Punjab Technical University
Course contents for
B.Tech (Bio-Medical Engg)

3rd Semester

Course Code	Course Title	Hours	Per	Week	External Marks	Internal Marks	Total
		L	T	P			
BM-201	Basics of Bio Technology	4	-	-	60	40	100
BM-203	Anatomy & Physiology	4	1	-	60	40	100
BM-205	Electronic Devices & Circuits	4	1	-	60	40	100
BM-207	Bio Chemistry	4	1	-	60	40	100
BM-209	Histology	4	1	-	60	40	100
BM-211	Bio Chemistry Lab	-	-	2	20	30	50
BM-213	Anatomy & Physiology Lab	-	-	2	20	30	50
BM-215	Electronic Devices & Circuit Lab	-	-	2	20	30	50
	Workshop Training				40	60	100
	Grand Total	**20**	**4**	**6**	**400**	**350**	**750**

Contact Hours: 30

4th Semester

Course Code	Course Title	L	T	P	External Marks	Internal Marks	Total
AM-201	Applied Mathematics-III	4	1	0	60	40	100
BM-202	Analog & Digital Electronics	4	1	-	60	40	100
EE-201	Network Analysis & Synthesis	3	2	-	60	40	100
EC-206	Signals & Systems	3	1	-	60	40	100
BM-204	Physical Biochemistry	4	1	-	60	40	100
BM-206	Biomedical Instrumentation-I	4	1	-	60	40	100
BM-208	Lab IV - Analog & Digital Electronics Lab	-	-	2	40	60	100
BM-210	Lab V - Biochemistry Lab	-	-	3	20	30	50
BM-212	Lab VI - Biomedical Instrumentation Lab	-	-	2	20	30	50
	General Fitness					100	100
	Grand Total	**22**	**7**	**7**	**380**	**420**	**800**

Contact Hours: 36

5ᵗʰ Semester

Course Code	Course Title	L	T	P	External Marks	Internal Marks	Total
BM-301	Clinical Sciences	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	Control System in Medicine	3	1	-	60	40	100
BM-309	Tissue Engineering.	3	1	-	60	40	100
BM-311	Biomechanics	4	0	-	60	40	100
BM-313	Lab-VII Medical Imaging & Clinical Sciences	-	-	2	20	30	50
BM-315	Lab-VIII T Numerical Methods & Computer Programming	-	-	2	20	30	50
BM-317	Lab-IX Tissue Culture	-	-	2	20	30	50
	Industrial training	-	-	-	40	60	100
	Grand Total	**19**	**5**	**6**	460	390	**850**

Contact Hours: 30

6ᵗʰ 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 Con-trollers & Embedded System	3	1	-	60	40	100
BM-306	Biomedical Instrumentation-II	3	1	-	60	40	100
BM-308	Biomaterials	4	-	-	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 Biomaterial	-	-	2	20	30	50
BM-314	Lab-XI Microprocessors & Microcontroller	-	-	2	20	30	50
BM-316	Lab-XII Genetic Engineering.	-	-	2	20	30	50
	General Fitness					100	100
TOTAL		**19**	**5**	**6**			**850**

Contact Hours : 30

BM- 201   Basics of Biotechnology

Internal Marks : 40	**L T P**
External Marks : 60	**4 0 0**
Total Marks : 100	

1.   Introduction of Life
       Characteristics of living
       A hierarchy of organization and factors responsible for regulating different levels of organisms.
       Cellular basis of life
2.   Structure and Functions of Macromolecules:
       Carbohydrates.
       Lipids
       Proteins
       Nucleic acids
3.   Enzyme as biocatalysts :
       Structure and Functions, Factors affecting activities of enzymes
4.   Plant Anatomy and physiology:
       Parts of a flowering plant and their functions with special reference to their role in
       Absorption
       Nutrition
       Photosynthesis
       Reproduction
       Growth regulators
5.   Genetics:
       Mitosis and Meiosis
       Bio-chemical basis of inheritance
       Central Dogma
6.   Evolution:
       Theories of evolution Gene Pool and genetic basis of variation
7.   Ecology:
       Basic concept, ecosystem, energy cycles, population growth patterns
8.   Introduction to Biotechnology:
       Definition
       Scope and achievement
       Tools used in biotechnology
9.   Genetic Engineering
       Element: Knowledge of Recombinant DNA
       BIO-Informatics and Genomics
10.   Applications of Biotechnology in
       Agricultural
       Medicine
       Environment.

Recommended Books:

1.   Life Scene of Biology y by Williams K.Purves. David Sadava.Gordon H.Orians and H.Criag Heller W.H.Freman &Company ISA 6th edition (2001)
2.   Cell Biology and Genetics by Cecic Starr and Ralph Taggard Brokks/ Cole. Thomson Learning USA :9TH Edition (2001)
3.   A Text Book of Biotechnology by H.D. Kumar, Affiliated East-West Press. Private Ltd New Delhi,2nd Edition (2002)
4.   Basic Biotechnology by Rev Fr.Dr.S.Ignacimuthu.Tata McGrawhill Publication Company Ltd., New Delhi (2002)
5.   Genes VII by Benjamin Lewis Oxford univ.Press (2002).

