B.Sc. (H) Biomedical Science

THREE-YEAR FULL-TIME PROGRAMME
(Six-Semester Course)

COURSE CONTENTS

(Effective from the Academic Year 2010-2011)

UNIVERSITY OF DELHI

DELHI – 110 007
## Course Structure

### YEAR-1

#### PART I: Semester – 1

<table>
<thead>
<tr>
<th>Paper 1</th>
<th>LSPT 101</th>
<th>Biology – I : Introduction to Biology with Practicals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paper 2</td>
<td>BOHT 101</td>
<td>Human Physiology I with Practicals</td>
</tr>
<tr>
<td>Paper 3</td>
<td>CHCT 301</td>
<td>Chemistry I with Practicals</td>
</tr>
<tr>
<td>Paper 4</td>
<td>ENAT 101*/CSAT 101 *</td>
<td>Technical writing and Communication in English / Computational Skills</td>
</tr>
</tbody>
</table>

#### PART I: Semester – 2

<table>
<thead>
<tr>
<th>Paper 5</th>
<th>ENAT 201*/CSAT 201 *</th>
<th>Technical writing and Communication in English / Computational Skills</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paper 6</td>
<td>BOHT 202</td>
<td>Human Physiology II with Practicals</td>
</tr>
<tr>
<td>Paper 7</td>
<td>CHCT 402</td>
<td>Chemistry II with Practicals</td>
</tr>
<tr>
<td>Paper 8</td>
<td>MACT 303</td>
<td>Mathematics and Statistics</td>
</tr>
</tbody>
</table>

*The college will have an option to take either of the two papers in a particular semester for a particular course, while students have to appear in both the papers

In addition, there shall be one qualifying paper in self-learning mode called Environmental Studies offered in Semester-2

### YEAR-2

#### PART II: Semester – 3

<table>
<thead>
<tr>
<th>Paper 9</th>
<th>BOHT 303</th>
<th>Microbiology with Practicals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paper 10</td>
<td>BOHT 304</td>
<td>Pathology with Practicals</td>
</tr>
<tr>
<td>Paper 11</td>
<td>CBHT 301</td>
<td>Cell Biology I</td>
</tr>
<tr>
<td>Paper 12</td>
<td>MBHT 301</td>
<td>Molecular Biology I</td>
</tr>
<tr>
<td>Paper</td>
<td>Code</td>
<td>Course</td>
</tr>
<tr>
<td>---------</td>
<td>------------</td>
<td>---------------------------------------------</td>
</tr>
<tr>
<td>Paper 13</td>
<td>BOHT 405</td>
<td>Biochemistry with Practicals</td>
</tr>
<tr>
<td>Paper 14</td>
<td>BOHT 406</td>
<td>Medicinal Chemistry with Practicals</td>
</tr>
<tr>
<td>Paper 15</td>
<td>CBHT 402</td>
<td>Cell Biology II</td>
</tr>
<tr>
<td>Paper 16</td>
<td>MBHT 402</td>
<td>Molecular Biology - II</td>
</tr>
</tbody>
</table>

**YEAR-3**

**PART III: Semester – 5**

| Paper 17 | BOHT 507 | Pharmacology with Practicals                |
| Paper 18 | BOHT 508 | Biophysics with Practicals                  |
| Paper 19 | BOHT 509 | Clinical Biochemistry with Practicals       |
| Paper 20 | GGHT 501 | Genetics & Genomics I                       |

**PART III: Semester – 6**

| Paper 21 | BOHT 610 | Toxicology with Practicals                  |
| Paper 22 | BOHT 611 | Immunology with Practicals                  |
| Paper 23 | BOHT 612 | Special Paper with Practicals               |
| Paper 24 | GGHT 602 | Genetics & Genomics - II                    |

**CHOICES FOR SPECIAL PAPER: SEMESTER 6- Paper-23**

1. Bioinformatics (BOHT 612a)
2. Human Genetics (BOHT 612b)
3. Medical Biotechnology (BOHT 612c)
4. Social and Preventive Medicine (BOHT-612d)
Preamble

