Syllabus

B.Sc.(H) Biomedical Sciences
(Six Semester Course)

THREE YEAR FULL TIME PROGRAMME

Rules, Regulations and Course Contents

Semester System at the undergraduate level

Course of Study: **B.Sc (Honours) BIOMEDICAL SCIENCE**

Total number of papers:24

MAIN-12-RED

COMMON PAPERS-6- BLUE

INTERDISCIPLINARY-6- GREEN

Semester I

Paper 1	Paper 2	Paper 3	Paper 4
Introduction to Biology	Human Physiology-I	Chemistry-I	Computational Skills

Semester II

Paper 5	Paper 6	Paper 7	Paper 8
Technical Writing and Communication in English	Human Physiology-II	Chemistry-II	Mathematics and Stats.

Semester III

Paper 9	Paper 10	Paper 11	Paper 12
Microbiology	Pathology	Cell Biology-I	Molecular Biology I

Semester IV

Paper 13	Paper 14	Paper 15	Paper 16
Biochemistry	Medicinal Chemistry	Cell Biology-II	Molecular Biology-II

Semester V

Paper 17	Paper 18	Paper 19	Paper 20
Pharmacology	Biophysics	Clinical Biochemistry	Genetics & Genomics-I

Semester VI

Paper 21	Paper 22	Paper 23	Paper 24
Toxicology	Immunology	*Special Paper	Genetics & Genomics-II

***Special Papers 23:** Bioinformatics, Human Genetics. Medical Biotechnology, Social and Preventive Medicine.

DEPARTMENT OF BIOMEDICAL SCIENCE
UNIVERSITY OF DELHI

B. Sc. (Hons) Biomedical Science
(Scheme of Examination)

Scheme of Selection of Students for B.Sc.(H) Biomedical Science.

The Selection of students will be based on PCB as per University guidelines for other honours courses..

Proposed scheme for B. Sc. (Hons) Biomedical Science

The course for Bachelor of Science (B.Sc.) in Biomedical Science shall comprise of six semesters. In all there are 12 main Papers, 6 Common Papers and 6 Interdisciplinary Papers. There is choice of special paper in Semester VI. Colleges may introduce at least two special papers in Semester VI so that students have a choice. In addition, the students are required to undergo about two months of summer training and submit the dissertation work as part of their B. Sc. degree at the end of the VI semester. The Project Work could include either Research or Diagnostic Lab or may include some survey analysis or review article. Faculty members of the Department should share the responsibility of placing students with appropriate training. As far as possible, the papers should be dealt by the faculty of the Biomedical Science Department. Where the papers are such that there is no trained faculty available in the Biomedical Science Department, other Departments expertise may be used. For Tutorials, Number of lectures and Examination scheme, the University guidelines may be followed.

SEMESTER: I

Paper No.	Semester I
1	Introduction to Biology with Practicals
2	Human Physiology I with Practicals
3	Chemistry I with Practicals
4	Computational Skills with Practicals

SEMESTER: II

Paper No.	Semester II
5	Technical Writing and Communication in English
6	Human Physiology II with Practicals
7	Chemistry II with Practicals
8	Mathematics and Statistics

SEMESTER: III

Paper No.	Semester III
9	Microbiology with Practicals
10	Pathology with Practicals
11	Cell Biology I with Practicals
12	Molecular Biology I with Practicals

SEMESTER: IV

Paper No.	Semester IV
13	Biochemistry with Practicals
14	Medicinal Chemistry with Practicals
15	Cell Biology II with Practicals
16	Molecular Biology II with Practicals

SEMESTER: V

Paper No.	Semester V
17	Pharmacology with Practicals
18	Biophysics with Practicals
19	Clinical Biochemistry with Practicals
20	Genetics & Genomics I with Practicals

SEMESTER: VI

Paper No.	Semester VI
21	Toxicology with Practicals
22	Immunology with Practicals
23	Special Paper with Practicals
24	Genetics & Genomics II with Practicals

CHOICES FOR SPECIAL PAPER I: SEMESTER VI

1. Bioinformatics
2. Human Genetics
3. Medical Biotechnology
4. Social and Preventive Medicine

THEORY: **100 marks** (75 end of term exam and 25 for internal assessment)
PRACTICALS: **50 marks**
PROJECT WORK **100 MARKS**

TOTAL MARKS = **3600**

PAPER-1 : INTRODUCTION TO BIOLOGY

Unit 1: Biological systems, evolution and biodiversity

a. Introduction to concepts of biology

(Ch 1 Campbell) (4 Lectures)

Themes in the study of biology; A closer look at ecosystem; A closer look at cell; The process of Science; Biology and everyday life.

b. Evolutionary history of biological diversity

(Ch 25 Campbell) (6 Lectures)

Early earth and the origin of life; Major events in the history of life; Mechanism of Macroevolution; Phylogeny and the tree of life.

c. Classifying the diversity of life

(Ch 25 Raven) (8 Lectures)

Kingdoms of Life –Prokaryotes, Eukaryotes, Archaea.

d. Darwinian view of life and origin of species

(Ch22, 24 Campbell) (10 Lectures)

Darwin's theory of evolution; The evolution of populations; Concepts of species; Mechanism of speciation.

e. Genetic approach to Biology

(Ch 1 Griffiths) (8 Lectures)

Patterns of inheritance and question of biology; Variation on Mendel's Law; The molecular basis of genetic information; The flow of genetic information from DNA to RNA to protein; Genetic Variation; Methodologies used to study genes and gene activities; Developmental noise; Detecting macromolecules of genetics; Model organisms for the genetic analysis; Distinction between Phenotype and Genotype.

Unit 2: Chemical context of living systems

a. Chemistry of life

(Ch 2 Campbell) (6 Lectures)

The constituents of matter; Structure of an atom; The energy level of electron; The formation and function of molecules depend on chemical bonding between atoms; Chemical reaction make or break chemical bonds.

b. Water and life

(Ch 3 Campbell) (5 Lectures)

The water molecule is polar; Properties of water; Ionization of water.

c. Carbon and life

(Ch 4 Campbell) (5 Lectures)

Organic chemistry-the study of carbon compounds; What makes carbon special? Properties of organic compounds.

d. Structure and function of biomolecules

(Ch 5 Campbell) (8 Lectures)

Most macromolecules are Polymers; Carbohydrates act as fuel and building materials; Lipids are group of hydrophobic molecules; Protein have diverse structures and functions; Nucleic acids store and transmit hereditary information

PRACTICALS

1. To learn a) use of microscope b) principles of fixation and staining.
2. Preparation of Normal, molar and standard solutions, phosphate buffers, serial dilutions
3. Use of micropipettes
4. Separation of A) amino acids B) chloroplast pigments by paper chromatography.
5. To perform gram staining of bacteria.
6. To study the cytochemical distribution of nucleic acids and mucopolysaccharides with in cells/tissues from permanent slides.
7. To perform quantitative estimation of protein using the Lowry's method.
8. To separate and quantify sugars by thin layer chromatography.
9. To raise the culture of *E. coli* and estimate the culture density by turbidity method. Draw a growth curve from the available data.
10. Isolation of genomic DNA from *E.coli*.

SUGGESTED BOOKS

1. Campbell, N.A. and Reece, J.B. (2008) Biology 8th edition, Pearson Benjamin Cummings, San Francisco.
2. Raven, P.H et al (2006) Biology 7th edition Tata McGrawHill Publications, New Delhi
3. Griffiths, A.J.F et al (2008) Introduction to Genetic Analysis, 9th edition, W.H. Freeman & Co. NY

Paper 2: HUMAN PHYSIOLOGY–I

Total No of Lectures per week = 4 Total Lectures per semester = 60

1. General Anatomy of the body

(Chapter 1: Fox) (3 lectures)

Introduction to basic concepts of: Body planes, Tissues (Types, origin & function) organs.

2. Blood

(Chapter 13: Fox) (9 lectures)

Composition of blood, haemopoesis, structure and function of hemoglobin, haemostasis (all types of clotting mechanisms), blood groups and introduction to basic concepts of transfusion.

3. Nerve physiology

(Chapter 7: Fox and Chapter 4: Guyton) (12 lectures)

Origin of resting membrane potential and action potential, electrophysiology of ion channels. Structure and function of neuron, conduction of nerve impulsein a neuron, Synapse, its types and synaptic transmission , Neurotransmitters, types and functions.

4. Muscular system

(Chapter 12: Fox and Chapter 7: Guyton) (12 lectures)

Types of muscles, Functional anatomy of muscular system, concepts of degeneration and regeneration of muscle, neuromuscular transmission, muscle excitation and contraction, types of contraction and its properties.

5. Cardiovascular system

(Chapter 13 and 14: Fox) (12 lectures)

Structure and function of heart, cardiac cycle, Basic concepts of electrocardiogram (ECG), circulatory system and hemodynamics, Lymph and lymphatic circulation, blood pressure(causes and factors effecting it).

6. Endocrine system

(Chapter 11: Fox) (12 lectures)

General mechanism of hormone action, Glands and their hormone, structure, function, regulation and deficiency diseases: Thyroid, parathyroid, adrenal, pancreas, pituitary and hypothalamus.

REFERENCE BOOKS FOR THEORY PAPER

Text Books:

1. Human Physiology by Stuart I. Fox, 9th Edition, Mcgraw- Hill, 2006.
2. Text book of Medical physiology by Guyton and Hall, 11th Edition, W B Saunders and Company, 2006.

Reference Books:

1. Gerad J. Tortora and Sandra R. Grabowski, Principles of Anatomy and Physiology, control systems of human body, Vol-3, 10th edition, Wiley and Sons, 2006.

2. K.E. Barett, S.M. Barman, S. Boitans and H. Brook, Ganong's Review of Medical physiology, 23rd Edition (Lange basic science), Tata McGraw Hill, 2009.

PRACTICALS FOR HUMAN PHYSIOLOGY I

Periods per week = 04

1. Introduction to experiments on blood.
2. Estimation of haemoglobin (Sahl's method).
3. Determination of bleeding time & clotting time of blood.
4. To ascertain one's blood group.
5. Determination of specific gravity of blood.
6. Determination of osmotic fragility of RBC.
7. Formation of Hematin & Hemochromogen crystals
8. Preparation of blood smear and identification of different WBC
8. Permanent slides of various endocrine organs: thyroid, testis, ovary, pancreas, parathyroid, pituitary, adrenal.

REFERENCE BOOKS FOR PRACTICAL PAPER

1. Manual of Practical Physiology for MBBS by A.K.Jain, Arya Publication.
2. Textbook of Practical Physiologyby CL Ghai. 7th Edition, Jaypee Publication, 2007.

PAPER-3: CHC-301: CHEMISTRY-1

Section A: Inorganic Chemistry **(30 Lectures)**

Unit 1: Atomic Structure: *Recapitulation of: Bohr's theory and its limitations, dual behaviour of matter and radiation, de-Broglie's relation, Heisenberg Uncertainty principle. Need of a new approach to Atomic structure.*

What is Quantum mechanics? Time independent Schrodinger equation ($H\Psi = E\Psi$) and meaning of various terms in it. Significance of Ψ and Ψ^2, Schrodinger equation for hydrogen atom in Cartesian coordinates (x,y,z). Need of polar coordinates, transformation of Cartesian coordinates (x,y,z) into polar coordinates (r,θ,ϕ). Radial and angular parts of the hydogenic wavefunctions (atomic orbitals) and their variations for 1s, 2s, 2p, 3s, 3p and 3d orbitals. (Only graphical representation), Radial and angular nodes and their significance. Radial distribution functions and the concept of the most probable distances with special reference to 1s and 2s atomic orbitals. Significance of quantum numbers, orbital angular momentum and quantum numbers m_r and m_s. Shapes of s, p and d atomic orbitals, nodal planes. Discovery of spin, spin quantum number (s) and magnetic spin quantum number (m_s).

Rules for filling electrons in various orbitals, Electronic configurations of the atoms. Stability of half-filled and completely filled orbitals, concept of exchange energy. Relative energies of atomic orbitals, Anomalous electronic configurations.

Unit 2: Chemical Bonding and Molecular Structure

Ionic Bonding: General characteristics of ionic bonding. Energy considerations in ionic bonding, lattice energy and salvation energy and their importance in the context of stability and solubility of ionic compounds. Statement of Born-Lande equation for calculation of lattice energy, Born-Haber cycle and its applications, polarizing power and polarizability. Fajan's rules, ionic character in covalent compounds, bond moment, dipole moment and percentage ionic character.

Covalent bonding: *VB Approach* Shapes of some inorganic molecules and ions on the basis of VSEPR and hybridization with suitable examples of, linear, trigonal planar, square planar, tetrahedral, trigonal bipyramidal and octahedral arrangements. Concept of resonance and resonating structures.

Section B: Physical Chemistry **(30 Lectures)**

Unit 3: Chemical Thermodynamics

What is thermodynamics? State of a system, state variables, intensive and extensive variables, co ncept of heat and work, thermodynamic equilibrium, thermodynamic properties, various types of systems and processes. First Law of thermodynamics. Calculation of work (w), heat (q), change s in internal energy (ΔU) and enthalpy (ΔH) for expansion or compression of ideal gases under is othermal and adiabatic conditions for both reversible and irreversible processes. Calculation of w , q, ΔU and ΔH for processes involving changes in physical states.