BM-203   Anatomy & Physiology

Internal Marks : 40   **L T P**
External Marks : 60   **4 1 0**
Total Marks   : 100

ANATOMY
Introduction of anatomy and Histology, Elementary Histology of cell, Tissues of the body organs and system, Elementary Anatomy and Histology of :-Skeletel System :Development of bones, types of bones, Micro-anatomical and gross structure of bones, Osteology of human skeleton and various movement of joints.
Muscular System: Structure and type of muscles in human body, important muscles and their group action.
Criculation System: Structure of heart and blood vessels, Systemic criculation, pulmonary circulation, Portal criculation, and coronary circulation.Lymphatic System:Lymph vessels, Lymph nodes and Lymphoid organs, their
structure and functions.

Elementary Anatomy and Histology of Digestive System: Gastrointestinal tract and associated glands (Salivery Glands, Liver, Pancreas etc).Respiratory System:Trachea, Lungs including other air passages.Urinary System, Kidney, ureter and urinary bladder etc..Endocrine System:Thyroid glands, Parathyroid glands, Adrenal glands and Pituitary glands. i.Femal and Male reproductory organs System. Skin and its appendages, Special sense organs: Eye, Ear, Nose Taste buds, Subcutaneous sense organs.
l.Nervous System: Brain, Spinal cord and peripheral nerves.

Physiology of Blood:
Blood volume, composition and function of blood, haemopoesis, blood coagulation, blood groups, body fluids. Cardiovascular System :General plan of circulatory system, function of heart and blood vessels (arteries, arterioles, capillaries and veins) heart sound and E.C.G. nervous control of heart and blood vessels, regular of blood pressure. Respiratory System: Functional anatomy of respiratory system, mechanism of breathing and exchange of gases in the lungs. Regulation of respiration, Oxygen and. carbondioxide carriage, anoxia, dysproes, cyanisis, artificial respiration and pulmonary function test. Gastrointestinal System : Alimentary canal and its various glands, digestion of food in mouth, stomach and small intestines, gastro-intestinal tract movements and absorption. Function of liver and liver function tests and metabolism.

Physiology of Excretory System: Structure and function of kidney and Urinary bladder, Structure and function of skin.Endocrine Glands & Reproductive System: Endocrine glands and their function. Regulation of endocrine secreation. Physiology of male and female reproductive System. Muscular System: Types of muscles, innervation of muscles, neuromuscular transmission, mechanism of muscular contraction. Nervous System : 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, automatic nervous system, Physiology of vision, hearing test and olfaction.

Recommended Books :

1.   Experimental Physiology, Rastogi, S.C. (New Age)
2.   Textbook of Human Physiology, Singh H.D. (S.Chand)
3.   Animal Physiology & Bio Chemistry, Agarwal R.A. (S.Chand)
4.   Introduction to Animal Physiology, Kay, Ian (Viva)
5.   Textbook of Human Physiology, Subramunyam (S.Chand)
6.   Textbook of Human Anatomy, Ranganathan, T.S. (S.Chand)

BM- 205   **Electronic Devices And Circuits**

Internal Marks : 40   **L   T   P**
External Marks : 60   **4   1   0**
Total Marks   : 100

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.   Electronics Devices & Circuits, Salivaahanan, S. (TMH)
2.   Electronics Devices & Circuits -Millman, Jacob (TMH)
3.   Electronics Devices & Circuits, Gupta, J.B. (Kataria)
4.   Electronics Devices & Circuits,-Boystad (New Age)
5.   Electronics Devices & Circuits, Bell, David (AHI)

BM-207   Bio Chemistry

Internal Marks : 40   **L   T   P**
External Marks : 60   **4   1   0**
Total Marks : 100

1.   Biomolecules : Chemistry and properties of amino acids, proteins, carbohydrates, lipids, purines, pyrimidines and vitamins.

2.   Chemical Bonds : Covalent bonds, ionic bonds, co-ordinate bonds, hydrogen bonds, vander waal forces, hydrophobic interactions, diode interactions.

3.   Proteins : Primary, secondary, tertiary and quaternary structure, proteins analysis, methods for isolation and purification of proteins.

4.   Fat Metabolism : Oxidation of fatty acids, synthesis of fatty acids (fatty acid synthesis complex system), ketone bodies

5.   Carbohydrates Metabolism : Glycolysis, glycogenolysis, glycogenesis and their regulations, citric acid cycle.

6.   Amino acid Metabolism : Oxidative degradation and synthesis of amino acids, estimation of amino acids.

7.   Nucleic Acid Metabolism : Biosynthesis of purines and pyrimidines, their regulation and catabolism.

8.   Mitochondria : Structure of mitochondria, organization of respiratory chain, oxidative phosphorylation and its inhibitors.