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

The Selection of students will be based on PCB as per University guidelines as 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.
Paper 1-LSPT 101: BIOLOGY-I (INTRODUCTION TO BIOLOGY)

THEORY

Marks: 100

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

Paper 1-LSPP 101: BIOLOGY-I (INTRODUCTION TO BIOLOGY)

PRACTICALS

Marks: 50

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

Paper 2- BOHT 101: HUMAN PHYSIOLOGY–I

THEORY

Marks: 100

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 impulse in 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:


Reference Books:


BOHP 101: HUMAN PHYSIOLOGY–I

PRACTICALS

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
9. Permanent slides of various endocrine organs: thyroid, testis, ovary, pancreas, parathyroid, pituitary, adrenal.

REFERENCE BOOKS FOR PRACTICAL PAPER

Paper 3 - CHCT 301: CHEMISTRY-1

THEORY

Section A: Inorganic Chemistry


What is Quantum mechanics? Time independent Schrodinger equation (H $\Psi = E\Psi$) and meaning of various terms in it. Significance of $\Psi$ and $\Psi^2$, 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,$\theta$, $\phi$). 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 $m_l$ 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 salutation 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

Unit 3: Chemical Thermodynamics

What is thermodynamics? State of a system, state variables, intensive and extensive variables, concept 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 ($\Delta U$) and enthalpy ($\Delta H$) for expansion or compression of ideal gases under isothermal and adiabatic conditions for both reversible and irreversible processes. Calculation of $w$, $q$, $\Delta U$ and $\Delta H$ 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.

**Unit 4: Ionic Equilibria**


**CHCP 301: CHEMISTRY-1**

**PRACTICALS**

**Marks: 50**

**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 KMnO₄.
3. Estimation of water of crystallization in Mohr’s salt by titrating with KMnO₄.
4. Estimation of Fe(II) ions by titrating it with K₂Cr₂O₇ using internal indicator.
5. Estimation of Cu(II) ions idometrically using Na₂SO₄.
6. Estimation of (i) Mg²⁺ or (ii) Zn²⁺ 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

5. J. D. Lee: A new Concise Inorganic Chemistry, E L. B. S.
11. Senior practical Physical Chemistry, B.D. Khosla, R. Chand & Co.
PAPER 4/5 – ENAT 101 / 201: TECHNICAL WRITING AND COMMUNICATION IN ENGLISH

Marks: 100

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

2. L. Hamp-Lyons and B. Heasely: Study Writing; A course in written English. For academic and professional purposes, Cambridge Univ. Press.

Additional Reference Books

PAPER 4/5 – CSAT 101 / 201: COMPUTATIONAL SKILLS

THEORY

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.
CSAP 101 / 201: COMPUTATIONAL SKILLS

PRACTICALS

Marks: 50

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 Handling, Working with worksheets, Creating a spreadsheet, entering and formatting information, basic functions and formulas, creating charts, tables and graphs.

SUGGESTED BOOKS


Note: Use of Open Office/Star Office is recommended, as they are freely downloadable. Reference manual for Open Office available at: [http://www.openoffice.org](http://www.openoffice.org).
Paper 6 - BOHT 202: HUMAN PHYSIOLOGY–II

THEORY

Marks: 100

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 spermatogenesis), menstrual cycle fertilization, implantation, pregnancy, parturination and lactation.

REFERENCE BOOKS FOR THEORY PAPER

Text Books:

Reference Books:


BOHP 202: HUMAN PHYSIOLOGY–II

PRACTICALS         Marks: 50

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, Ovariectomty (any two).

REFERENCE BOOKS FOR PRACTICAL PAPER

Paper 7- CHCT 402: CHEMISTRY-2

THEORY Marks: 100

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 disaccharides (sucrose, cellobiose, maltose, lactose) and polysaccharides (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 –NH₂ group, complexation with Cu²⁺ 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.