Important principles and definitions of thermochemistry. Concept of standard state and standard enthalpies of formations, integral and differential enthalpies of solution and dilution.

Calculation of bond energy, bond dissociation energy and resonance energy from thermochemic al data. Variation of enthalpy of a reaction with temperature – Kirchhoff's equation.

Various statements of Second Law of thermodynamics, Carnot cycle, concept of entropy, Gibbs

free energy and Helmholtz energy, Calculations of entropy change and free energy change for re versible and irreversible processes under isothermal and adiabatic conditions. Criteria of spontan eity. Gibbs-Helmholtz equation,Maxwell's relations.
Statement of Third Law of thermodynamics and calculation of absolute entropies of substances.

Unit 4: Ionic Equilibria
Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionizati on, ionization
constant and ionic product of water. Ionization of weak acids and bases, pH scale, common ion e ffect, Salt hydrolysis calculation of hydrolysis constant, degree of hydrolysis and pH for differe nt salts. Buffer solutions. Solubility and solubility product of sparingly soluble salts - applications of solubility product principle.
Qualitative treatment of acid base titration curves (calculation of pH at various stages of HCl – NaOH titration only). Theory of acid – base indicators.

PRACTICALS

Section A: Inorganic Chemistry

Volumetric Analysis

1. Estimation of sodium carbonate and sodium hydrogen carbonate present in a mixture.
2. Estimation of oxalic acid by titrating it with $KMnO_4$.
3. Estimation of water of crystallization in Mohr's salt by titrating with $KMnO_4$.
4. Estimation of Fe(II) ions by titrating it with $K_2Cr_2O_7$ using internal indicator.
5. Estimation of Cu(II) ions idometrically using Na_2SO_4.
6. Estimation of (i) Mg^{2+} or (ii) Zn^{2+} by complexometric titration using EDTA.

Section B: Physical Chemistry

1. **Surface tension measurement** (use of organic solvents excluded).
   Determination of the surface tension of a liquid or a dilute solution using a stalagmometer.

2. **Viscosity measurement** (use of organic solvents excluded)
   Determination of the relative and absolute viscosity of a liquid dilute solution using an Ostwald's viscometer.

3. **Kinetic studies**
   Study of the kinetics of the following reaction by integrated rate method: Acid hydrolysis of methyl acetate with hydrochloric acid volumetrically.

SUGGESTED BOOKS

1. Barrow, G. M. *Physical Chemistry* Tata McGraw-Hill (2007).
2. Castellan, G. W. *Physical Chemistry* 4th Ed. Narosa (2004).
3. Kotz, J. C., Treichel, P. M. & Townsend, J. R. *General Chemistry* Cengage Learning India Pvt. Ltd., New Delhi (2009).
4. Mahan, B. H. *University Chemistry* 3rd Ed. Narosa (1998).
5. J. D. Lee: *A new Concise Inorganic Chemistry*, E L. B. S.

6. F. A. Cotton & G. Wilkinson: *Basic Inorganic Chemistry*, John Wiley.
7. Douglas, McDaniel and Alexader: *Concepts and Models in Inorganic Chemistry*, John Wiley.
8. James E. Huheey, *Ellen Keiter and Richard Keiter: Inorganic Chemistry: Principles of Structure and Reactivity*, Pearson Publication.
9. Vogel's Qualitative Inorganic Analysis, A.I. Vogel, Prentice Hall, 7th Edition.
10. Vogel's Qualitative Chemical Analysis, A.I. Vogel, Prentice Hall, 6th Edition.
11. Senior practical Physical Chemistry, B.D. Khosla, R. Chand & Co.

PAPER-4: COMPUTATIONAL SKILLS

Computer Fundamentals

(12 Lectures)

Introduction to Computers: Characteristics of Computers, Uses of computers, Types and generations of Computers.
Basic Computer Organization - Units of a computer, CPU, ALU, memory hierarchy, registers, I/O devices.
User Interface with the Operating System, System Tools

Data Representation

(8 Lectures)

Binary representation of integers and real numbers, 1's Complement, 2's Complement, Addition and subtraction of binary numbers, BCD, ASCII, Unicode;

Networks terminology

(4 Lectures)

Types of networks, router, switch, server-client architecture

Multimedia

(4 Lectures)

Introduction, Characteristics, Elements, Applications

Problem Solving

(10 Lectures)

Notion of algorithms, stepwise methodology of developing an algorithm, developing macros in spreadsheet

General Awareness

(4 Lectures)

IT Act, System Security (virus/firewall etc.), ***I-Tax, Reservations, Banking.***

PRACTICALS

1. Defined projects will be done by the students and evaluated by the instructor.
2. Document Preparation
3. Presentation Software
4. Familiarizing with the Operating System, Control Panel, Networking Configuration, Firewall setting
5. Spreadsheet Handing, Working with worksheets, Creating a spreadsheet, entering and formatting information, basic functions and formulas, creating charts, tables and graphs.

SUGGESTED BOOKS

1. V Rajaraman, **Fundamentals of Computers,** Fourth Edition, PHI.
2. Anita Goel, **Fundamentals of Computers;** Forthcoming title in Pearson-Education

Note: Use of Open Office/Star Officeis recommended, as they are freely downloadable. Reference manual for Open Office available at: http://www.openffice.org. Reference manual for Star Office available at: http://www.sun.com/software/staroffice/

PAPER-5: TECHNICAL WRITING AND COMMUNICATION IN ENGLISH

Unit 1

Communication: Language and communication, differences between speech and writing, distinct features of speech, distinct features of writing.

Unit 2

Writing Skills; Selection of topic, thesis statement, developing the thesis; introductory, developmental, transitional and concluding paragraphs, linguistic unity, coherence and cohesion, descriptive, narrative, expository and argumentative writing.

Unit 3

Technical Writing: Scientific and technical subjects; formal and informal writings; formal writings/reports, handbooks, manuals, letters, memorandum, notices, agenda, minutes; common errors to be avoided.

SUGGESTED READINGS

1. M. Frank. Writing as thinking: *A guided process approach, Englewood Cliffs,* Prentice Hall Reagents.
2. L. Hamp-Lyons and B. Heasely: Study Writing; *A course in written English.* For academic and professional purposes, Cambridge Univ. Press.
3. R. Quirk, S. Greenbaum, G. Leech and J. Svartik: *A comprehensive grammar of the English language*, Longman, London.
4. Daniel G. Riordan & Steven A. Panley: "*Technical Report Writing Today"* - Biztaantra.

Additional Reference Books

5. Daniel G. Riordan, Steven E. Pauley, Biztantra: *Technical Report Writing Today*, 8th Edition (2004).
6. *Contemporary Business Communication*, Scot Ober, Biztantra, 5th Edition (2004).

Paper 6: HUMAN PHYSIOLOGY–II

Total No of Lectures per week = 4 Total Lectures per semester = 60

1. Central Nervous System

(Chapter 8: Fox)(10 Lectures)

Functional Anatomy of central nervous system, autonomic nervous system and peripheral nervous system. Basic concepts of temperature regulation of the body.

2. Special Senses:

(Chapter 10: Fox) (8 Lectures)

Functional anatomy and regulation of Vision, hearing, Taste, Smell, Touch

3. Respiratory System:

(Chapter 16: Fox and Chapter 39: Guyton) (10 Lectures)

Functional Anatomy of respiratory system, mechanisms of pulmonary ventilation, alveolar ventilation, gaseous exchange, transport of gases in blood.

4. Gastrointestinal System:

(Chapter 18: Fox)(10 Lectures)

Anatomy and physiology of digestive tract, digestion, absorption and assimilation. Gastrointestinal hormones.

5. Renal Physiology:

(Chapter 17: Fox and Chapter 27:Guyton) (10 Lectures)

Body fluid and electrolyte balance, Functional Anatomy of kidney, function and histology of nephron ,Urine formation (glomerular filtration and tubular reabsorption), renal regulation of urine volume and osmolarity, acid-base balance, urinary bladder structure and micturition.

6. Reproductive System:

(Chapter 20: Fox and Chapter 81: Guyton)(12 Lectures)

Structure of male and female reproductive gonads and tract, testicular and ovarian hormones, gametogenesis (oogenesis and spermatogensis), menstrual cycle fertilization, implantation, pregnancy, parturination and lactation.

REFERENCE BOOKS FOR THEORY PAPER

Text Books:

1. Human Physiology by Stuart I Fox, 9th Edition, McGraw Hill, 2006.
2. Text book of Medical physiology by Guyton and Hall, 11th Edition, W.B. Saunders and Company., 2006.

Reference Books:

1. Gerad J. Tortora and Sandra R. Grabowski, Principales of Anatomy and Physiology, control systems of human body, Vol. 3, 10th Edition, Wiley and Sons, 2003.
2. K.E. Barett, S.M. Barman, S. Boitans and H. Brook, Ganong's Review of Medical Physiology, 23rd Edition, Mc Graw Hill, 2009.

PRACTICAL FOR HUMAN PHYSIOLOGY II

Periods per week = 04

1. Determination of total leukocyte count.
2. Determination of total erythrocyte count.
3. To perform differential leucocyte count of blood.
4. Simple Reflex arc.
5. Study of Sensations of touch, smell and taste
6. To make a temporary mount of a neuron.
7. To study different human organs and their sections through permanent slides. T.S. of brain, spinal cord, , liver, thymus, spleen, ovary, artery, vein, capillaries, different tissues, testis, pancreas, skeletal fibres, lungs, trachea, bronchioles, pititutory, heart.
8. Dissection of Rat – Vasectomy, Orchidectomy, Hysterectomy, Ovariectomy (any two).

REFERENCE BOOKS FOR PRACTICAL PAPER

1 Manual of Practical Physiology for MBBS by A.K.Jain, Arya Publication.
2 Text book of Practical Physiology by CL Ghai. 7th Edition, Jaypee Publication, 2007.

PAPER-7: CHC-402: CHEMISTRY-2

Section A: Basic Organic Chemistry **(30 Lectures)**

Unit 1: Fundamentals of Organic Chemistry

Concept of hybridization of carbon. Cleavage of a covalent bond: homolysis and heterolysis. Electronic effects and their applications (inductive, electromeric, hyperconjugation and resonance). Structure and stability of reactive intermediates (carbocations, carbanions and free radicals). Relative strength of carboxylic acids (aliphatic, aromatic and halo-substituted aliphatic), alcohols, phenols and nitro-phenols. Relative basic strength of amines (aliphatic and aromatic) Intermolecular and intramolecular forces: types of intermolecular forces and their characteristics (ion-dipole, dipole-dipole, dipole-induced dipole and dispersion forces). Intermolecular and intramolecular hydrogen bonding. Effect of intermolecular and intramolecular forces on properties such as solubility, vapour pressure, melting and boiling points of organic compounds.

Unit 2: Stereochemistry

Conformations w.r.t. ethane, butane and cyclohexane. Interconversion of Wedge Formula, Newman, Sawhorse and Fischer representations. Concept of chirality (upto two carbon atoms). Configuration: Geometrical and Optical isomerism; Enantiomerism, Diastereomerism and Meso compounds) . Threo and erythro; D and L; *cis - trans* nomenclature; CIP Rules: R/ S (for upto 2 chiral carbon atoms) and E / Z Nomenclature (for upto two C=C systems).

Section B: Chemistry of Biomolecules **(30 Lectures)**

Unit 3: Carbohydrates

Classification, and General Properties, Glucose and Fructose (open chain and cyclic structure), Determination of configuration of monosaccharides, absolute configuration of Glucose and Fructose, Mutarotation, ascending and descending in monosaccharides. Structure of disacharrides (sucrose, cellobiose, maltose, lactose) and polysacharrides (starch and cellulose) excluding their structure elucidation.

Unit 4: Amino Acids, Peptides and Proteins

Preparation of Amino Acids: Strecker synthesis, using Gabriel's phthalimide synthesis. Zwitter ion, Isoelectric point and Electrophoresis.

Reactions of Amino acids: ester of –COOH group, acetylation of $–NH_2$ group, complexation with Cu^{2+} ions, ninhydrin test.

Overview of Primary, Secondary, Tertiary and Quaternary Structure of proteins. Determination of Primary structure of Peptides by degradation Edmann degradation (N-terminal) and C–terminal (thiohydantoin and with carboxypeptidase enzyme). Synthesis of simple peptides (upto dipeptides) by N-protection (t-butyloxycarbonyl and phthaloyl) & C-activating groups and Merrifield solid-phase synthesis.

PRACTICALS

Organic Chemistry

1. Detection of extra elements (N,S,Cl, Br, I) in organic compounds (containing up to two extra elements).
2. Systemic Qualitative Organic Analysis of organic compounds possessing monofunctinal groups(-cooh, phenolic, aldehyde, ketonic,amide,nitro,1o amines) and preparation of one derivative.

