Faculty of Life Sciences

Syllabus

For

M. Sc. Molecular Biology & Biochemistry
(Credit Based Evaluation & Grading System)
(Semester I-IV)

Examinations: 2019 –20

Guru Nanak Dev University
Amritsar

Note: (i) Copy rights are reserved
Nobody is allowed to print it in any form.
Defaulters will be prosecuted.

(ii) Subject to change in the syllabi at any time.
Please visit the University website time to time
M.Sc. Molecular Biology & Bio Chemistry (Semester System)
(Credit Based Evaluation & Grading System)

**SCHEME**

Programme Code: MBB

**Note**: All Theory Papers having Mid Semester Marks: 20 & End Semester Marks: 80. Total Marks will be 100.

<table>
<thead>
<tr>
<th>Semester-I</th>
<th>Course No.</th>
<th>C/E/I</th>
<th>Course Title</th>
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<tr>
<td>Core Course</td>
<td>MBL-401</td>
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<td>Biomolecules</td>
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<td>MBL-402</td>
<td>C</td>
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<td>MBL-403</td>
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<td>Fundamentals of Molecular Biology</td>
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<td>CSL-591</td>
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<td>Computer Applications</td>
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<td>MBP-422</td>
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<td>Practicals in Basic and clinical Biochemistry</td>
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| Semester II | MBL-451 | C | Concepts in Immunology | 4 | 0 | 0 | 4 |
|             | MBL-452 | C | Metabolism of Carbohydrates and Lipids | 4 | 0 | 0 | 4 |
|             | MBL-454 | C | Recombinant DNA Technology | 4 | 0 | 0 | 4 |
|             | E       | Elective-I* | 4 | 0 | 0 | 4 |
| Outside course-I | I | Interdisciplinary course-1** | 4 | 0 | 0 | 4 |
| MBP-471    | C | Practicals in Molecular Biology | 0 | 0 | 6 | 6 |

| Semester III | MBL-502 | C | Metabolism of Proteins and Nucleic Acids | 4 | 0 | 0 | 4 |
|              | MBL-503 | C | Biophysical and Biochemical Techniques | 3 | 1 | 0 | 4 |
|              | E       | Elective-II* | 4 | 0 | 0 | 4 |
| Outside course-II | I | Interdisciplinary course-2** | 4 | 0 | 0 | 4 |
| MBP-522    | C | Practicals in Immunology & Microbiology | 0 | 0 | 6 | 6 |

| Semester IV | MBL-552 | C | Seminars on Current Topics | 2 | 0 | 0 | 2 |
|             | MBP-556 | C | Research Project | 0 | 0 | 4 | 4 |
|             | MBL-555 | C | Genomics and Proteomics | 4 | 0 | 0 | 4 |
|             | E       | Elective-III* | 4 | 0 | 0 | 4 |
| Outside course-III | I | Industrial/Educational tour | Non credit |

* The students are required to study any three of the following Elective papers
  MBL-582 Molecular Immunology
  MBL-585 Environmental Biochemistry
  MBL-586 Lipid Biochemistry
  MBL-589 Molecular Genetics
  MBL-590 Medical Biochemistry
  MBL-591 Applied and Medical Microbiology
  MBL-592 Molecular Cell Biology
  MBL-593 Advanced Molecular Biology
  MBL-595 SPORTS BIOCHEMISTRY

** Interdisciplinary courses 1, 2 and 3 will be selected from schemes of courses of other Science Departments as decided by the BOC.

**NOTE**: PSL-053 ID Course Human Rights & Constitutional Duties (Compulsory Paper) Students can opt. this paper in any odd semester. This ID Paper is one of the total ID Papers of this course.
M.Sc. Molecular Biology & Bio Chemistry (Semester-I)  
(Credit Based Evaluation & Grading System)

Course No. MBL-401  
BIOMOLECULES

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Time: 3 Hours  
Max. Marks: 100  
Mid Semester Marks : 20  
End Semester Marks : 80

Mid Semester Examination: 20% weightage  
End Semester Examination: 80% weightage

Instructions for the Paper Setters:  
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Course Contents

Section-A
Introduction:  
Biological fitness of organic compounds, dimensions and shape of biomolecules, supramolecular assemblies and cell organelles. Structure of atoms, molecules and chemical bonds. Carbohydrates: Definition importance and functions, families of monosaccharides and structure of carbohydrates, stereoisomerism and mutarotation, derivatives of monosaccharides, disaccharides, trisaccharides and polysaccharides (starch, glycogen, cellulose, dextrins), sugars of bacterial cell wall.