9.   Plant & Microbial Biochemistry : Photosynthesis, differences in respiratory mechanisms and anherobes.

10.   N2-fixation : role of various enzymes in Nitrogen cycle.

Books

1.   B.D. Hames et al : Instant Notes in Biochemistry, BIOS Sci. Pub. Ltd. U.K. (2001)
2.   G.Zubay : Biochemistry, W.C. Brown Publishers, Oxford England (1993)
3.   L. Stryer : Biochemistry, W.H. Freeman and Company, New York (1995)
4.   A.L. Lehninger : Principles of Biochemistry, worth publishers, New York (1994)

BM-209   **Histology**

Internal Marks : 40		**L T P**
External Marks : 60		**4 1 0**
Total Marks : 100		

Part "A"
GENERAL HISTOLOGY

1. Histology, its scope in Veterinary sciences and bearing with other faculties.
2. The structure of cell, organelles and inclusion bodies.
3. Cell Division
4. The epithelium, definition and classification and modification of epithelia.
5. Classification of glands.
6. The connective tissue: definition and classification of connective tissues. The Embryological and adult forms of connective tissues
7. Specialized connective tissue, the reticular, the adipose and pigmented Connective tissues.
8. Cartilage; structure and different types of cartilages.
9. General histology of the bone.
10. Histology of blood cells.
11. The muscular tissue, various types, their characterization and identification under microscope.
12. Nervous tissue, different types of neurons, nerve fibers and glial cells.
13. Histological structures of cerebral cortex, spinal ganglion and autonomic ganglion

Part "B"
SYSTEMATIC HISTOLOGY

1. Histology of the lips, cheek, teeth and tongue.
2. Histology of the pharynx, oesophagus and stomach.
3. Histology of the intestine and salivary glands.
4. Histology of Liver and Pancreas.
5. Histology of various divisions of the nasal cavity, larynx, fruchea and bronchi.
6. Histology of bronchus, bronchioles, respiratory structures of lung and blood air barrier.
7. Histology of the kidney, ureter and urinary bladder.
8. Histology of the testis and ducts of the male genital system.
9. Histology of the penis and accessory genital glands.
10. Histology of the female genital glands, ovary, Fallopian tubes, uterus, vagina and vulva.
11. Histology of mammary glands and adrenal glands.
12. Histology of thyroid and parathyroid glands.
13. Histology of the thymus, spleen and lymph glands. 14. Histology of pericardium, heart and conduction system. 15. Histology of arteries, veins and lymphatic.

Recommended Books :
- A Text Book of Histology, Rudolf Krause (Rebman)
- A Text Book of Histology, Arthur Clarkson
- Robbins S.L. & Ramzi S.C., "Pathologic Basis of Diseases, W. 1999
- Anatha Narayanan. R. & Jayaram Panicker C.R., 'Text Book of Laongman'1988

BM-211 Bio Chemistry Lab

Internal Marks : 30   **L T P**
External Marks : 20   **0 0 2**
Total Marks   : 50

1.   Preparation of solutions of different moralities and normalities.

2.   Preparation buffers of different range and checking of p 11

3.   Isoelectric point of casein.

4.   polyacrylamide gel electrophoresis

5.   Blood chemistry- separation of serum, preparations of plasma, estimation of blood glucose,

        urea and cholesterol.

6.   Liver function tests- SGOT, SGPT, Alkaline phosphates

7.   Estimation of bilirubin

8.   Use of centrifuge, simple, ultra centrifuge.

9.   Use of HPLC for separation.

10.   Use of GLC for separation.

BM-213   **Anatomy & Physiology Lab**

Internal Marks : 30   **L T P**
External Marks : 20   **0 0 2**
Total Marks   : 50

     Lymphocytes, lymph nodes- functional aspect, stem cells

D.Slides/ Charts (III),,Kinesiology, Functional Aspects of Joints

CNS, CSF circulation D. slides/ Charts (III) , Functional Areas of CNS

Eye and Ear, Dental Anatomy ,Para nasal sinuses, Circulatory system, X-ray study of

Anatomy, Determine HR via palpation of the radical artery

Determine blood pressure using a manual sphygmomanometer   ECG electrode

placement and skin preparation

Recommended books :

EXPOGY-RASS.Ce-Experiemental Physiology, Rastogi, S.C. New Age

TEXOGY-SINH.De-Textbook of Human Physiology, Singh, H.D. S.Chand

BM-215 Electronic Devices and circuits Lab

Internal Marks: 30   **L   T   P**
External Marks:20   **0   0   2**
Total Marks: 50

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.

13.   Study the working of electronic stethoscope, Digital Thermometer, Audiometer and hearing aids.

.

AM 201 MATHEMATICS-III

Internal Marks: 40   **L T P**
External Marks: 60   **4 1 0**
Total Marks: 100

Detailed Contents

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 of various standard functions, properties of Laplace transforms, inverse 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 Power series solution of differential equations, Frobenius method, Legendre's equation, 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.

Books

Advanced Engineering Mathematics by Kreyszing Erwin ; Wiley Eastern, New Delhi

Higher Engineering Mathematics by BS Grewal : Khanna Publishers, New Delhi.

Numerical Solutions of Differential Equations by NK Jain ; Prentice Hall, Delhi.

Differential Equations by Sharma and Gupta ; Krishna Prakashan Media (P) Ltd., Meerut.

BM-202   Analog & Digital Electronics

Internal Marks:40   **L   T   P**
External Marks:60   **4   1   0**
Total Marks:100

Part A
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.

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.

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

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

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 :

1)   Electronic Devices & Circuits by Millman – Jacob Halkias, T Mcgraw Hill, 1967.
2)   Electronic Devices & Circuits Theory by Robert Boylestad and Louis Nashelsky, 2005.
3)   Electronic Devices & Circuits by Allen Mottorshead, PHI
4)   Digital principle and applications by Malvino (TMH)
5)   Modern digital electronics by R.P.Jain ,2006, T McGraw Hill(PIH)
6)   Digital electronics principle by Malvino (THM)
7)   Modern digital systems design by Cheung &-----(WPC)

8)   Microelectronics by Botker

EE-201   **Network Analysis & Synthesis**

Internal Marks : 40   **L   T   P**
External Marks : 60   **3   2   0**
Total Marks : 100

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 Nortan's Maximum Power Transfer, Reciprocity.