SUGGESTED BOOKS

1. T. W. Graham Solomons : *Organic Chemistry, John Wiley and Sons*.
2. Arun Bahl and B. S. Bahl : *Advanced Organic Chemistry,* S. Chand.
3. E. L. Eliel : *Stereochemistry of Carbon Compounds*, Tata McGraw Hill.
4. I. L. Finar : *Organic Chemistry* (Vol. I & II), E. L. B. S.
5. R. T. Morrison & R. N. Boyd : *Organic Chemistry*, Prentice Hall.
6. Textbook of Practical oOrganic Chemistry,A.I.Vogel, Prentice Hall,5th Edition.
7. Practical organic chemistry, Mann F.G. & Saunders B.C>, Orient Longman,1960

PAPER-8: MATHEMATICS AND STATISTICS

(24 periods)

Unit 1.

Sets. Functions and their graphs: polynomial, sine, cosine, exponential and logarithmic functions. Motivation and illustration for these functions through projectile motion, simple pendulum, biological rhythms, cell division, muscular fibres etc. Simple observations about these functions like increasing, decreasing and, periodicity. Sequences to be introduced through the examples arising in Science beginning with finite sequences, followed by concepts of recursion and difference equations. For instance, the Fibonacci sequence arising from branching habit of trees and breeding habit of rabbits. Intuitive idea of algebraic relationships and convergence. Infinite Geometric Series. Series formulas for ex, log (1+x), sin x, cos x.Step function. Intuitive idea of discontinuity, continuity and limits. Differentiation. Conception to be motivated through simple concrete examples as given above from Biological and Physical Sciences. Use of methods of differentiation like Chain rule, Product rule and Quotient rule. Second order derivatives of above functions. Integration as reverse process of differentiation. Integrals of the functions introduced above.

Unit 2.

(14 periods)

Points in plane and space and coordinate form. Examples of matrices inducing Dilation, Rotation, Reflection and System of linear equations. Examples of matrices arising in Physical, Biological Sciences and Biological networks. Sum and Produce of matrices upto order 3.

Unit 3.

(20 periods)

Mesures of central tendency. Measures of dispersion; skewness, kurtosis. Elementary Probability and basic laws. Discrete and Continuous Random variable, Mathematical Expectation, Mean and Variance of Binomial, Poisson and Normal distribution. Sample mean and Sampling variance. Hypothesis testing using standard normal variate. Curve Fitting. Correlation and Regression. Emphasis on examples from Biological Sciences.

SUGGESTED READINGS

1. H. S. Bear: *Understanding Calculus*, John Wiley and Sons (Second Edition); 2003.
2. E. Batschelet : *Introduction to Mathematics for Life Scientists,*Springer Verlag, International Student Edition, Narosa Publishing House, New Delhi (1971, 1975)
3. A. Edmondson and D. Druce: *Advanced Biology Statistics*, Oxford University Press; 1996.
4. W. Danial: Biostatistics: *A foundation for Analysis in Health Sciences*, John Wiley and Sons Inc; 2004.

Note: It is desirable that softwares should be used for demonstrating visual, graphical and application oriented approaches.

Paper 9: MICROBIOLOGY

Total No of Lectures per week = 4 Total Lectures per semester = 60

1. History of Microbiology and classification

(Chapter 1 and 19: Presscot) (3 Lectures)

History of microbiology, Discovery of microorganisms, Molecular methods of assessing microbial phylogeny- molecular chronometer, phylogenetic trees, rRNA, DNA and proteins as indicator of phylogeny. Major Divisions of life- Domains, Kingdoms.

2. Microbial Nutrition, Growth and control of Microorganisms by physical and chemical methods

(Chapter 5 and 7: Presscot) (10 Lectures)

Common nutrient requirements: requirements for C, H, O, N, P and S. Nutritional types of microorganisms, growth factors, culture media- synthetic and complex, types of media; isolation of pure cultures, growth curves, mean growth rate constant, generation time; general concept of effect of environmental factors on growth of microbes; sterilization and disinfection; activity, use of physical methods (heat, low temperature, filtration, radiation)and chemical agents (phenolics, halogens, heavy water, sterilization gases).

3. Microbial Cells - fine structure and function.

(Chapter 5: Pelczar) (5 Lectures)

Size, shape and arrangement of bacterial cells. Cell membrane, cytoplasmic matrix, inclusion bodies, nucleoid, cell wall peptidoglycan structure, gram +ve and gram –ve cell wall, capsule, flagella and motility, mechanism of flagellar movement, bacterial endospore.

4. Microbial Genetics

(Chapter 12: Pelczar) (7 Lectures)

Bacterial recombination: general and site specific and replicative; bacterial plasmid- fertility factor, col plasmid; bacterial conjugation- (Hfr, F′, F^+ X F^-), transformation, transduction- generalized and specialized.

5. Viruses

(Chapter 6: Brock) (10 Lectures)

General properties of viruses, cultivation of viruses, virus purification and assays, structure of viruses-general structure, properties – viral envelops and enzymes, principles of virus taxonomy. Bacteriophages-classification, reproduction of animal viruses, replication and transcription in DNA viruses-influenza virus, reteroviruses-HIV. Viroids, virusoids and prions.

6. Food and Microbiology

(Chapter 28: Pelczar) (7 Lectures)

Overview of importance of microbiology in food and industrial microbiology. Microorganism growth in food, extrinsic and intrinsic factors, microorganisms causing food soilage in fresh food, milk, and canned food. Preservation of foods by aseptic handling, high temperature, low temperature, dehydration, osmotic pressure, chemicals and radiations. Microscopic examination of food, culture techniques, food borne infections and intoxications. Preparation of fermented food products, fermented milk such as yoghurt, curd and cheese and other fermented foods like pickles.

7. Industrial Microbiology

(Chapter 27 and 29: Pelczar) (6 Lectures)

Industrial microbiological processes in industry, basic design of fermenter-continuous and discontinuous. Treatment of waste water (Municipal treatment plant), sewage. Preparation of wine, beer, cheese. Single cell proteins.

8. Microbial diseases

(Chapters 37, 38 and 39: Presscot) (8 Lectures)

Introduction to disease caused by microbes, Bacterial diseases of respiratory tract– corynebacterium and mycobacterium. Protozoal diseases-malaria and Kala Azar. Helminthic diseases- filarial. Fungal diseases- Candida infection and Mycetoma.

9. Antimicrobial chemotherapy

(Chapter 10: Brock) (4 Lectures)

Range of activity and mechanism of action of antibiotics-sulfa drugs, penicillin, aminoglycosides, quinolones, cyclosporine, tetracycline and macrolides.

REFERENCE BOOKS FOR THEORY PAPER

Text Books:

1. Microbiology, Prescott, Harley and Kleins, 5th Edition McGraw Hill International, 2002.
2. Microbiology, Pelczar, Chan and Krieg.5th Edition McGraw Hill International .
3. Biology of Microorganisms, T. D. Brock and M.T. Madigan, 12th Edition, Pearsons, Benjamin Cummings, 2009.

MICROBIOLOGY PRACTICALS

Periods per week = 04

1. To study disinfectants and sterilization techniques.
2. To study types of Media and perform media preparation.
3. To perform subculturing- streaking techniques (T streaking).
4. To study Growth Curve of bacteria.
5. To study the effect of pH/temperature/UV light on bacterial growth.
6. To perform Gram's staining.
7. To perform plaque assay.
8. To perform Methyl reductase test to check the purity of milk.
9. To perform Antibiotic resistance assay.
10. Enumeration of CFU of E.coli by serial dilution method.

REFERENCE BOOKS FOR PRACTICAL PAPER

1. Microbiology-A Laboratory Mannual by James G Cappuccaino, 7th Edition, Pearson Education, 2004.

Paper 10: PATHOLOGY

Total No of Lectures per week = 4 Total Lectures per semester = 60

1. Introduction:

(Chapter 1: Underwood) (2 lectures)

Basic definitions and familiarizing with the terms used in pathology

2. Cellular Adaptations, Cell Injury and Cell Death

(Chapter 1: Kumar) (8 lectures)

Causes and mechanisms of cell injury, reversible and irreversible injury, Necrosis, Apoptosis, subcellular and intracellular response, cellular ageing, cellular adaptations: Hyperplasia, Hypertrophy, Atrophy, Metaplasia

3. Acute and Chronic Inflammation

(Chapter 2: Kumar) (10 lectures)

General features of inflammation: Acute Inflammation Vascular Changes, cellular events, chemical mediators of inflammation. termination of acute inflammation. Outcome and morphological effects of acute inflammation. Chronic Inflammation with examples, Systemic effects of Inflammation

4. Tissue Renewal and Repair, Healing and Fibrosis:

(Chapter 3: Kumar) (10 lectures)

Regeneration and its mechanism. Role of Extracellular Matrix, repair and its types and mechanisms wound healing, healing-scar formation and fibrosis.

5. Hemodynamic Disorders:

(Chapter 4: Kumar) (10 lectures)

Edema, hyperemia, congestion, hemorrhage, hemostasis and thrombosis, Embolism, Infarction and shock.

6. Applications of Pathology in understanding diseases

(Chapter 8,12,13,18 & 24: Kumar; Chapter 45 & 48: Copstead) (20 lectures)

Diabetes, Asthma, Anemia, Myocardial Infarction, Jaundice, Tuberculosis, Schizophrenia, Parkinson, Infertility: Etiology, pathogenesis of the diseases, diagnosis and their clinical symptoms.

REFERENCE BOOKS FOR THEORY PAPER

Text Books:

1. Robbins and Cotrans Pathologic Basis Of Disease, 7th Edition, Kumar, Abbas and Fausto, Elsevier Publication, 2004.

Reference Books:

1. General and Systematic Pathology, J.C.E. Underwood, 3rd Edition, Churchill Livingstone, 2004.

2. Pathophysiology (A study guide), Lee-Ellen C.Copstead-Kirkhorn and Jacquelyn L.Banasik; 4th Edition, Saunders Publication, 2006.
3. Robbins Basic Pathology, Kumar, Abbas, Fausto and Mitchell, 8th Edition, Elsevier Publication.

PRACTICAL'S FOR PATHOLOGY

Periods per week = 04

1. Urine Analysis- normal and abnormal constituents.
2. Tissue Processing, section cutting using Microtome, Staining and Preparation of Permanent Histological Slides
3. Diagnostic tests for detection of various conditions-CRP, VDRL, RA, Pregnancy, Dengue and HIV (any four)
4. Physiological Data Acquisition system (Biopac)-ECG, EMG, PFT, Temperature
5. Cell Count : Platelet count and Reticulocyte count
6. Demonstration of Erythrocyte Sedimentation Rate.
7. Measuring Blood pressure.
8. Permanent histological slides of common diseases (any five basic slides).
9. First aid box and its contents.
10. Study of fractures.
11. Acid fast staining of mycobacterium in human sputum.

REFERENCE BOOKS FOR PRACTICAL PAPER

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

PAPER-11: CELL BIOLOGY-I

Unit 1. An Overview of Cells (Ch 1 Cooper *et al.*/ Ch 1 Karp)

Overview of prokaryotic and eukaryotic cells, cell size and shape, Phages, Viriods, Mycoplasma and *Escherichia coli*.

Unit 2. Tools and techniques of Cell Biology (Ch 1 Cooper *et al.*/ Ch 18 Karp/ Ch 3 De Robertis)

Microscopic-Principles of Light microscopy; Phase contrast microscopy; Confocal microscopy;Electron microscopy (EM)- scanning EM and scanning transmission EM (STEM); Fluorescence microscopy;

Analytical-Flow cytometry- flurochromes, fluorescent probe and working principle; Spectrophotometry; Mass spectrometry; X-ray diffraction analysis.

Separation-Sub-cellular fractionation- differential and density gradient centrifugation; Chromatography- paper, thin-layer, gel-filtration, ion-exchange, affinity and High-Performance Liquid Chromatography (HPLC).

Unit 3. Composition of Cells (Ch 2 Cooper *et al.*)

Molecules of cell, cell membranes and cell Proteins.

Unit 4. The Nucleus (Ch 9 Cooper *et al.*)

Nuclear Envelope- structure of nuclear pore complex, nuclear lamina, Transport across Nuclear Envelope, Chromatin: molecular organization, Nucleolus and rRNA Processing.

Unit 5. Protein Sorting and Transport (Ch 10 Cooper *et al.*)

The Endoplasmic reticulum, The Golgi Apparatus, Mechanism of Vesicular Transport, Lysosomes.

Unit 6. Mitochondria, Chloroplasts and Peroxisomes (Ch 11 Cooper *et al.*)

Structural organization, Function, Marker enzymes,Mitochondrial biogenesis, Protein import in mitochondria, Semiautonomous nature of mitochondria and chloroplast, chloroplast DNA, Peroxisomes'assembly

Unit 7. Cytoskelton and Cell Movement (Ch 12 Cooper *et al.*)

Structure and organization of actin filaments; actin, myosin and cell movement; intermediate filaments; microtubules.

PRACTICALS FOR CELL BIOLOGY-I

1. Separation of nucleic acid bases by paper chromatography.
2. Microscopy- Theoretical knowledge of Light and Electron microscope.
3. Study of the following techniques through electron / photo micrographs: Fluorescence microscopy, autoradiography, positive staining, negative staining, freeze fracture, freeze etching shadow casting.
4. Study of structure of cell organelles through electron micrographs.

Permanent slide preparation:

1. Cytochemical staining of DNA-Feulgen.
2. Cytochemical staining of DNA and RNA- Methyl Green Pyronin (MGP).
3. Cytochemical staining of Polysaccharides-Periodic Acid Schiff's (PAS).
4. Cytochemical staining of Total proteins- Bromophenol blue.
5. Cytochemical staining of Histones -Fast Green.