CHCP 402: CHEMISTRY-2

PRACTICALS

Marks: 50

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 monofunctional groups(-cooh, phenolic, aldehyde, ketonic,amide,nitro,1o amines) and preparation of one derivative.

SUGGESTED BOOKS

Paper 8- MACT 303: MATHEMATICS AND STATISTICS

Marks: 100

Unit 1.  
(24 periods)
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 exp, 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)

SUGGESTED READINGS


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

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)*  
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 spoilage 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: Prescott) (8 Lectures)*

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:**

BOHP 303: MICROBIOLOGY

PRACTICALS

Marks: 50

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.
10. Enumeration of CFU of E.coli by serial dilution method.

REFERENCE BOOKS FOR PRACTICAL PAPER

THEORY

Marks: 100

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:**


**Reference Books:**
3. Robbins Basic Pathology, Kumar, Abbas, Fausto and Mitchell, 8\textsuperscript{th} Edition, Elsevier Publication.

**BOHP 304: PATHOLOGY**

**PRACTICALS**

**Marks: 50**

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.
8. Permanent histological slides of common diseases (any five basic slides).
10. Study of fractures.
11. Acid fast staining of mycobacterium in human sputum.

**REFERENCE BOOKS FOR PRACTICAL PAPER**

THEORY

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.)

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. Cytoskeleton and Cell Movement (Ch 12 Cooper et al.)
Structure and organization of actin filaments; actin, myosin and cell movement; intermediate filaments; microtubules.
CBHP 301: CELL BIOLOGY-I

PRACTICALS

Marks: 50

1. Separation of nucleic acid bases by paper chromatography.
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

Paper 12 - MBHT 301: MOLECULAR BIOLOGY-I

THEORY

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), O (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.
MBHP 301: MOLECULAR BIOLOGY-I

PRACTICALS

Marks: 50

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

THEORY

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, Regulatory enzymes: General properties of allosteric enzymes, theories of allosteric regulation, regulation by covalent modification, kinetics, multi-enzyme 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 ΔG, 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, 18, 21, 22: Nelson and Cox) (32 Lectures)
Carbohydrates metabolism:
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:

Mobilization of triglycerides, metabolism of glycerol, $\beta$-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:**

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:**

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:**


**References Books:**

BOHP 405: BIOCHEMISTRY

PRACTICALS

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 $\lambda_{\text{max}}$.
5. Quantitative estimation of DNA/RNA.
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. General Introduction:  
Definition and scope of medicinal chemistry  
(2 Lectures)

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, bioavailability, 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.  
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.  
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).

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

REFERENCE BOOKS FOR THEORY PAPER

Text Books:


Reference Books:


BOHP 406: MEDICINAL CHEMISTRY

PRACTICALS Marks: 50

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

Paper 15 - CBHT 402: CELL BIOLOGY-II

THEORY

Marks: 100

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 surface 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.

CBHP 402: CELL BIOLOGY-II

PRACTICALS

Marks: 50

1. To demonstrate the presence of mitochondria in striated muscle cells using vital stain Janus Green B.
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

Paper 16 - MBHT 402: MOLECULAR BIOLOGY-II

THEORY

Unit 1. Mechanism of Transcription
RNA Polymerase and the transcription unit
Transcription in Prokaryotes
Transcription in Eukaryotes

Unit 2. RNA Modifications
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)
Regulation of translation
Translation-dependent regulation of mRNA and Protein Stability.

Unit 4. Transcription Regulation in Prokaryotes
Principles of transcriptional regulation, regulation at initiation with examples from *lac* and *trp* operons

Unit 5. Transcription Regulation in Eukaryotes
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
Riboswitches, RNA interference, miRNA, siRNA, Regulatory RNA and X-inactivation
MBHP 402: MOLECULAR BIOLOGY-II

PRACTICALS

Marks: 50

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 with or without antibiotic pressure and interpretation of results).
3. Isolation and quantitative estimation of salmon sperm / calf thymus DNA using colorimeter (Diphenylamine reagent) or spectrophotometry (A260 measurement).
4. To perform Ames test in *Salmonella/ E. Coli*. To study mutagenicity.