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 behaviors from poles and zeros. Convolution Theorem.

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.

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

EC-206   **Signals and Systems**

Internal Marks:40   **L   T   P**
External Marks:60   **3   1   0**
                              Total Marks:100

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.

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.

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, Gaussion 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.& elimination.

Recommended Books
1.   Communication Signal and Systems by Simon Haykin, 2nd ed., John Wiley, New York
2.   Signal and Systems by Oppenheim and Willsky, Pearson, 2nd ed., 2003.

BM-204   Physical Biochemistry

Internal Marks : 40   **L T P**
External Marks : 60   **4 1 0**
Total Marks   :   100

Kinetic Theory of Gases
Molecular motion, Kinetic theory of gases. Maxwell-Boltzmann Distribution Law
Transport phenomena
Active & Passive Transport, Fick's laws of diffusion, diffusion equation, Applications to biochemistry: Donnan membrane Equilibrium
Chromatography
Theory, operations and applications of Partition, Adsorption, Ion Exchange and Affinity Chromatography. Thin layer and column Chromatography, GLC and HPLC, DNA Cellulose Chromatography.
Sedimentation
Theory of velocity sedimentation, preparative and analytical ultracentrifugation, factors affecting sedimentation velocity, sedimentation coefficient, Determination, of Molecular wt. by Sedimentation equilibrium, Density gradient, Applications of density gradient.
Electrophoresis
Theory, operations and applications, Electrophoresis on paper, cellulose acetate and gel. SDS-PAGE, Agarose gel electrophoresis, Electrophoretic transfers – Southern, Northern & Western, Isoelectric focusing, Combined electrophoresis and chromatography-Finger printing, Pulse field electrophoresis.
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
Light Scattering : Zim plot, flow birefringence.
Absorption Spectroscopy: Theory of light absorption, Absorption by bimolecules Instrument Used for measurement of light / UV light ; structural analysis of DNA and Proteins using absorption of light, CD and ORD, Infrared spectroscopy.
Diffraction Techniques: X-ray Diffraction, Electron Diffraction, Neutron Diffraction, Crystal structures, Space symmetry groups, Structural determination of biomacromolecules.
Thermodynamics: Laws of Thermodynamics, Thermodynamics of solutions, Gibbs-Duhem equation, Biological Thermodynamics
Bioenergetics : Production of energy in biological systems, high energy bonds, free energy coupling processes in biology, redox Potentials in biology & Significance, Electron Transport Chain, Properties of dehydrogenases and Cytochromes.
Cell Signalling and mechanism of hormone action, Signal Transduction - Role of cAMP, cGMP, Ca^{2+}, Inositol Triphosphate, Diacyl Glycerol, Ca^{2+} Homeostasis.
Recommended Books
1.   Physical Biochemistry by David Frifelder, Wiley, New York, 1998.
2.   Biophysical Chemistry I & III by Cantor and Schimmel,1985.
3.   Proteins – Structure and Molecular Principles by T.E. Criesghton.
4.   Biophysical Chemistry by A.G. Marshal, Wiley New York, 1985..
5.   The tools of Biochemistry by Terrance G. Cooper.
6.   Biochemistry by Voet and Voet, Wiley, New York, 2004.
7.   Physical Chemistry with application to life Sciences by D. Eisenberg and D Crothers, Benjamin /Cunningham Pub. Co. 1971.

BM-206   Biomedical Instrumentation-I

Internal Marks : 40   **L   T   P**
External Marks : 60   **4   1   0**
Total Marks   : 100

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, Bio-electrodes, electrodes tissue interface, contact impedance, effects of high contact impedance, Biomedical recorders; Recording Systems; Different types of electrodes; Ag-AgCl electrode, pH electrodes and their uses.

Physiological Transducers
Biological sensors in human Body, Physiological monitoring, Need for sensor system in diagnosis.
Transducers for Biomedical Application: Resistive transducers Strain gauge, Potentiometers, humidity, thermistors; Inductive Transducers – LVDT; Capacitive Transducers, Photoelectric Transducers ; Piezoelectric Transducers; Chemical Transducers, Optical Transducers, Biosensors, Smart sensors .

Patient Monitoring and diagnostic Systems
Digital Pulse Monitor, Digital Heart Rate Monitor, Diagnostic Aids Electronic Stethoscope, Digital Tele - Thermometer, ECG, EEG, Electromyograph, Digital Electronic ergometer, Biomonitors.

Electrical Instruments
Blood Flowmeters, Cardiac Output Measurement, Pulmonary Function Analysers, Clinical Laboratory Instruments, Blood Gas Analyzers, Blood Cell Counters, Audiometers and Hearing Aids.