REFERENCE BOOKS

1. Karp, G. (2010). Cell and Molecular Biology: Concepts and Experiments. VI Edition. John Wiley & Sons. Inc.
2. De Robertis, E.D.P. and De Robertis, E.M.F. (2006). Cell and Molecular Biology. VIII Edition. Lippincott Williams and Wilkins, Philadelphia.
3. Cooper, G.M. and Hausman, R.E. (2009). The Cell: A Molecular Approach. V Edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
4. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. (2009). The World of the Cell. VII Edition. Pearson Benjamin Cummings Publishing, San Francisco.

PAPER-12: MOLECULAR BIOLOGY-I

Unit 1. Nucleic Acids convey Genetic Information (Ch 2 Watson)

DNA as the carrier of genetic information, Key experiments establishing-The Central Dogma, DNA Double helix, Genetic code, Direction of Protein Synthesis, Genomics.

Unit 2. The Structures of DNA and RNA / Genetic Material (Ch 6 Watson/ Ch 18 Becker)

DNA Structure: Miescher to Watson and Crick- historic perspective, DNA structure, Salient features of double helix, Types of DNA, Types of genetic material, denaturation and renaturation, cot curves.

DNA topology - linking number, topoisomerases; Organization of DNA- Prokaryotes, Viruses, Eukaryotes.

RNA Structure

Organelle DNA -- mitochondria and chloroplast DNA.

Unit 3. Genome Structure, Chromatin and the Nucleosome (Ch 7 Watson/ Ch 18 Becker)

Genome Sequence and Chromosome Diversity, Chromosome Duplication and Segregation,

The Nucleosome

Chromatin structure- Euchromatin, Heterochromatin- Constitutive and Facultative heterochromatin.

Regulation of Chromatin Structure and Nucleosome Assembly.

Organization of Chromosomes

Unit 4. The Replication of DNA (Prokaryotes and Eukaryotes) (Ch 8 Watson/ Ch 19 Becker)

Chemistry of DNA synthesis, general principles - bidirectional replication, Semi-conservative, Semi discontinuous,RNA priming, Various models of DNA replication including rolling circle, D-loop (mitochondrial), Θ (theta) mode of replication, replication of linear ds-DNA, replicating the 5'end of linear chromosome. Enzyme involved in DNA replication – DNA polymerases, DNA ligase, Primase, Telomerase and other accessory proteins

Unit 5. The Mutability and Repair of DNA (Ch 9 Watson)

Replication Errors, DNA Damage and their repair.

PRACTICALS FOR MOLECULAR BIOLOGY-I

1. Preparation of Polytene chromosome from *Chironomous* larva/*Drosophila* larva
2. Demonstration of mammalian sex chromatin.
3. Preparations of temporary mount and study the different stages of Mitosis (Onion root tip).

4. Perform Southern Blot Hybridization (Restrict DNA for Southern Blot electrophoresis, perform electrophoresis of restricted DNA, perform southern transfer, hybridization and detection of gene of interest).
5. Demonstration of Southern Blotting.
6. Demonstration of Northern Blotting.
7. Demonstration of Western Blotting.
8. Demonstration of PCR technique

REFERENCE BOOKS

1. Karp, G. (2010). Cell and Molecular Biology: Concepts and Experiments. VI Edition. John Wiley & Sons. Inc.
2. De Robertis, E.D.P. and De Robertis, E.M.F. (2006). Cell and Molecular Biology. VIII Edition. Lippincott Williams and Wilkins, Philadelphia.
3. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. (2009). The World of the Cell. VII Edition. Pearson Benjamin Cummings Publishing, San Francisco.
4. Watson, J. D., Baker T.A., Bell, S. P., Gann, A., Levine, M., and Losick, R., (2008) Molecular Biology of the Gene (VI Edition.). Cold Spring Harbour Lab. Press, Pearson Pub.

Paper 13: BIOCHEMISTRY

Total No of Lectures per week = 4 Total Lectures per semester = 60

1. Biomolecules

(Chapter 3,4,7,8 and 10: Nelson and Cox) (8 Lectures)

Over view of amino acids, proteins and carbohydrates**.**

Lipids- Fatty acids, triacyl glycerols; glycerophospholipids, sphingolipids, sterols.

Nucleic acids- Nucleotides, Nitrogenous Bases- Purines and Pyrimidines; tautomers of bases, nucleotide derivatives, nucleotides as regulating molecules, different types of DNA and RNA

2. Enzymes Classification- Kinetics and Control

(Chapter 6: Nelson and Cox) (8 Lectures)

The Michaelis-Menten equation-derivation and physiological significance, the double reciprocal plots, kinetics of multisubstrate reactions, enzyme inhibition, turn over number of enzymes, *Regulatary enzymes*: General properties of allosteric enzymes, theories of allosteric regulation, regulation by covalent modification, kinetics, multienzyme complexes, negative and positive cooperativity, zymogens, isoenzymes, abzymes, ribozymes. *Mechanisms* of enzyme-catalysis, specificity, reactions rate, equilibrium, interaction between an enzymes and substrate, role of binding energy, acid base and covalent catalysis, lock and key & induced fit theories.

3. Coenzymes

(Chapter 6: Nelson and Cox) (2 Lectures)

Classifications (metabolite derived/vitamin derived) function of various types, structure of NAD^+, $NADP^+$, FAD & FMN,

4. Metabolism and Bioenergetics

(Chapter 13: Nelson and Cox) (4 Lectures)

Principles of bioenergetics-Standard free energy change, experimental measurement of ÎG, ATP and other reaction molecules, metabolic roles of ATP-Phosphoryl group transfer, nuleotidyl group transfer, biological oxidation-reduction reactions. General scheme of studying metabolic pathways, their local and global regulatory agents, energetics, disorders associated with the malfunctioning of pathways.

5. Metabolic Pathways:

(Chapter 14,16,17,21,18,22: Nelson and Cox) (32 Lectures)

Carbohydrates metabolism: **8**

Glycolysis, alcoholic and lactic acid fermentation, Pasteur Effect, gluconeogenesis, Cori-cycle, glucose-alanine cycle, futile cycle. TCA cycle, HMP shunt, glycogenolysis & glycogen synthesis.

Disorders associated with defects in carbohydrate metabolism- a brief account on fructose intolerance, lactose intolerance, lactic acidosis, disorders related to glycogen metabolism, genetic deficiency of Glucose-6-phosphate dehydrogenase, Galactosemia, pentosuria, Diabetes Mellitus (NIDDM and IDDM)

Lipid metabolism: **8**

Mobilization of triglycerides, metabolism of glycerol, *β-oxidation* of saturated, mono-unsaturated and poly-unsaturated fatty acids, even and odd chain fatty acids. Ketone bodies.

Biosynthesis of fatty acids, fatty acid elongation and desaturation, biosynthesis of triacylglycerols.

Disorders associated with defects in Lipid metabolism: Refsum's disease, Gaucher's disease, Niemann Pick's disease, Tay Sach's disease

Metabolism of amino acids: **8**

Assimilation of Ammonia: its incorporation in glutamate, glutamine and alanine as nitrogen carrier, regulation of glutamate dehydrogenase and glutamine synthetase, transamination reactions-role of pyridoxal phosphate, nitrogen excretion and *urea cycle*.

An overview of degradation pathways of amino acids with detailed pathway of phenylalanine and branched chain amino acids.

Disorders associated with defects in protein and amino acid metabolism: disorder associated with deficiency of Urea cycle enzymes, Phenylketonuria, Alcaptonuria, Maple syrup urine disease, tyrosinemia

Metabolism of Nucleotides: **8**

Brief outline of *Denovo* synthesis of purines and pyrimidines, salvage pathway, reduction of ribonucleotides to deoxyribonucleotides, degradation of purines and pyrimidines, nucleotide analogs as chemotherapeutic agents.

Disorders associated with defects in nucleotide metabolism- Gout, Lesch Nyhan Syndrome, SCID, Orotic aciduria.

6. Electron-transport chain (ETC) and oxidative phosphorylation: (Chapter 19: Nelson and Cox) (6 Lectures)

Constituents of ETC & their sequence (Complex I-IV) & location, inhibitors of ETC, chemiosmotic theory, ATP synthase complex- structure and function, dicarboxylic acid shuttle, glycerol phosphate shuttle, P:O ratio, regulation of oxidative phosphorylation.

REFERENCE BOOKS FOR THEORY PAPER

Text Books:

1. Lehningers Principles of Biochemistry, David L. Nelson and Michel M. Cox., 5th Edition, WH Freeman, 2008.

References Books:

1. Biochemistry, Lubert Stryer, 6th Edition, WH Freeman, 2006.
2. Harper's illustrated Biochemistry by Robert K. Murray, David A Bender, Kathleen M. Botham, Peter J. Kennelly, Victor W. Rodwell, P. Anthony Weil. 28th Edition, McGraw Hill, 2009.
3. Biochemistry, Donald Voet and Judith Voet, 2nd Edition, Publisher: John Wiley and Sons, 1995.

4. Biochemistry by Mary K.Campbell & Shawn O.Farrell, 5th Edition, Cenage Learning, 2005.

PRACTICAL FOR BIOCHEMISTRY

Periods per week = 04

1. Separation of Biomolecules by electrophoresis.
2. Qualitative analysis of sugars.
3. To study the principle of spectrophotometer and verify Beer's law.
4. To plot absorption spectrum of DNA and protein and find λmax.
5. Quantitative estimation of DNA/RNA.
6. Quantitative estimation of protein using spectrophotometer.
7. To perform biochemical assay of an enzyme under optimal conditions.
8 To study the effect of pH/temperature/heavy metals on the activity of enzymes (any one factor).
9. To determine Km and Vmax of an enzyme.
10. Case studies related to metabolic disorders (Tay Sach / Niemann Pick, von Gierke's / Galactosemia, Phenylketonuria / Maple syrup, Gout /ADA)

REFERENCE BOOKS FOR PRACTICAL PAPER

1. Introductory Practical Biochemistry by S.K. Sawhney and R. Singh, 2nd Edition, Alpha Science International, 2005.
2. Principles and Techniques of Practical Biochemistry, Keith Wilson (Editor), John Walker (Editor), John M. Walker, 5th Edition, Cambridge University Press, 2000.

Paper 14: MEDICINAL CHEMISTRY

Total No of Lectures per week = 4 Total Lectures per semester = 60

1. General Introduction:

(2 Lectures)

Definition and scope of medicinal chemistry

2. Principles of drug design

(Chapter 2: Silvermann) (6 Lectures)

Strategies in the search for new lead compounds
Analogue synthesis versus rational drug design,
Prodrugs

3. Physicochemical principles of drug action

(Chapter 13: Patrick) (16 Lectures)

Partition coefficient, drug dissolution, acid-base properties, surface activity, bioavailablity, stereochemical aspects of drug action, electronic structure (Hammet correlations), determining relationship between chemical and biological data (Hansch approach.)

4. Introduction to Quantitative Structure Activity Relationships

(Chapter 13: Patrick) (6 Lectures)

Statistical techniques behind QSAR, classical QSAR

5. Measurement of drug effects

(Chapter 3: Nogrady) (10 Lectures)

Kinetic analysis of ligand receptor interactions using Schatchard, double reciprocal plot, Hill plot, forces involved, relationship between dose and effect (graded and quantal response)

6. Drug target classification

(16 Lectures)

Proteins as drug targets

(Chapter 4,5: Patrick)

Enzymes: Enzyme inhibitors (competitive, non-competitive, suicide inhibitors), medicinal use of enzyme inhibitors. 4
Receptors: The receptor role, ion channels, membrane bound enzyme activation, agonist and antagonists, concept of inverse agonist, desensitization and sensitization of receptors, affinity, efficacy and potency. 8

Nucleic acids as drug targets

(Chapter 7: Patrick)

Classes of drugs that interact with DNA: DNA intercalators (amsacrine), Groove binders (netropsin), DNA alkylators (amines: mechlorethamine, nitrosoureas: carmustine), Antisense therapy (Introduction). 4

7. Introduction to combinatorial synthesis

(Chapter 2: Silvermann; Chapter 14: Patrick) (4 Lectures)

Methods of parallel synthesis, methods in mixed combinatorial synthesis (mix and split method), limitations of combinatorial synthesis.

REFERENCE BOOKS FOR THEORY PAPER

Text Books:

1. Introduction to Medicinal Chemistry: Graham l. Patrick, 3rd Edition, Oxford University Press, 2006.
2. The Organic Chemistry of Drug Design and Drug Action: Richard B. Silvermann, 2nd Edition, Elsevier, Academic Press, 2004.
3. Medicinal Chemistry: A Molecular and Biochemical Approach: Thomas Nogrady and Donal F. Weaver, 3rd Edition, Oxford University Press, 2004.

