dermatology, Ophthalmology, Cardiovascular and Chest surgery, Dentistry, Neuro surgery, Otolaryngology, Head and Neck surgery, Tumor Surgery, Gynecologic Laser.

Recommended Books

1. David Bacter : Therapeutic Lasers- Theory and Practice, Churchill Livingstone, 1997
2. Shiney, Stephen & Trokel: Medical Lasers and their safe use, Springer-Verlag, 2001
3. Wymer, SL : Elements of Fiber Optics, Regents-Prentice Hall Pub.
4. Katzer and Abraham : Laser and Optical Fibers in Medicine, Academic Press.
5. Cherin AM : An Introduction to optical fibres, MGH