Recommended Books
1. Medical Instrumentation by John. G. Webster -John Wiley and sons, 3rd ed., 2004
2. Principles of Applied Biomedical Instrumentation by L.A.Geddes &L.E. Baker – John Wiley.1967
3. Biomedical Instrumentation & Measurement by J.J. Carr & Brown-Pearson
4. Biomedical Instrument by Cromwell et al.-Pearson Edu., N. Delhi, 2nd ed, 2003
5. Handbook of Biomedical Instrumentation by R.S. Khandpur, TMH, N. Delhi 2nd ed. 2003.
6. Medical Electronics and Instrumentation by Sujay Guha - University Publication
7. Introduction to Biomedical Electronics by Edward J. Bukstein -sane and Co. Inc. USA.
8. Instrumentation Devices and Systems by C.S. Rangan, -TMH, N. Delhi.
9. Transducers for Biomedical Measurements: Principles and Applications by R.S.C Cobbold –Wiley, New York.

BM-208   Lab-I   Analog & Digital Electronics Lab

Internal Marks : 30　　　　　　　　　　　　　　　　　　　**L   T   P**
External Marks: 20　　　　　　　　　　　　　　　　　　　　**0   0   2**
Total Marks   : 50
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 ofa J-K flip-flop (7476)
　　　(a) Verify the truth table ofa D flip-flop (7474) and study its operation in the toggle and asyneronous modes.

BM-210　　　　　　　Biochemistry Lab

Internal Marks : 30　　　　　　　　　　　　　　　　　　　**L   T   P**
External Marks : 20　　　　　　　　　　　　　　　　　　　　**0   0   3**
Total Marks   : 50

1.　　Separation of amino acids by ion exchange chromatography,
2.　　Separation of proteins by ion exchange chromatography / partition chromatography/ gel filtration
3.　　Separation of lipids by thin layer chromatography
4.　　Preparation of an affinity column.
5.　　Polyacrylamide gel electrophoresis.
6.　　SDS electrophoresis and Molecular Weight determination
7.　　Raising of antisera and showing Ag-Ab reactions by immunoelectrophoresis and immunodiffusion methods.
8.　　Verification of Lambert-Beer's Law
9.　　Validity of Lambert-Beer's Law for chlorimetric estimation of Creatinine
10.　　Quantitative estimation of amino acids using the Ninhydrin reaction
11.　　Estimation of carbohydrate by the anthrone method
12.　　The Saponification value of a fat.
13.　　Lipidogram of serum
14.　　Isolation of bacterial DNA

BM-212   Biomedical Instrumentation Lab

Internal Marks : 30	**L T P**
External Marks : 20	**0 0 2**
Total Marks : 50	

1.   Measurement of Waveform, amplitude, duration and frequency using CRO, Triggering of beam with external signal
2.   Demonstration of OHP & LCD projectors and their maintenance
3.   Use of simple microscope, Calculation of magnification, Illustrations of parts and functions
4   Demonstration of electron microscope and illustration of electronic parts, function and assemblies.
5.   Use of various types of transducers and their maintenance.
6.   To set up animal experiment and measure pressure, temperature, distance, volume etc using transducers
7.   Study of autoanalysers, illustration of parts and functions
8.   Study the working of Electronic Stethoscopes, Digital Thermometers, E.C.G. Audio-meters and Hearing aids, biomonitors and pH meters.

Note: Visit to nearby hospitals/Central Instrumentation Labs can be made for demonstration

BM-301   Clinical Sciences

Internal Marks :   40   **L T P**

    External Marks :   60   3   1   0
Total Marks   : 100

Basis of Common Disease and Clinical Investigations
Disease Codes from WHO, Diabetes, Hypertension, Rheumatic heart disease, Ischemic heart disease, Asthma, Functions of Hospital clinical chemistry laboratory- Various tests performed, Equipments- automatic clinical analyzer, principle and functions.

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.

Instruments/ Devices in Respiratory System
Spriometry – Measurement of lung volume plathysmohraphy, FEV, Body box, Principle and applications. Blood gas analyzer – principle and applications, oximeteres.

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.

Recommended Books

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

BM-303 Numerical Methods and Computer Programming

Internal Marks : 40   L T P

External Marks : 60   3 1 0

Total Marks   : 100

1. Overview of C++ language   **7 hours**
     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   **3 hours**
     2.1 Sources of errors in numerical computation.
     2.2 Round-off error.
     2.3 Truncation error.
     2.4 Inherent error.
     2.5 Stability of numerical algorithms.

3. Transcendental and Polynomial Equations   **9 hours**
     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   **9 hours**
     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   **9 hours**
     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   **6 hours**

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   9 hours

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   3 hours

Taylor's series method.
8.1 Euler method.
8.2 Runge-Kutta methods (Second and fourth order).

Recommended Books

1.   Programming in ANSI C by E. Balagurusamy , Tata Mc Graw Hill, 1992.

2   Numerical Methods for Scientific and Engineering Computation by M.K. Jain, S.R.K. Iyengar and R.K. Jain, Fourth Edition, New Age International Publishers, 2003.

Reference Books

1.   Numerical Methods : Problems and Solutions by M.K. Jain, S.R.K. Iyenger and R.K. Jain New Age International Publishers, 1994.
2   A First Course in Numerical Analysis by A. Ralston and P. Rabinowitz, McGraw- Hill, 2nd edition, 1978.
1.   Elementary Numerical Analysis, by K. Atkinson John Wiley.
2.   Applied Numerical Analysis, by C.F. Gerald, P.O. Wheatley, Addison-Wesley.
3.   Numerical Methods for Scientific and Engineering, by M.K. Jain, S.R.K. Iyenger, R.K. Jain,
4.   Computation, New Age International.
5.   Introductory Methods of Numerical Analysis, S.S. Sastry, Prentice Hall of India.
6.   Advanced Engineering Mathematics, by E. Kreyszig, 8th Edition, John Wiley
7.   Applied Numerical Methods, by T.J. Akai, John Wiley.