Reference Books:

1. Wilson Gisvold textbook of Organic Medicinal and Pharmaceutical Chemistry: Edited by Block & Beale, 11th Edition, Baltimore, Lippincot, 2004.
2. The Practice of Medicinal Chemistry: Camille G. Wermuth, 2nd Edition, Academic Press, 2003.
3. Principles & Practice of Medicinal Chemistry: Frank. D. King. 2nd Edition, The Royal Society of Chemistry, 2002.
4. Principles of Medicinal Chemistry: William O. Foye, David A. Williams, Thomas L. Lemke, 5th Edition, B.I. Baverly Pvt. Ltd., 2002.
5. Introduction to Medicinal Chemistry: How Drugs Act and Why, Alex Gringauz, 2nd Edition, Wiley-VCH, 2009.
6. Burger's Medicinal Chemistry and Drug Discovery: Edited by Daniel J. Abrahim, 6th Edition, Wiley Interscience, John, Wiley Sons, Inc., 2003.

PRACTICALS FOR MEDICINAL CHEMISTRY

Periods per week = 04

1. Preparation of Benocaine
2. Preparation of Benzoquinone
3. Preparation of Aspirin and determination of partition coefficient in octanol-water system
4. Preparation of Paracetamol
5. Preparation of Phenacetin
6. Extraction of caffeine from Tea leaves and study its absorption properties.
7. Preparation of Hippuric acid
8. Preparation of s-benzyl thiouronium salt
9. Effect of inhibitor (methotrexate) of NAD+ dependent enzyme activity

(Minimum of Eight practicals must be conducted from the given 12 practicals.)

REFERENCE BOOKS FOR PRACTICAL PAPER

1. Advance Practical Medicinal Chemistry by Ashutosh Kar, 4th Edition, Publisher New Age International Pvt. Ltd., 2007.

PAPER-15: CELL BIOLOGY-II

Unit 1. The Plasma Membrane (Ch 13 Cooper *et al.*)

Structure; Transport of small molecules, Endocytosis

Unit 2. Cell Wall, the Extracellular Matrix and Cell Interactions (Ch 14 Cooper *et al.*)

Bacterial and Eukaryotic Cell Wall; the extracellular matrix and cell matrix interactions; cell-cell interactions.

Unit 3. Cell Signaling (Ch 15 Cooper *et al.*)

Signaling molecules and their receptor; functions of cell su rface receptors; Intracellular signal transduction pathway; signaling networks.

Unit 4. The Cell Cycle (Ch 16 Cooper *et al.*)

Eukaryotic Cell Cycle, Regulation of Cell cycle progression, Events of Mitotic Phase, Meiosis and Fertilization.

Unit 5. Cell Death and Cell Renewal (Ch 17 Cooper *et al.*)

Programmed Cell Death, Stem Cells and Maintenance of adult tissues, Embryonic Stem Cells and Therapeutic cloning.

Unit 6. Cancer (Ch 18 Cooper *et al.*)

Development and Causes of Cancer, Tumor Viruses, Oncogenes, Tumor Suppressor genes, Cancer Treatment- molecular approach.

PRACTICALS

1. To demonstrate the presence of mitochondria in striated muscle cells using vital stain Janus Green B.
2. Study of polyploidy in Onion root tip by colchicine treatment.
3. Preparations of temporary mount of Grasshopper testis and study the different stages of Meiosis.
4. Study of mitosis and meiosis from permanent slides.
5. Identification and study of cancer cells –Slides/ photomicrographs

SUGGESTED BOOKS

1. Karp, G. (2010). Cell and Molecular Biology: Concepts and Experiments. VI Edition. John Wiley & Sons. Inc.
2. De Robertis, E.D.P. and De Robertis, E.M.F. (2006). Cell and Molecular Biology. VIII Edition. Lippincott Williams and Wilkins, Philadelphia.
3. Cooper, G.M. and Hausman, R.E. (2009). The Cell: A Molecular Approach. V Edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
4. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. (2009). The World of the Cell. VII Edition. Pearson Benjamin Cummings Publishing, San Francisco.

PAPER-16: MOLECULAR BIOLOGY-II

Unit 1. Mechanism of Transcription (Ch 12 Watson/ Ch 21 Becker)

RNA Polymerase and the transcription unit
Transcription in Prokaryotes
Transcription in Eukaryotes

Unit 2. RNA Modifications (Ch 13 Watson)

Split genes, concept of introns and exons, removal of Introns, spliceosome machinery, splicing pathways, alternative splicing, exon shuffling, RNA editing, and mRNA transport.

Unit 3. Translation (Prokaryotes and Eukaryotes) (Ch 14 Watson/ Ch 22 Becker/ Ch 21 DeRobertis)

Assembly line of polypeptide synthesis - ribosome structure and assembly, various steps in protein synthesis. Charging of tRNA, aminoacyl tRNA synthetases. Proteins involved in initiation, elongation and termination of polypeptides. Fidelity of translation. Inhibitors of protein synthesis.
Regulation of translation
Translation-dependent regulation of mRNA and Protein Stability.

Unit 4. Transcription Regulation in Prokaryotes (Ch 16 Watson)

Principles of transcriptional regulation, regulation at initiation with examples from *lac* and *trp* operons

Unit 5. Transcription Regulation in Eukaryotes (Ch 17 Watson)

Conserved mechanism of regulation, Eukaryotic activators, Signal integration, combinatorial control, transcriptional repressors, signal transduction and control of transcriptional regulator, Gene Silencing

Unit 6. Regulatory RNAs (Ch 18 Watson)

Riboswitches, RNA interference, miRNA, siRNA, Regulatory RNA and X-inactivation

PRACTICALS

1. Preparation of culture medium (LB) for *E.coli* (both solid and liquid) and raise culture of *E.coli.*
2. Demonstration of antibiotic resistance. (Culture of *E.coli* containing plasmid (pUC 18/19 in LB medium withor without antibiotic pressure and interpretation of results).
3. Isolation and quantitative estimation of salom sperm / calf thymus DNA using colorimeter (Diphenylamine reagent) or spectrophotometyer(A260 measurement).
4. To perform Ames test in *Salmonella/ E. Coli.* To study mutagenicity.

SUGGESTED BOOKS

1. Karp, G. (2010). Cell and Molecular Biology: Concepts and Experiments. VI Edition. John Wiley & Sons. Inc.
2. De Robertis, E.D.P. and De Robertis, E.M.F. (2006). Cell and Molecular Biology. VIII Edition. Lippincott Williams and Wilkins, Philadelphia.
3. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. (2009). The World of the Cell. VII Edition. Pearson Benjamin Cummings Publishing, San Francisco.
4. Watson, J. D., Baker T.A., Bell, S. P., Gann, A., Levine, M., and Losick, R., (2008) Molecular Biology of the Gene (VI Edition.). Cold Spring Harbour Lab. Press, Pearson Pub.

Paper 17: PHARMACOLOGY

Total No of Lectures per week = 4 Total Lectures per semester = 60

1. General Pharmacological Principles:

(Chapter 1: Tripathi) (4 Lectures)

Nature and source of drugs, Routes of drug administration.

2. Pharmacokinetics and Pharmacodynamics:

(Chapter 2,3: Tripathi) (16 Lectures)

Absorption, distribution, metabolism and excretion (ADME) of drugs (02), enzyme induction and inhibition (02), first pass metabolism, excretion and kinetics of elimination (04), factors responsible for drug receptor interactions (02), dose response relationships, drug potency and efficacy, therapeutic index (04), combined effect of drugs (synergism and antagonism), factors modifying drug action (02).

3. Drugs acting on Central Nervous System:

(Chapter 5: Tripathi) (12 Lectures)

i. Introduction to Central nervous system.
ii. General aneasthetics: principle, Inhalation and I.V. (halothane, propofol and ketamine).
iii. Sedatives & hypnotics: classification, valium.
iv. Anti-epileptic drug: (phenytoin).
v. Anti-parkinsonism drug: (syn-dopa), CNS stimulants (cocaine).
vi. Anti-alzheimer's drug: (Donepezil).

4. Drugs acting on Autonomic Nervous System:

(Chapter 5 (Section 2) 6,7,8: Tripathi) (12 Lectures)

i. Introduction to Autonomic nervous system.
ii. Cholinergics (acetylcholine, muscarine).
iii. Anti-cholinesterases (physostigmine, parathione).
iv. Adrenergic drugs (salbutamol, amphetamine).

5. Drugs acting on Peripheral Nervous System:

(Chapter 23,24: Tripathi) (2 Lectures)

Skeletal muscle relaxants (tubocurarine), local aneasthetics (procaine).

6. Anti-inflammatory drugs

(Chap 13: Tripathi) (2 Lectures)

NSAID's (probenecid, allopurinol).

7. Antimicrobial drugs and cancer chemotherapy

(Chapter 50,55,56,58, 60: Tripathi) (12 Lectures)

Antimicrobial drugs: General consideration, Antibacterial (tetracyclines), antiviral classification (acyclovir), antifungal (ketaconazole), protozoal classification (meteroinadazole) and cancer chemotherapy classification, general principles in cancer chemotherapy and toxicity of drugs.

8. Hormones

(Section 5: Chapter 18, 22: Tripathi) (4 Lectures)

Insulin, oral hypoglycemic drugs and glucagons (one example each); drugs affecting calcium balance (one example).

REFERENCE BOOKS FOR THEORY PAPER

Text Book:

1. Pharmacology by K.D. Tripathi, 6th Edition, Jaypee Brothers, 2008.

Reference Book:

1. Pharmacology H.P. Rang, M.M. Dale; J.M. Ritter and P.K. Moore, 5th Edition, Churchill Livingstone, 2003.

PRACTICALS FOR PHARMACOLOGY

Periods per week = 04.

A. General experiments

1. Handling of laboratory animals.
2. Routes of drug administration (Oral, I.M.)

B. Clinical Observation based experiments

3. Effect of analgesic (Tail-flick test)
4. Anti-anxiety effect of valium (Plus maze test)

C. Experiments on isolated tissue preparations.

5. Fixing of organ bath and kymograph
6. To record CRC of acetylcholine using guinea pig ileum / rat intestine
7. Determination of dose ratio.
8. Study of competitive antagonism using acetylcholine and atropine.

REFERENCE BOOKS FOR PRACTICAL PAPER

1. Hand book of Experimental Pharmacology, S.K. Kulkarni, 3rd Edition, Vallabh Prakashan, 2005.

Paper 18: BIOPHYSICS

Total No of Lectures per week = 4 Total Lectures per semester = 60

1. Biophysical Methods: Basic principles and applications

(30 Lectures)

Spectroscopic techniques:

(Chapter 5: Freifelder) (12)

Basic principles of electromagnetic radiation, energy, wavelength, wave numbers and frequency. Review of electronic structure of molecules (Molecular Orbital theory), absorption and emission spectra. Beer-Lambert law, light absorption and its transmittance. UV and visible spectrophotometry-principles, instrumentation and applications. fluorescence spectroscopy, static & dynamic quenching, energy transfer, fluorescent probes in the study of protein, nucleic acids, Infra-red spectroscopy, light scattering in biology, circular dichroism, optical rotatory dispersion, magnetic resonance spectroscopy.

Hydrodynamic methods:

(Chapter 7: Sheehan) (8)

Viscosity: theory, measurement of viscosity, relation between intrinsic viscosity and molecular weight, measurement of visco-elasticity of DNA; (ii) Sedimentation: Basic principles of centrifugation. Differential, density gradient, isopycnic and equilibrium centrifugation. Preparative and analytical ultracentrifugation techniques. Determination of molecular weight by centrifugation method (Derivation included), (iii) Flow Cytometry: Design, Cell sorting, detection strategies in flow cytometry.

Biosensors: Various types of biosensors.

(Chapter15: Wilson and Walker) (2)

2. Molecular Biophysics

(Chapter 1, 6, 7: Van Holde) (12 Lectures)

Forces involved in biomolecular interactions, Ramachandran plot, dihedral / torsional angles, supercoiling of DNA (linking, twisting, and writhing- brief ideas), Interaction of ligands with biomolecules. Protein folding (Myoglobin, ribosome), use of various techniques to determine the native state of protein (UV, Florescence).

3. Biological membranes:

(Chapter 12: Hoppe) (8 Lectures)

Colloidal solution, Micelles, reverse micelles, bilayers, liposomes, phase transitions of lipids, active, passive and facilitated transport of solutes and ions, Fick's Laws, Ionophores, transport equation, membrane potential, water potential.

4. Radiation Biophysics:

(Chapter 6,7: Hoppe) (10 Lectures)

Introduction of radiations, Atomic structure, radiation, types of radioactive decay, half-life, units of radioactivity. Use of radioisotopes in Biology: Effect of radiations (ionising and non-ionizing) on living systems. Detection and measurement of radioactivity-methods based upon ionization (GM counter), methods based upon excitation (scintillation counter), Autoradiography and isotope dilution techniques, Examples of radioisotopes in the elucidation of metabolic pathways, radio dating, safety measures in handling radio isotopes.

REFERENCE BOOKS FOR THEORY PAPER

Text Books:

1. Physical Biochemistry, David Freifelder, Applications to Biochemistry and Molecular Biology, 2nd Edition, W.H. freeman and Company, 2005.
2. David Sheehan, Physical Biochemistry: Principles and Applications, 2nd Edition, John Wiley, 2009.
3. Keith Wilson and John Walker, Principles and Techniques of Biochemistry and Molecular Biology, 6th Edition, Cambridge University Press, 2005.
4. K.E. Van Holde, W.C. Jhonson and P. Shing Ho, Principles of Physical Biochemistry, 2nd Edition, Prentice-Hall Inc, 1998.
5. Hoppe *et. al.*, Biophysics, Translation of 2nd German Edition, Springer Verlag, 1983.