SUGGESTED BOOKS

Paper 17 - BOHT 507: PHARMACOLOGY

THEORY

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 anesthetics: principle, Inhalation and I.V. (halothane, propofol and ketamine).
   iii. Sedatives & hypnotics: classification, valium.
   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 anesthetics (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
Insulin, oral hypoglycemic drugs and glucagon (one example each); drugs affecting calcium balance (one example).

REFERENCE BOOKS FOR THEORY PAPER

Text Book:


Reference Book:


BOHP 507: PHARMACOLOGY

PRACTICALS Marks: 50

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. **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)

   **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, Fluorescence).

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:**


**Reference Books:**


**BOHP 508: BIOPHYSICS**

**PRACTICALS**

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**

Paper 19 - BOHT 509: CLINICAL BIOCHEMISTRY

THEORY

Marks: 100

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 isoenzymes: 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.**
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:**


**Reference books:**


**BOHP 509: CLINICAL BIOCHEMISTRY**

**PRACTICALS**

**Marks: 50**

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:

Paper 20 – GGHT 501: GENETICS AND GENOMICS-I

THEORY Marks: 100

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 dominance 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 effecting 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 Chllydomonas, 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.
GGHP 501: GENETICS AND GENOMICS-I

PRACTICALS

Marks: 50

2. Chi-square and probability.
4. Study of Human and Phlox/Allium Karyotype (normal and abnormal).
5. Pedigree analysis of some human inheritance traits.

SUGGESTED BOOKS


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

Marks: 100

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:

Reference Books:

BOHP 610: TOXICOLOGY

PRACTICALS Marks: 50

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, \(\text{-naphthol}\) 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)
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)  
Hematopoiesis, 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)  
(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)  
(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).

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:**


**Reference Books:**

BOHP 611: IMMUNOLOGY

PRACTICALS

Marks: 50

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 - BOHT 612a: BIOINFORMATICS

THEORY

Marks: 100

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, pharmaco informatics, chemical libraries, search programming

**REFERENCE BOOKS FOR THEORY PAPER**

**Text Books:**


**Reference Books:**


**BOHP 612a: BIOINFORMATICS**

**PRACTICALS**

**Marks: 50**

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 - BOHT 612b: HUMAN GENETICS

THEORY

Marks: 100

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)
   - Autosomal inheritance-dominant, recessive
   - Sex-linked inheritance
   - Sex-limited and sex-influenced traits
   - Mitochondrial inheritance
   - 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
   - Mosaicism and chimerism
   - Consanguinity and its effects
   - Epigenetic modifications, imprinting
   (Website: OMIM)

4. Human Genome Project:
   (Chapters 4,13: Strachan and Read; Chapter 11: Cantor and Smith) (4 Lectures)
   - History, organization and goals of human genome project
   - Tools (Vectors- BAC, PAC, YAC and sequencing techniques) and approaches (Hierarchial and shotgun sequencing),
   - Outcomes and ethical issues.
   - 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)
   - General features: Gene density, CpG islands, RNA-encoding genes,
   - Gene clusters
   - Diversity in size and organization of genes
   - Types of repetitive DNA
   - Pseudogenes, gene families
   - Endoreplication and amplification
   - 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 anemia
   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:


BOHP 612b: HUMAN GENETICS

PRACTICALS

Marks: 50

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 lobes, Blood group, Color blindness.
6. Polymorphism analysis using PCR.
7. Website based analysis.
8. Haplotype construction.
Special Paper 23c - BOHT 612c: MEDICAL BIOTECHNOLOGY

THEORY Marks: 100

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 α- 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
   2006.