BM-305   Medical Imaging Technologies

Internal Marks :   40   L   T   P
External Marks :   60   **3   1   0**
Total Marks   :   100

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-ay equipment.

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

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 ratio 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.

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.   Handbook of Biomedical Instrumentation by R.S. Khandpur, Mc graw Hill, 3rd ed. ,2005.
2.   Text Book of Radiology by Christensens, 3rd ed., 1998.
3.   Applied Clinical Engineering by Barry N. Fimberg
4   Digital Image Processing by Garzole R.C.

BM-307   Control System in Medicine

Internal Marks : 40   **L T P**
External Marks : 60   **3 1 0**
Total Marks   : 100

Introduction of Concept
Open loop systems, closed loop systems, regulatory servo mechanisms, transfer function and impulse response of system.

Study of Components
Op-Amp as differential amplifier of error detector, stepper motor, synchronous control transformer, synchronous control, transmitter, potentiometer and two phase servo-motor.

Modeling of Systems
RLC circuits, Armature and field controlled motors, importance of mathematical model.

Block Diagrams
Various techniques o block diagram reduction, Mason's gain formula and its application to block diagram reduction.

Transient Response of Systems
Importance of First order and Second order system models, time domain specification of systems and the analysis of transient response using second order model.

Steady-State Error Analysis
Type of systems, steady state error analysis of different types of systems using step, ramp and parabolic input signals.

Stability Analysis
Introduction to the concept of stability, stability analysis using Routh-Hurwitz Crieterian.

Frequency Domain Analysis of Systems
Frequency domain specification of systems, resonance peak and peak resonating frequency regarding complex poles and zeros, relationship between time and frequency domain specification of systems.

Stability Analysis of Systems using Bode Plots
Biological controls systems, pupil control system, skeletal muscle servomechanism, the semicircular canals free swinging limbs, thermoregulation.

System Mechanism
Respiratory models and controls, cardiovascular control systems, visual fixation system, coulometer system. Sugar level control mechanism endocrine control mechanism.

Nephrology
Models of human operator, tracking characteristics biological receptors, transfer function model of receptors. Estimation of constituents of physiological fluids (urinary blood, serum, CSF), Demonstration of a kidney dyalizer.

Medical Devices
Study and operation of various pacemakers. DC Defibrillators, Monitors, Heart lung Heart Lung machine, hypothermia unit, Blood oxygenator, electrolyte analyzer, study and operation of spirometers, Measurements of FEV, Lung volume Measurements of conductance and resistance using plathysmography, ICU visit and study the different monitor.

Recommended Books

1.   A manual of medical laboratory technology by A.H. Patel.
2.   Anatomy and physiology in Health and illness by Ross and Wilson, 2003.
3.   Control system by Kent and Olsen, Mc graw Hill, 2003.
4.   Physiological Control systems: Analysis, Stimulation and estimation by Michael C K Khoo.

BM-309   Tissue Engineering

Internal Marks   :   40   L T P
External Marks :   60   **3 1 0**
Total Marks   : 100

Culture Media and Procedures
Advantages and Disadvantages of Tissue culture, Culture Procedures

Animal Cell Metabolism
Regulation and nutritional requirements, Cell growth characteristics and kinetics; nutrients, substrates and product transport through mammalian cell; Cell culture in continuous perfusion and hollow- fiber reactor.

Primary cultures and Pluripotent Stem Cell lines
Types of culture, Evolution of cell lines, Large scale cell cultures, 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.

Organ/Embryo Culture
Explanation Techniques, Organ Culture, Whole Embryo Culture; *In vitro* Fertilization; Embryo Transfer Technology

Tissue Engineering
Tissue Engineering of skin, Bone grafts, Nerve Grafts, Bioartificial or Biohybrid organs

Transgene and Transgenic animals
Transgenic animals including livestocks; Trangenics as bioreactors.

Recommended Books

1. Animal Cell Biotechnology, Vol I & II by Griffith and Smith, 1989.
2. Animal Cell Culture by R. Ian Freshney, Wiley Liss, 2005.
3. Biotechnology and Genomics by P.K.Gupta, Rastogi Publications 2nd ed, 2005.

BM 311   Biomechanics

Internal Marks : 40   L T P
External Marks : 60   **4 0 0**
Total Marks   : 100

Introduction to Fluid Mechanism
Basic laws governing conservation of mass, momentum and energy, laminar flow, Couette flow and Hager – poiseville equation, turbulent flow.

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 vs stress properties and their physiological connotation, Intra-ventricular blood

Flow Analysis of Velocity and Pressure Gradient
Arterial impedance relating pulse pressure and flow rate, microcirculatory flow, transcapillary fluid movements in systemic circulation, physiological factors controlling blood pressure, heart valves.

Biomechanical Stress Strain Model
Muscle in terms of its elastic and contractile elements parameters

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

Recommended Books
1.   Biomechanics Circulation by Y.C. Fung, Springer Verlag, 1997.
2.   Fundamentals of Biomechanics by Nihat Ozkay & Margareta Nordin, Springer Verlag, 1999.
3.   Basic Biomechanics by Susan J. Hall , Mc graw Hill, 2002.