Reference Books:

1. Principles of Instrumental Analysis, D.A. Skoog *et. al.,* 5th Edition, Saunders College Publishing, 1998.
2. Biophysical Chemistry by C.R. Cantor, P.R. Schimmel, W.H. Freeman & Company, 1980.
3. Biophysics by Vasantha Pattabhi, 2nd Edition, N. Gautham Alpha Science Intl Ltd., 2010.

PRACTICALS FOR BIOPHYSICS

Periods per week = 04.

1. Determination of viscosity of a macromolecule (Protein/DNA)
2. Effect of different solvents on UV absorption spectra of proteins.
3. Study of structural changes of proteins at different pH using UV Spectrophotometry.
4. Study of structural changes of proteins at different temperature using UV Spectrophotometry.
5. Analysis, identification and comparison of various spectra (UV, NMR, MS, IR) of simple organic compounds.
6. Differentiate single stranded DNA from double stranded DNA.

REFERENCE BOOKS FOR PRACTICAL PAPER

1. Introductory Practical Biochemistry by S.K. Sawhney and R. Singh, 2nd Edition, Alpha Science International, 2005.
2. Principles and Techniques of Practical Biochemistry by Keith Wilson, John Walker, John M. Walker, 5th Edition, Cambridge University Press, 2000.

Paper 19: CLINICAL BIOCHEMISTRY

Total No of Lectures per week = 4 Total Lectures per semester = 60

1. Basic concepts and scope.

(Chapter 1: Harper) (2 Lectures)

2. Enzymes: Distribution and diagnostic significance.

(Chapter 19: Tietz; Chapter 11: Chatterjea and Shinde) (8 Lectures)

Clinical significance and interpretation of diagnostically important enzymes and iso-enzymes: creatine kinase, lactate dehydrogenase, alanine- & aspartate aminotransferases, alkaline phosphatase, acid phosphatase, cholinesterase with a detailed account of the biochemical reactions catalysed by these enzymes and of their clinical assays.

3. Hormones.

(Chapter 23: Nelson and Cox; Chapters-41 and 42: Harper) (10 Lectures)

Classification (with reference to their biochemical nature, mechanism of action (one example from each class of hormones) with special reference to epinephrine and thyroid hormones (T3 & T4); functions.

4. Biomolecules, their Structural Complexities and Diseases associated with them.

(Chapters 7, 10 and 21: Nelson and Cox; Devlin- pages: 730, 740, 752-754, 766-770, 960-961, 1109- 1112, 1127- 1129; and Chapters, 15 and 26: Harper) (12 Lectures)

Carbohydrates

Sugars as information molecules; detailed account on Lectins; Dietary fibres and glycoconjugates.

Lipids

Lipoproteins- types (chylomicron, VLDL, LDL, HDL); disorders of lipoprotein metabolism (hypercholesterolemia, Atherosclerosis, Alzheimer's disease). Plasmalogens-biosynthesis, functions. Other ether lipids like Platelet activating factor and its function. Prostaglandins-classification, biosynthesis, role of COX-1, COX-2, NSAIDS in synthesis; functions. Steroids-Cholesterol: biosynthesis and regulation, inhibitors of cholesterol biosynthesis (Statins-structure and mechanism of action); bile acids-structure, metabolism and function; hyperbilirubinemia- conjugated and unconjugated; vitamin D3; gall stones.

5. Vitamins.

(Chapter 27: Tietz; Chapter 9: Chatterjea and Shinde) (10 Lectures)

Definition, classification; chemistry and sources, absorption, transport, requirement and RDA, effects of deficiency and excess.

6. An overview of Integrative Metabolism.

(Chapter 23: Nelson and Cox) (6 Lectures)

7. Biochemical analysis of body fluids- blood, urine, saliva, CSF.

(Chapters 5, 33, 34 and 38: Chatterjea and Shinde) (10 Lectures)

Specimen collection and processing; blood proteins as normal and abnormal constituents; detailed account on Liver function test (LFT) and Kidney function test (KFT).

REFERENCE BOOKS FOR THEORY PAPER

Text Books:

1. Tietz Fundamentals of Clinical Chemistry. 6th Edition, Elsevier, 2008.
2. Harper's Illustrated Biochemistry 28th Edition McGraw Hill, 2009.
3. Principles of Biochemistry by Nelson and Cox, 4th Edition, 2005.
4. Biochemistry with Clinical Correlation, Devlin, 6th Edition, John Wiley & Sons, 2006.
5. Textbook of Medical Biochemistry, Chatterjea & Shinde, 5th Edition, Jaypee Publications, 2004.

Reference books:

1. Biochemistry by D.Voet and J.Voet, 3rd Edition, J. Wiley & Sons, 2008.

PRACTICALS FOR CLINICAL BIOCHEMISTRY

Periods per week = 04.

1. Preparation of serum and plasma from whole blood.
2. Quantitative determination of the following in the whole blood/plasma/serum:

i. LFT:

a.	SGPT and SGOT	b.	Alkaline phosphatase		
c.	Bilirubin	d.	Creatine kinase		

ii. KFT:

e.	Urea	f.	Uric acid

iii. Metabolites:

g.	HDL, LDL and triglycerides	h.	Serum protein A: G ratio	i.	Serum glucose

iv. Hormonal profile:

j. T3/T4, TSH

3. Two-three case studies based on above quantitative studies performed.

REFERENCE BOOK FOR PRACTICAL PAPER

Text Book:

1. Medical Laboratory Technology, Ramnik Sood; Jaypee Brothers Medical Publishers, 2009.
2. Tietz Fundamentals of Clinical Chemistry. 6th Edition, Elsevier, 2008.

PAPER-20: GENETICS AND GENOMICS-I

Unit 1. Introduction to Genetics (Ch 1 Klug and Cummings)

Mendel's work on transmission of traits, Genetic Variation, Molecular basis of Genetic Information.

Unit 2. Mitosis and Meiosis (Ch 2 Klug and Cummings)

Interrelation between the cell structure and the genetics function, Mitosis, Meiosis (explaining Mendel's ratios).

Unit 3. Mendelian Genetics and its Extension (Ch 3-4 Klug and Cummings)

Principles of Inheritance, Chromosome theory of inheritance, Laws of Probability, Pedigree analysis Incomplete and codominance, Multiple alleles, Lethal alleles, Epistasis, Pleiotropy, Environmental effects on phenotypic expression, sex linked inheritance.

Unit 4. Linkage, Crossing Over and Chromosomal Mapping (Ch 5 Klug and Cummings, Ch 7, Gardner)

Linkage and crossing over, Cytological basis of crossing over, Molecular mechanism of crossing over, Recombination frequency as a measure of linkage intensity, two factor and three factor crosses, Interference and coincidence, Somatic cell genetics – an alternative approach to gene mapping.

Unit 5. Mutations (Ch 8 Klug and Cummings/ Ch 11 Gardner)

Chromosomal Mutations: Deletion, Duplication, Inversion, Translocation, Aneuploidy and Polyploidy; Gene mutations: Induced versus Spontaneous mutations, Back versus Suppressor mutations, Molecular basis of Mutations in relation to UV light and chemical mutagens, Detection of mutations: CLB method, Attached X method, DNA repair mechanisms.

Unit 6. Sex Determination (Ch 7 Klug and Cummings)

Chromosomal mechanisms, Environmental factors determining sex determination, Barr bodies, Dosage compensation.

Unit 7. Extrachromosomal Inheritance (Ch 9 Klug and Cummings/ Ch 20 Gardner)

Chloroplast mutation/Variegation in Four o' clock plant and *Chlymodomonas,* Mitochondrial mutations in *Neurospora* and yeast, Maternal effects, Infective heredity- Kappa particles in *Paramecium.*

Unit 8. Quantitative Genetics (Ch 25 Klug and Cummings/ Ch 21, Gardner)

Quantitative and multifactor inheritance, Transgressive variations, Heterosis.

PRACTICALS

1. Mendelian laws and gene interaction using Drosophila crosses.
2. Chi-square and probability.
3. Study to Linkage, recombination, gene mapping using marker based data from *Drosophila*.
4. Study of Human and *Phlox / Allium* Karyotype (normal and abnormal).
5. Pedigree analysis of some human inheritance traits.
6. Study of Hardy-Weinberg Law using simulations (seeds).

SUGGESTED BOOKS

1. Gardner, E.J., Simmons, M.J., Snustad, D.P. (2008). VIII ed. Principles of Genetics. Wiley India.
2. Snustad, D.P., Simmons, M.J. (2009). Principles of Genetics. V Edition. John Wiley and Sons Inc.
3. Klug, W.S., Cummings, M.R., Spencer, C.A. (2009). Concepts of Genetics. XI Edition. Benjamin Cummings.
4. Russell, P. J. (2009). *i*Genetics- A Molecular Approach. III Edition. Benjamin Cummings.
5. Glick, B.R., Pasternak, J.J. (2003). Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington.
6. Pevsner, J. (2009). Bioinformatics and Functional Genomics. II Edition. John Wiley & Sons.
7. Griffiths, A.J.F., Wessler, S.R., Lewontin, R.C. and Carroll, S.B. IX Edition. Introduction to Genetic Analysis.

Additional Readings

Both students as well as teachers of genetics can further benefit from knowledge of following topics as given below:-

- Epigenetics- http://www.nature.com/nrg/focus/epigenetics/index.html
- Tetrad Analysis in fungi
- Centromere Mapping
- Cytogenetic Mapping

Paper 21: TOXICOLOGY

Total No of Lectures per week = 4 Total Lectures per semester = 60

1. Introduction to Toxicology

(Chapter 1 and 2: Klaassen) (6 Lectures)

Definition, scope and different branches of toxicology, Spectrum of toxic doses, Classification of toxic agents, Characteristic of exposure, Spectrum of undesired effects, Interaction of chemicals and their toxic effect, Tolerance

2. Dose-Response relationship

(Chapter 2: Klaassen) (4 Lectures)

Graded and Quantal response, Hormesis, Assumption and evaluation of dose response relationship, Variation in toxic responses

3. Measuring toxicities

(Chapter 2: Klaassen; Chapter 1: Stine and Brown) (10 Lectures)

Toxicity testing methods, The LD_{50} Experiment, Acute, Short-Term and Chronic toxicities and its manifestations: Mode of application, administration, exposure and *in vitro* tests

4. Disposition of toxicants

(Chapter 5 and 6: Klaassen) (15 Lectures)

Absorption, Distribution, Metabolism and Excretion (ADME) of toxicants and chemicals, Xenobiotic Biotransformation by Phase I (Hydrolysis, Oxidation, and Reduction) and Phase II (Glucuronidation, Sulfation, Acetylation, Methylation and Conjugation reactions).

5. Mechanism of toxicity

(Chapter 3: Klaassen) (7 Lectures)

Delivery of the toxicant, Concept of ultimate toxicant, Reaction of the ultimate toxicants.

6. Toxic agents

(Chapter 22, 23 and 24: Klaassen and Whatkins) (12 Lectures)

Toxic effects of metals: Mercury, Lead, Arsenic, Fluoride; Source, exposure, absorption, target site interaction and health hazards.

Toxic effects of pesticides: Brief classification with examples; Residual and non-residual pesticides; Mode of entry and mode of action of pesticides in target and non-target organisms.

Toxic effects of solvents and vapours: Solvent-induced chronic encephalopathy, solvent abuse, Chlorinated hydrocarbons, fuel and fuel additives

7. Ecological Toxicology

(Chapter 29: Klaassen and Whatkins; Chapter 14: Stine and Brown) (3 Lectures)

Ecotoxicology: Chemical movement, fate and exposure; Biomarkers; Effects of Toxicants at the population, community and ecosystem level, Examples of ecosystems and vulnerability to toxicants

8. Applications of Toxicology

(Chapter 31 and 32: Klaassen and Whatkins) (3 Lectures)

Toxicologic investigation of a poison death, Therapeutic and Biological monitoring, Clinical Strategy for treatment of the Poisoned Patient.

REFERENCE BOOKS FOR THEORY PAPER

Text Books:

1. Cassarett and Doull's Toxicology: The Basic Science of Poison by Curtis D. Klassen 7th Edition, McGraw Hill Publishers, 2007.
2. Cassarett and Doull's Essentials of Toxicology by Klassen and Whatkins, 1st Edition, McGraw Hill Publishers, 2003.

Reference Books:

1. Principles of Toxicology by Karen E. Stine and Thomas M. Brown 2nd Edition, Taylor and Francis Publishers, 2006.
2. Lu's Basic Toxicology by Frank C. Lu and Sam Kacew 4th Edition. Taylor and Francis Publishers, 2002.
3. Introduction to Toxicology by John Timbrell 3rd Edition, Taylor and Francis, 2002.

TOXICOLOGY PRACTICALS

Periods per week = 04.

1. Toxicological Investigations and Therapeutic drug monitoring (At least two)

a. Perform a colour test to check the presence of salicylates in the given urine sample.
b. Indicate the presence of paracetamol in the given biological sample using the O-cresol test.
c. General screening for alcohols and acetone OR methanol and formaldehyde.
d. Testing for phenol toxicity.