Reference Books:
BOHP 612c: MEDICAL BIOTECHNOLOGY

PRACTICALS

Marks: 50

1. Separation of DNA by agarose electrophoresis.
2. Extraction of DNA from agarose gel
3. Analysis of DNA sequences
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

Special Paper 23d - BOHT 612d:
SOCIAL AND PREVENTIVE MEDICINE

THEORY

1. **Concepts of Health and Disease:**
   
   (Chapter 2: Park) (3 lectures)
   

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)
   

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:**


**BOHP 612d:**

**SOCIAL AND PREVENTIVE MEDICINE**

**PRACTICALS**

Marks: 50

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

Marks: 100

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/ Ch 2, 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.
GGHP 602: GENETICS AND GENOMICS II

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

## SEMESTER SYSTEM AT THE UNDERGRADUATE LEVEL

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

<table>
<thead>
<tr>
<th>Semester I</th>
<th>Semester II</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Paper 1</strong> Biology-I (Introduction to Biology) <strong>LSPT - 101</strong></td>
<td><strong>Paper 4</strong> Technical Writing and Communication in English/Computational Skills <strong>ENAT – 201/CSAT - 101</strong></td>
</tr>
<tr>
<td><strong>Paper 2</strong> Human Physiology-I <strong>BOHT - 101</strong></td>
<td><strong>Paper 5</strong> Technical Writing and Communication in English/Computational Skills <strong>ENAT – 201/CSAT - 201</strong></td>
</tr>
<tr>
<td><strong>Paper 3</strong> Chemistry-I <strong>CHCT - 301</strong></td>
<td><strong>Paper 6</strong> Human Physiology-II <strong>BOHT - 202</strong></td>
</tr>
<tr>
<td><strong>Paper 7</strong> Mathematics &amp; Statistics <strong>MACT- 303</strong></td>
<td><strong>Paper 8</strong> Biophysics <strong>BOHT - 507</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Semester III</th>
<th>Semester IV</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Paper 9</strong> Microbiology <strong>BOHT - 303</strong></td>
<td><strong>Paper 10</strong> Pathology <strong>BOHT - 304</strong></td>
</tr>
<tr>
<td><strong>Paper 11</strong> Cell Biology-I <strong>CBHT - 301</strong></td>
<td><strong>Paper 12</strong> Molecular Biology I <strong>MBHT - 301</strong></td>
</tr>
<tr>
<td><strong>Paper 13</strong> Biochemistry <strong>BOHT - 405</strong></td>
<td><strong>Paper 14</strong> Medicinal Chemistry <strong>BOHT - 406</strong></td>
</tr>
<tr>
<td><strong>Paper 15</strong> Cell Biology II <strong>CBHT - 402</strong></td>
<td><strong>Paper 16</strong> Molecular Biology II <strong>MBHT - 402</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Semester V</th>
<th>Semester VI</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Paper 17</strong> Pharmacology <strong>BOHT - 507</strong></td>
<td><strong>Paper 18</strong> Biophysics <strong>BOHT - 508</strong></td>
</tr>
<tr>
<td><strong>Paper 19</strong> Clinical Biochemistry <strong>BOHT - 509</strong></td>
<td><strong>Paper 20</strong> Genetics &amp; Genomics I <strong>GGHT - 501</strong></td>
</tr>
<tr>
<td><strong>Paper 21</strong> Toxicology <strong>BOHT - 610</strong></td>
<td><strong>Paper 22</strong> Immunology <strong>BOHT - 611</strong></td>
</tr>
<tr>
<td><strong>Paper 23</strong> Genetics &amp; Genomics II <strong>GGHT - 602</strong></td>
<td><strong>Paper 24</strong> <em>Special Paper</em>*</td>
</tr>
</tbody>
</table>

**Total number of papers:** 24

*Special Papers 23: Bioinformatics (BOHT-612a), Human Genetics (BOHT-612b), Medical Biotechnology (BOHT-612c), Social and Preventive Medicine (BOHT-612d).