BM-313   Lab-VII   Medical Imaging & Clinical Sciences

Internal Marks : 30   **L   T   P**
External Marks : 20   **0   0   2**
Total Marks   : 50

1.   Study of factors affecting the quality control of X ray – relating the dark room, cassettes & U-films used.
2.   How mA (milliamperes) and K volts of X ray affect its quality and how it should be monitored.
3.   How to plan radiology Deptt.- Its power supply and dark room.
4.   Maintenance of X ray machine (its cooling filament)
5.   Study of Probes / Transducers – Its different frequencies and shapes.
6.   To study the technique of b-mode and how is it superior to m-mode.
7.   Demonstration of CT* scan – How is CT tube superior to X ray tube.
8.   Demonstration of MRI*

*- From CD's or net

BM-315   Lab-VIII   Numerical Methods   & Computer Programming

Internal marks : 30   **L   T   P**
External marks : 20   **0   0   2**
                              Total marks   : 50

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:
        a. 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) Eular Method (ii) Runge-Kutta Method (iii) Taylor Series Methods
6.   Various matrix operation-and their use as sub-routines

BM-317   Lab-IX   Tissue Culture

Internal marks : 30   **L   T   P**
External marks : 20   **0   0   2**
                              Total marks   : 50

1.   Establishment of Primary cell culture

2. Lymphocyte culture
3. Cell culture in static phase
4. Cell culture in spinner flasks
5. Metabolic study of culture cell

BM-302   Genetic Engineering

Internal Marks :   40   **L T P**

   External Marks :   60   3   1   0
Total Marks   : 100

Introduction

Milestones in Genetic Engineering
Molecular tools and their applications: Restriction enzymes, modification enzymes, DNA and RNA markers.
Gene Cloning Vectors: Plasmids, bacteriophages, phagemids, cosmids, Artificial chromosomes.
Restriction Mapping of DNA fragments and Map Construction, Nucleic Acid Sequencing.
cDNA 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.
PCR- Basic principles, Different forms of PCR eg multiplexes, RT PCR, e PCR etc., Applications of PCR in detecting genetic disorders.
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.
Gene Regulation DNA transfection, Northern blot, primer extendion, SI mapping. RNAse protection assay. Reporter assays.
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.
Processing of Recombinant Proteins Purification and refolding, characterization of recombinant proteins, stabilization proteins.
Phage Display
Transgenic and Gene Knockout Technologies, targeted gene replacement, chromosome engineering.
Gene Therapy Vector engineering, Strategies of gene delivery, gene replacement / augmentation, gene correct, gene editing, gene regulation and silencing.

Recommended Books
1.   Molecular Biology and Biotechnology by Walker and Gingold, 1991 Royal Society of Chemistry, London.
2.   Molecular Biology of Gene by Watson. J. et. A1 (4th ed), 1994, Benjamin / Cummings, California, USA.
3.   Molecular Biology of Cell by Alberts, B.et.al1994, Garland Publishers Inc.
4.   Recombinant DNA by Watson, J.D. et al, 1993, Scientific American Books, New York.
5.   Principles of Gene Manipulation by Old, R.W. and Primorose, S.B. 1994, Blackwell, U.K.
6.   Recombinant Microbes for Industrial and Agricultural Applications by Murroka, I.I. 1994, Mercel Dekker, Inc, New York.
7.   Methods in Gene Technology by Date, J.N. 1994, Jai Press Ltd. London, England.
8.   Gene Cloning and Manipulation by Christopher Howe, 1995, Cambridge University Press.

9. Manual of Industrial Microbiology and Biotechnology A.L. Demain and J.E. Davis. 1999 ASM Press Washington DC.
10. Principles of gene manipulation by old R.W. and Pimorse S.B. 1994; Blackwell U.K.

BM-304   Microprocessor, Microcontroller and Embedded Systems

Internal Marks : 40   **L   T   P**
External Marks : 60   **3   1   0**
Total Marks   : 100

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.

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.

Introduction to an embedded system and FPGA Kit
Introduction to latest micro controllers   such as ARM processors, its design.
 and   applications.

Recommended Text Books :

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

BM-306   Biomedical Instrumentation-II

Internal Marks :   40   L T P

External Marks :   60   3 1 0

Total Marks   : 100

Bio-Medical Stimulators and Destimulators

Principles, Varieties and applications, Nerve and Muscle stimulators, Pain relievers, Ultrasonic stimulators, diathermy equipment, Electro surgical stimulators and analyzers, Functional electrical stimulators and Destimulators.

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.

Therapeutic Equipments for Cardiology

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

Therapeutic Equipments (For ICU)

Ventilators – Anesthesia ventilators and critical care ventilators, oxygen and CO_2 analyzers, Pulse Monitors, ECG analyzers, Pulse Meters. Holter Monitors, Arrhythmia Monitors and analyzers.

Recommended Books

1.   Handbook of Biomedical Instrumentation by R.S. Khandpur, TMH, N. Delhi 2nd ed. 2003.
2   Introduction of Analytical Instruments by R.S. Khandpur
3.   Introduction to Bio-medical Equipment Technology by Carr and Brown
4.   Bio Medical Instrumentation Tech. & Application, Mr. Graw Hill (USA)
5.   Biomedical Instrumentation : J.G. Webster, 3rd ed, 2004.