2. Solvent Extraction and separation methods (any one)

a. Separation of a mixture of benzoic acid, □-naphthol and naphthalene by solvent extraction and identification of their functional groups.
b. Analysis of the given sample for the presence of pesticides

3. Water analysis (Perform any four analysis)

a. Determination of total dissolved solids.
b. Determination of dissolved oxygen of water (DO) using Winkler's Method.
c. Determination of biochemical oxygen demand (BOD) of water.
d. Determination of chemical oxygen demand (COD) of water.
e. Detection of coliforms to determine water purity using membrane filter method.
f. Perform quantitative estimation of residual chlorine in the given water sample.

g. To determine the total, permanent and temporary hardness of water by complexometric method using EDTA.

4. Other Misc. Experiments

a. Determine the acid value of the given oil sample.
b. Estimate the formaldehyde content of the given sample.
c. Estimation of LD_{50} value of an insecticide from the data provided.

(Perform at least one experiment from each group and in all at least eight practicals)

Paper 22: IMMUNOLOGY

Total No of Lectures per week = 4 Total Lectures per semester = 60

1. Introduction:

(Chapter 1: Kuby) (2 Lectures)

Historical background, general concepts of the immune system. Innate and adaptive immunity, Active and passive immunity. Primary and secondary immune response (Concepts and definitions).

2. Structure, properties and functions of the immune cells & organs:

(Chapter 2: Kuby) (3 Lectures)

Hematopoeisis, T and B lymphocyte, NK cells, Monocytes and macrophages; Neutrophils, eosinophils, basophils, Mast cells and dendritic cells. Thymus and bone marrow; Lymph nodes, spleen, MALT, GALT and SALT.

3. Innate Immune Response:

(Chapter 31: Prescott and Chapter 7: Kuby) (8 Lectures)

a. Skin, Inflammatory responses,Role of monocytes neutrophils, macrophages NKcells in innate immune responses. Mechanisms of pathogen killing by macrophages and neutrophils. (3)

b. Complement system: Components of the complement activation - classical, alternative and lectin pathways. Biological consequence of complement activation (5)

4. Adaptive immune response:

(Chapter 4,8,10 & 11: Kuby) (23 Lectures)

a. Concepts of primary and secondary immune response. Antigens and haptens: Properties (foreignness, molecular size, heterogeneity). B and T cell epitopes. T-dependent and T- independent antigens. (2)

b. Major Histocompatibility Complex: Organization of MHC and inheritance in humans. Concepts of polygeny and polymorphism with respect to MHC. (3)

c. Antigen presenting cells, antigen processing and presentation pathway (cytosolic and endocytic). (2)

d. Humoral immune response

Concepts of B cell development in bone marrow, generation of plasma cells and Memory B cells in lymphoid organs. (3)

Antibodies: Historical perspective of antibody structure .Structure, function and properties of the antibodies; Different classes and subclasses and biological activities of antibodies. Concepts of antibody diversity and class switching. (isotype, allotype and idiotype). Transport of IgA, Hybridoma technology, monoclonal antibodies Basic concepts of abzymes, immunotoxin, chimera ,hybrid antibodies. (6)

e. Cell mediated immune response.

T cell maturation in thymus, thymic selection, self MHC restriction of T cells, T cell receptor complex, Trimolecular complex formation between APC and NaiveT cells, clonal expansion, generation of effector and memory T cells. Cell types (CTLs, NK cells, macrophages and TDTH cells), effector mechanisms and effector molecules of cell mediated reactions. Assessment of cell-mediated cytotoxicity.

Cytokines - properties and functions of Interferon and Interleukins(IL1,IL2,IL4). (7)

5. **Immunological principles of various reactions and techniques**:

(Chapter 6: Kuby) (12 Lectures)

Affinity and avidity, cross reactivity, precipitation, agglutination, immunodiffusion, immunoelectrophoresis, ELISA (indirect, sandwich, competitive, chemiluminescence, and ELISPOT assay), western blotting, immunofluorescence, flow cytometry and fluorescence, and immunoelectron microscopy.

6. **Vaccines**

(Chapter 19: Kuby) (6 Lectures)

Types and their characteristics.Adjuvants, overview of National Immunization Programme.

7. **Dysfunctions of immune system:**

(Chapter 32: Prescott) (6 Lectures)

Hypersensitivity: Types with one example each.
Autoimmunity (general overview).
Immunodeficiency disorders: Animal models of primary immunodeficiency (nude mouse and SCID mouse). Specific impaired functions in lymphoid and myeloid lineage.

REFERENCE BOOKS FOR THEORY PAPER

Text Book:

1. Immunology by Kuby, 6th Edition J. W.H. Freeman and Company, New York, 2007
2. Microbiology, L. Prescott, John Ii Harley, Donald A. Klein, 7th Edition McGraw Hill.

Reference Books:

1. Essential Immunology by Roitt. I., 8th Edition, Blackwell Science, Oxford, 1994.
2. Immunology by Roitt, Brostoff and Male, 7th Edition, Mosby Edinburgh, 1991.
3. An Introduction to Immunology, Immunochemistry and Immunobiology Barrett, James T., 5th Edition, Mosby Company, St. Louis, 1988.
4. Immunology: An Introduction by I.R.Tizard, 4th Edition, Saunders College Publishing, Philadelphia, 1994.

PRACTICALS FOR IMMUNOLOGY

Periods per week = 04.

1. To perform immunodiffusion by Ouchterlony method.
2. Immunodiffusion by Mancini method
3. Analysis of the ouchterlony and Mancini method
4. To perform ELISA checkerboard experiment.
5. To perform Complement fixation assay
6. To perform Immuno affinity chromatography.
7. To perform Agglutination inhibition Assay
8. To perform sandwich ELISA.
9. To perform Immunoprecipitation

Special Paper 23a: BIOINFORMATICS

Total No of Lectures per week = 4 Total Lectures per semester = 60

1. Introduction to Bioinformatics

(Chapter 1: Ignacimuthu) (2 Lectures)

Definitions, important contributions, aim and task of bioinformatics, applications of bioinformatics in pharmaceuticals industry and business, challenges and opportunities

2. Information Networks

(Chapter 2: Ignacimuthu) (4 Lectures)

Introduction, computer and programs, internet, world wide web, browsers, EMBnet, and SRS, NCBI, HTTP, HTML and other URLs.

3. Databases, Tools and Uses.

(Chapter 5: Ignacimuthu and Chapter 13: Sundara Rajan & Balaji) (7 Lectures)

Introduction, biological databases, DNA sequence databases, specialized genomic resources, web address, protein primary sequences data bases, composite protein sequences databases secondary data bases, composite protein pattern databases, structure classification databases, web addresses.

4. DNA Sequence Analysis

(Chapter 4: Ignacimuthu and Chapter 14: Sundara Rajan & Balaji) (6 Lectures)

Introduction, why analyze DNA , gene structure and DNA sequences, feature of DNA sequence analysis, issue in the interpretation of EST searches, gene hunting, expression profile of a cell, cDNA libraries, and ESTS, different approaches to EST analysis, effect of EST data on DNA databases.

5. Sequence Alignment

(Chapter 3 & 4: Mount and Chapter 6: Ignacimuthu) (8 Lectures)

Algorithm, goals and type of alignment , study of similarities, scoring mutations, deletions and substitutions, dot plot , pair wise database searching, FASTA, BLAST, multiple sequence alignment.

6. Predictive methods using DNA and Protein Sequences

(Chapter 8 & 9: David Mount and Chapter 7: Ignacimuthu) (8 Lectures)

Gene-prediction strategies, programs, Proteins-prediction strategies, secondary structure prediction, intrinsic tendency of amino acids to form B turns, rotamer libraries, three dimensional structure, prediction comparative modeling, threading, energy bases prediction, protein prediction program, molecular visualization

7. Phylogenetic Analysis

(Chapter 8: Ignacimuthu) (8 Lectures)

Phylogenetics, cladestics and ontology, building phylogenetic trees, distance base methods and character bases methods, molecular approaches to phylogeny, phylogenetic analysis databases

8. Drug Discovery and Pharmainformatics

(Chapter 9: Ignacimuthu) (7 Lectures)

Discovering a drug, target identification and validation, identification the lead compounds, optimization of lead compounds, pharmacoinformatics, chemical libraries, search programming

REFERENCE BOOKS FOR THEORY PAPER

Text Books:

1. Basic Bioinformatics by S. Ignacimuthu, 1st Edition, S. J. Narosa Publishing House, 2005.
2. Bioinformatics: Sequence and Genome analysis by David W. Mount, Cold Spring Harbour Laboratory Press, 2001.

Reference Books:

1. Introduction to Bioinformatics by S. Sundara Rajan and R. Balaji. Himalaya Publishing House.
2. Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins by Andreas D. Baxevanis and B. F. Francis Ouellette, 2nd Edition, John Wiley & Sons, 2002.
3. Bioinformatics: Sequence, Structure and Databanks by Des Higgins and Willie Taylor. Oxford University Press, 2000.

PRACTICALS FOR BIOINFORMATICS (Special Paper)

Periods per week = 04.

1. Searching of scientific information using NCBI, or any search engine
2. Identification of gene using gene scan
3. Primer designing using software
4. Pair wise alignment and multiple sequence alignment.
5. Prediction of primary and secondary structure and various parameters in protein structure and function
6. Three dimensional analysis of protein molecule
7. Phylogenetic analysis.

Special Paper 23b: HUMAN GENETICS

Total No of Lectures per week = 4 Total Lectures per semester = 60

1. History of Human Genetics

(Chapter 1: Vogel and Motulsky) (1 Lecture)

2. Pedigree Analysis

(Chapter 3: Strachan and Read) (2 Lectures)

Gathering family history
Pedigree symbols and construction of pedigrees, inheritance pattern and risk assessment
Presentation of molecular genetic data in pedigrees

3. Patterns of Inheritance for Monogenic Traits

(Chapter 3: Strachan and Read) (9 Lectures)

a. Autosomal inheritance-dominant, recessive
b. Sex-linked inheritance
c. Sex-limited and sex-influenced traits
d. Mitochondrial inheritance
e. Deviations from the basic pedigree patterns- nonpenetrance, variable expressivity, pleiotropy, late onset, dominance problems, anticipation, genetic heterogeneity and uniparental disomy, spontaneous mutations and X-inactivation and dosage compensation
f. Mosaicism and chimerism
g. Consanguinity and its effects
h. Epigenetic modifications, imprinting

(Website: OMIM)

4. Human Genome Project:

(Chapters 4,13: Strachan and Read; Chapter 11:Cantor and Smith) (4 Lectures)

a. History, organization and goals of human genome project
b. Tools (Vectors- BAC, PAC, YAC and sequencing techniques) and approaches (Hierarchial and shotgun sequencing),
c. Outcomes and ethical issues.
d. Applications in human diseases

(For topics 1 and 3 refer to Human Genome Project site.)

5. Organization of the Human Genome:

(Chapters 7, 11: Strachan and Read) (5 Lectures)

a. General features: Gene density, CpG islands, RNA-encoding genes,
b. Gene clusters
c. Diversity in size and organization of genes
d. Types of repetitive DNA
e. Pseudogenes, gene families
f. Endoreplication and amplification
g. Genetic markers and their applications

6. Human Cytogenetics:
(Chapters 2,18: Strachan and Read; Chapter 7: Cantor and Smith) (5 Lectures)

a. Techniques (Karyotyping and FISH)
b. Human Karyotype: Banding pattern and nomenclature (G and Q banding)
c. Common syndromes due to numerical chromosome changes
d. Common syndromes due to structural alterations (translocations, duplications, deletions, microdeletion, fragile sites)
e. Common chromosome abnormalities in cancer.

7. Techniques for Genomics:
(Chapter 6: Strachan and Read) (4 Lectures)

a. DNA sequencing
b. DNA fingerprinting
c. Polymorphism screening (Genotyping of SNPs and Microsatellite markers)
d. Expression analysis and proteome analysis

8. Mapping strategies:
(Chapters 6, 8: Cantor and Smith) (3 Lectures)

a. Physical Maps (different types- restriction and cytogenetic maps)
b. Genetic Maps

9. Identification of Genetic Basis of Disease:
(Chapter 13: Cantor and Smith; Chapter 3: Vogel and Motulsky) (6 Lectures)

a. Principles and strategies
b. Positional and Candidate Gene approaches, Positional- cloning approach
Examples- HD, CFTR
c. Concept of Twin and Adoption Studies

10. Population Genetics:
(Chapters 3,12: Strachan and Read) (4 Lectures)

a. Genotypic and Allelic frequencies
b. Linkage Disequilibrium
c. Haplotype construction (two loci using SNPs and/or microsatellites)

11. Prenatal Diagnosis
(Chapter 18: Vogel and Motulsky) (2 Lectures)

a. Brief introduction
b. Methods of prenatal diagnosis

12. Clinical Genetics:
(Chapters 7, 10: Vogel and Motulsky; Chapter 11,12,15: Wilson) (6 Lectures)

a. Inborn errors of metabolism and their genetic basis (Example- Phenylketonuria)
b. Genetic disorders of Haemopoietic systems (Examples- Sickle cell anemia and Thalassemia)
c. Genetic basis of color blindness
d. Genetic basis of Familial Cancers (Example- Retinoblastoma)
e. Genetics of infertility and in vitro fertilization
f. Genetics of Mental Retardation

13. Implications of Genome Research:
(Chapters 7,18: Vogel and Motulsky; Chapter 6,17: Pasternak) (9 Lectures)

a. Diagnosis and screening of Genetic Disorders
b. Prenatal genotyping for mutations in β- globin gene and sickle cell aneamia
c. DNA profiling: establishing identity and relationships
d. Applications in personalized medicine (Genetic polymorphism in drug metabolism genes e.g. CytP450 and GST and their effect on drug metabolism and drug response)
e. Genetic counseling

REFERENCE BOOKS FOR THEORY PAPER

Text Books:

a. Strachan and Read. Human Molecular Genetics. 2nd Edition. John Wiley and Sons, 1999.
b. Cantor and Smith. Genomics. 1999, John Wiley and Sons, Inc.
c. Vogel and Motulsky. Human Genetics: Problems and Approaches. 3rd Edition. Springer Verlag, 1997.
d. G.N. Wilson. Clinical Genetics: A short Course. Wiley-Liss, 2000.
e. J.N. Pasternak. An introduction to Human Molecular Genetics, 2nd Edition, Wiley-Liss, 2005.