BM-308   Biomaterials

Internal Marks :   40   **L T P**

   External Marks :   60   4   0   0

Total Marks   : 100

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.

Mechanical Properties and Tests
For elasticity, plasticity, inelasticity, deformation and fracture.

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.

Metallic and Ceramic Biomaterials
Properties and use to titanium alloys stainless steel, cobalt based alloys degradable ceramics.

Carbon and Polymeric Biomaterials
Carbon, polythene, polypropylene, silicones rubber, acrylic implants, hydrogels.

Orthopedic Implants
Alvcolar bone replacements. Orthopedic implants – types of orthopedic function devices, permanent joint replacements, hip joint, bone cement, Biological testing of biomaterials.

Therapeutic Equipments (For Cardiology)
Cardiac Pacemakers, External and Internal Types, Programmable Packemakers, leads, wave pattern analysis, encapsulation techniques, battering source.
Coronary care devices**:** Coronary Stents, Balloon angioplasty, angiography, Laser equipments for plaque remover arrhythmia monitors.

Automated Drug Delivery Systems
Infusion Pumps, Components of Drug Infusion Systems, Implantable and Closed-loop control in Infusion Systems

Prosthetic Devices and Sensory Devices
Artificial limbs, hand and foot, dental prosthesis, Intraocular Lens and hearing aids

Recommended Books
1.   Biomaterials, An interfacial Approach by Hench L.L.and Ethridge E.C. New York Academic Press, 1982.
2.   Encyclopedia of Medical Devices and Instruments I-IV by John G. Webser, Wiley 2nd ed., 2006.
3.   Biocompatibility of clinical implants materials, Vol. I and IIby David F. Williams,1981.
4.   A Text book of Biomedical Engineering by Kennedy R.M., 1999.
5.   Therapeutic Medical Devices by Albert M Cook and John Webster
6.   Service manuals and application rules from manufactures Text books of Polymer Sciences by Fred W. Billmeyer Jr.
7.   The Biomedical Engineering Handbook by Bronzins J.D.
8.   Biomaterials – An Introduction by J.B. Park , CRC Press 1995
9.   Biomaterials an interfacial approach by L.Hench and E.G. Erhridge

BM-310	Communication Engineering

Internal Marks : 40   **L T P**

 External Marks : 60   3 1 0
Total Marks   : 100

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 if 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.   Digital Communication by Bernald Sklan, Pearson Education, 2nd edition 2001.
2.   Principles of Communication by Taub & Schilling, Tata McGraw-Hill, 1990.
3.   Digital Communication by Simon Haykins, John Wiley, 2001.
5   Analog and Digital Communication Systems by B.P.Lathi, PHI, 1992.
6   Digital Communication by Proakis, McGraw-Hill, 1992.
7   Communication Systems by A.B.Carlson, McGraw-Hill, 1992.
8   Digital and Analog Communication Systems by K. Sam Shanmugam, John Wiley, 1985.

CE-216   Environmental Sciences

Internal Marks   :40   **L   T   P**

  External Marks :60   3   1   0

Total Marks   :100

Unit 1: The Multidisciplinary nature of environmental studies
Definition, scope and importance   (2 Lectures)
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)
                                                                   (6 lectures)
Unit 4: Biodiversity and its conservation
- Introduction – Definition: genetic, species and ecosystem diversity.
- Bio-geographical 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 loess, 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 :-
   a.   Air pollution
   b.   Water pollution
   c.   Soil pollution
   d.   Marine pollution
   e.   Noise pollution
   f.   Thermal pollution
   g.   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.   (8 lectures)

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.   (7 lectures)

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)

Recommended books

1. Environmental Engineering by Sincero and Sincero, Prentice Hall of India, 2nd ed, 2002.
2. Society Environment and Engineering by M Ramaswamy, 4th ed., 2004.
3. A basic course in Environmental Studies by deswal and deswal, Dhanpat Rai and sons, 1st ed., 2005.
4. Introduction to Environmental Engineering and Science by Gilbert M Masters, 2nd ed., Pearson, 2005.

BM-312 Lab-X Biomaterial

Internal Marks : 30   **L   T   P**

  External Marks : 20   0   0   2
Total Marks : 50

1. Nerve and muscle stimulator
2. Ultrasonic Stimulator
3. Electro-surgical stimulator
4. Functional electrical stimulator
5. Demonstration of various types of Endoscopes, Laparoscope's Cystoscopes
6. Demonstration of Dialysis equipment
7. To study the working of Spirometery, Plathysmogram
8. ECG Monitor
9. Defibrillators
10. Holter Monitor
11. Ventilators
12. Treadmill, ergometer
13 Pace maker (external and implantable, power source of implantable pacemaker leads and electrodes)
14 Operation and trouble shooting of Heart Lung machine
15 Demonstration of coronary care devices-coronary stents.
16 Study and operation of laser equipments.
17 Dithermy equipment (Operation and Demonstration)
18 Orthopedic Appliances

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

BM-314   Lab-XI   Microprocessor & Microcontroller

Internal Marks : 30	**L T P**
External Marks : 20	**0 0 2**
Total Marks : 50	

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   Lab-XII   Genetic Engineering

Internal Marks : 30	**L T P**
External Marks : 20	**0 0 2**
Total Marks : 50	

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