PRACTICALS FOR HUMAN GENETICS

Periods per week = 04.

1. Demonstration of Giemsa-stained Human chromosome preparation under microscope.
2. Karyotyping with the help of photographs.
3. Abnormal karyotypes and chromosome aberrations.
4. PTC testing to prove monogenic inheritance.
5. Preparation of Pedigree charts of some common characters like Tongue rolling, Ear 6. lobes, Blood group, Color blindness.
7. Polymorphism analysis using PCR.
8. Website based analysis.
9. Haplotype construction.

Special Paper 23c: MEDICAL BIOTECHNOLOGY

Total No of Lectures per week = 4 Total Lectures per semester = 60

1. Introduction to Biotechnology

(Chapter 1,2: Primrose and Twyman) (1 Lectures)

Brief history and Importance.

2. DNA Manipulation

(Chapter 3: Primrose and Twyman) (5 Lectures)

Isolation and purification of genomic and plasmid DNA: Restriction and modification systems, Type I-IV restriction endonucleases, nomenclature and sequence recognition, restriction mapping.

3. Cloning Vectors

(Chapter 4,5: Primrose and Twyman) (8 Lectures)

Basic biology of plasmid and phage vectors (pBR322 and pUC vectors, T-vectors); *expression vectors* examples of prokaryotic and eukaryotic expression vectors; Inducible and constitutive expression vectors with one example each; *Bacteriophage λ vectors*-replacement & insertion vectors, *in vitro* packaging, cosmids, phasmids, brief life cycle and DNA replication of phage M13 and its vectors. Joining DNA molecules: ligase, adaptors, linkers, homopolymer tailing.

4. Cloning and Expression of cloned genes in

(Chapter 11: T.A. Brown) (8 Lectures)

a. Prokaryotic cells (4)

b. Eukaryotic cells (4)

Challenges in expression of foreign proteins in heterologous host; factors affecting the expression-host cell physiology, promoters, codon choice, plasmid copy no. etc.; expression in eukaryotic cells (yeast expression system, Baculovirus system; Shuttle vectors, ligation, transformation and selection procedures (blue/white and antibiotic selection methods).

5. Polymerase chain reaction (PCR)

(Chapter 9: Sambrook and Russell) (5 Lectures)

Principle and applications, primer-design, brief overview of various PCR techniques: inverse-, multiplex-, hotstart-, touchdown, nested PCR; RT-PCR

6. Construction of genomic and cDNA libraries, Screening & Selection of Recombinants

(Chapter 6: Primrose and Twyman) (7 Lectures)

Choice of vector, immunochemical methods of screening, nucleic acid hybridisation (Colony and Plaque hybridisation), gene probes, south-western screening.

7. Sequencing of DNA

(Chapter 7: Primrose and Twyman) (3 Lectures)

Conventional and modern Methods and analysis of sequence DATA.

8. Random and Site-directed mutagenesis

(Chapter 8: Primrose and Twyman) (8 Lectures)

Cassette mutagenesis, Primer extension methods, PCR methods of site directed mutagenesis, screening and identification of mutants, protein engineering- subtilisin, oxidation- resistant variants of ά- antitrypsin (AAT).

9. Application of Medical Biotechnology

(Chapter 14 and 16: T.A. Brown) (7 Lectures)

a. Production of recombinant biomolecules: (3)
Insulin, somatostatin, and recombinant factor VIII

b. DNA Profiling: (4)
Introduction, DNA profiling based on STRs, minisatellites, RFLP, AFLP, SNPs.

10. Genetic manipulation of animals

(Chapter 11: Primrose, Twyman and Old) (6 Lectures)

Transgenesis in mice: pronuclear microinjection; Transfection of Embryonic stem cells, Gene targeting in ES cells, Designing targeting vectors, Selection strategy, Application of genetically modified mice; Application of gene targeting; Nuclear transfer technology, Gene transfer in Zebra fish; Transgenic flies-Drosophila P-elements,

11. Protein interaction technologies

(Chapter 11: T.A. Brown) (2 Lectures)

Basics and applications: Phage display, yeast two-hybrid system,

REFERENCE BOOKS FOR THEORY PAPER

Text Books:

1. Principles of Gene Manipulation and Genomics (7th Edition) by S.B.Primrose and R.M.Twyman, 2006.
2. Gene cloning and DNA Analysis (5th Edition) by T.A. Brown, Blackwell Publishing, 2006.

Reference Books:

1. Genes IX by Benjamin Lewin, Johns and Bartlett Publisher, 2006.
2. Modern Biotechnology, 2nd Edition, S.B. Primrose, Blackwell Publishing, 1987.
3. Molecular Biotechnology: Principles and Applications of Recombinant DNA, 3rd Edition, B.R. Glick and J.J. Pasternak, 2003.
4. Molecular Biotechnology: Principles and Applications of Recombinant DNA, 4th Edition, B.R. Glick, J.J. Pasternak and C.L. Patten, 2010.
5. Molecular Cloning: A Laboratory Manual (3rd Edition) Sambrook and Russell Vol. I to III, 1989.
6. Principles of Gene Manipulation 6th Edition, S.B.Primrose, R.M.Twyman and R.W. Old. Blackwell Science, 2001.

PRACTICALS FOR MEDICAL BIOTECHNOLOGY

Periods per week = 04.

1. Separation of DNA by agarose electrophoresis.
2. Extraction of DNA from agarose gel
3. Analysis of DNA sequences
4. Preparation of solutions for acrylamide gel electrophoresis.
5. To perform Native PAGE for DNA.
6. To perform Native PAGE for protein.
7. To perform SDS-PAGE for proteins and analyse the result
8. Application of PCR and Analysis of the PCR amplicon

REFERENCE BOOKS FOR PRACTICAL PAPER

1. Molecular Cloning: A laboratory Manual (3rd Edition) Sambrook and Russell Vol. I to III, 1989.

Special Paper 23d: SOCIAL AND PREVENTIVE MEDICINE

Total No of Lectures per week = 4 Total Lectures per semester = 60

1. Concepts of Health and Disease:

(Chapter 2: Park) (3 lectures)

Definition of health, determinants of health. Agent, host and environmental factors in health and disease. Multifactorial etiology of disease.

2. Principle of Epidemiology and Epidemiological methods:

(Chapter 3: Park) (10 lectures)

Terms used in describing disease transmission and control. Morbidity and mortality indicators. Measurements of epidemiological indicators, Epidemiology study designs. Concept of association, causation and bias. Screening for diseases.

3. Epidemiology of Communicable diseases:

(Chapter 5,7: Park) (20 lectures)

Extent of problem, Diagnosis- clinical and lab, Treatment and control, Health Programmes (if applicable)

Respiratory infections: measles, rubella, mumps, influenza, diphtheria, whooping cough, tuberculosis.

Intestinal infections: poliomyelitis, viral hepatitis, cholera, typhoid, food poisoning, acute diarrheal diseases

Arthropod-borne infections: dengue, malaria, filariasis, leismaniasis.

Zoonosis: rabies,

Surface infections: leprosy, HIV/AIDS

4. Epidemiology of Chronic non-communicable disease and conditions:

(Chapter 6: Park) (5 lectures)

Coronary heart disease, cancer, diabetes, hypertension, blindness

5. Nutrition and Health:

(Chapter 10: Park) (6 lectures)

Concept of Balanced Diet- nutritional requirement. Nutrition related disorders- Protein Energy Malnutrition, Vitamin A deficiency, Iron deficiency anemia, Iodine deficiency disorders.

6. Environment and Health:

(Chapter 12: Park) (4 lectures)

Water pollution: Indicators of water pollution, Prevention and Control

Air pollution: Indicators of air pollution, Prevention and Control

7. Reproductive and Child Health:

(Chapter 8: Park) (6 lectures)

Child Health, Maternal Health, Immunization, Population Control Measures.

8. Occupational Health:

(Chapter 13: Park) (2 lectures)

Basic Concepts (Silicosis and Byssinosis.)

9. Health Care system in India:

(Chapter 19: Park) (4 lectures)

Health planning, National Health Policy, Primary Health Care, Health Care delivery system in India

REFERENCE BOOKS FOR THEORY PAPER

Text Books:

1. Park's Textbook of Preventive and Social Medicine by K. Park. 15th Edition M/s Banarsi Das Bhanot Publishers, 1997.

PRACTICALS

SURVEYS / COMMUNITY BASED STUDIES ON THE TOPICS RELATED TO THEORY.

Periods per week = 04.

PAPER-24: GENETICS AND GENOMICS II

Unit 1. Genetic Analysis and Mapping in Bacteria and Bacteriophages Ch 6, Klug and Cummings/ Ch 5, Griffith *et al.*)

Conjugation; Transformation; Transduction, Recombination.

Unit 2. Genome Dynamics-Transposable genetic elements, Eukaryotic Viruses (Ch 22, Klug and Cummings/ Ch 14, Griffith *et al.*)

Prokaryotic transposable elements- IS elements, Composite transposons, Tn-3 elements; Eukaryotic transposable elements- Ac-Ds system in maize and P elements in *Drosophila*; Uses of transposons; Eukaryotic Viruses.

Unit 3. Developmental Genetics and Model System (Ch 19, Klug and Cummings)

Study of model systems in developmental genetics- *Drosophila melanogaster Sachharomyces cerevisiae, Caenorhabditis elegans, Arabidopsis thaliana,* and *Xenopus laevis*.

Unit 4. Genomics, Bioinformatics and Proteomics (Ch 21, Klug and Cummings/Ch 8-9, Russell/ Ch2, 3, 4 Ghosh, Z. and Mallick,V.)

Genomes of bacteria, *Drosophila* and Humans*;* Human genome project; Evolution and Comparative Genomics.

Introduction to Bioinformatics, Gene and protein databases; Sequence similarity and alignment; Gene feature identification.

Gene Annotation and analysis of transcription and translation; Post-translational analysis- Protein interaction.

Unit 5. Genomic Analysis- Dissection of Gene Function (Ch 23, Klug and Cummings)

Genetic analysis using mutations, forward genetics, genomics, reverse genetics, RNAi, functional genomics and system biology.

Unit 6. Population Genetics (Ch 27, Klug and Cummings)

Allele frequencies, Genotype frequencies, Hardy-Weinberg Law, role of natural selection, mutation, genetic drift.

Unit 7. Evolutionary Genetics (Ch 28, Klug and Cummings)

Genetic variation and Speciation.

PRACTICALS

1. Genomic DNA isolation from *E.coli* (without plasmid*)*.
2. Restriction enzyme digestion of genomic DNA from *E.coli*.
3. Isolation of plasmid DNA and genomic DNA together from *E.coli*. and restriction enzyme digestion.
4. Restriction enzyme digestion (EcoRI)of genomic and plasmid DNA obtained from Expt.3.
5. Estimation of size of a DNA fragment after electrophoresis using DNA markers.
6. Construction of Restriction digestion maps from data provided.
7. Demonstration of DNA fingerprinting.

SUGGESTED BOOKS

1. Gardner, E.J., Simmons, M.J., Snustad, D.P. (2006). Principles of Genetics. VIII Edition John Wiley & Sons.
2. Snustad, D.P., Simmons, M.J. (2009). Principles of Genetics. V Edition. John Wiley and Sons Inc.
3. Klug, W.S., Cummings, M.R., Spencer, C.A. (2009). Concepts of Genetics. IX Edition. Benjamin Cummings.
4. Russell, P. J. (2009). *i*Genetics- A Molecular Approach. III Edition. Benjamin Cummings.
5. Glick, B.R., Pasternak, J.J. (2003). Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington.
6. Pevsner, J. (2009). Bioinformatics and Functional Genomics. II Edition. John Wiley & Sons.
7. Griffiths, A.J.F., Wessler, S.R., Lewontin, R.C. and Carroll, S.B. IX Edition. Introduction to Genetic Analysis.
8. Ghosh, Z. and Mallick,V. (2008). Bioinformatics-Principles and Applications. Oxford Univ. Press.