Section-B
Water: Physical properties and structure of water, hydrogen bonding, solvent properties of water, ionization of water, fitness of aqueous environment for living organisms. Lipids: Definition, importance and functions, classification of lipids, fatty acids and essential fatty acids, general structure and functions of major lipid subclasses, acylglycerols, phosphoglycerides, sphingolipids, terpenes, steroids, eicosanoids.

Section-C

Section-D
Vitamins and Minerals: Definition, chemistry and functions of water and fat soluble vitamins, major trace minerals, their bound forms and functions. Porphyrins: Nucleus and classification of porphyrins, important metallo porphyrins occurring in nature, chemical nature and physiological significance of bile pigment.
Books Recommended

Course No. MBL-402

ENZYMEOLOGY

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Course Contents

Section-A
Introduction to Enzymes: Nomenclature, Classification and Characteristics of enzymes, Enzyme specificity, Cofactors, Co-enzyme and Prosthetic group. Mechanism of Enzyme Action: Nature of active site, identification of functional groups at active site, enzyme substrate complex, Factors responsible for catalytic efficiency of enzymes: Proximity and orientation, covalent catalysis, Acid base catalysis, Strain and distortion theory, Induced fit hypothesis.

Section-B
Mechanism of action of selected enzymes: Chymotrypsin, Lysozyme, Carbonic anhydrase, Ribonuclease, Involvement of co-enzymes in enzyme catalyzed reactions, RNA molecules as enzymes. Enzyme Kinetics: A brief concept of bioenergetics and kinetics, Kinetics of single and bi-substrate enzyme catalyzed reactions, MichaelisMenten equation. Derivation of MichaelisMenten equation and determination of Km and Vmax values

Section-C
Enzyme inhibition: reversible and irreversible inhibition, Kinetics of competitive, uncompetitive and non-competitive inhibition, Random, Ordered, Theorell & Chance, and Ping-pong mechanism, their rate equations and diagnostic plots, Substrate inhibition and activation, Effect of pH and temperature on rate of enzyme catalyzed reactions. Regulation of Enzyme Activity: Allosteric enzymes, control of metabolic pathways, Mechanism of Aspartate transcarbamylase, Sigmoidal behavior, sequential and concerted models, Reversible covalent modification and zymogen activation, Isozymes and their importance

Section-D
Enzyme Technology: Extraction and purification of enzymes, Enzymes as analytical reagents, Immobilized enzymes, Biotechnological applications of enzymes, Application of enzymes in medicine and industry.
Books Recommended:

Course No. MBL-403

FUNDAMENTALS OF MOLECULAR BIOLOGY

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Course Contents

Section-A

Section-B
DNA replication, repair and recombination: Unit of replication, enzymes involved, replication origin and replication fork, fidelity of replication, extrachromosomal replicons, DNA damage and repair mechanisms.

Section-C
RNA synthesis and processing: Structure and function of RNA polymerases. Transportation in prokaryotes Transcription factors and machinery, formation of initiation complex, transcription activators and repressors, RNA polymerases, capping, elongation and termination, RNA processing, RNA editing, splicing, polyadenylation, structure and function of different types of RNA, RNA transport.

Section-D
Protein synthesis and processing: Ribosome, formation of initiation complex, initiation factors and their regulation, elongation and elongation factors, termination, genetic code, aminoacylation of tRNA, tRNA-identity, aminoacyl tRNA synthetase, translational proof-reading, translational inhibitors, post-translational modification of proteins.
Books Recommended:
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Note: - The scope of this paper is restricted only to the applications of various statistical techniques. The mathematical derivations of various results are excluded.

Section-A
Statistical Methods — Collection of data, Frequency distribution and, Measures of Central Tendency, Dispersion.

Correlation and Regression — Relationship between variables, Covariance, Karl-Pearson's Correlation Coefficient, Spearman's rank Correlation Coefficient, Least square technique for regression lines (without proof), Regression Coefficients, Relationship between Correlation analysis and Regression Analysis.

Section-B
Probability — Mathematical definition of probability of an event, Use of permutations and combinations in calculations of Probability, Conditional probability, Additive and Multiplication law of Probability, Random Variables and its pmf, pdf, cdf, Mathematical expectation and variances, Theoretical Distributions: Binomial, Poisson and normal, Properties of these distributions (applications only).

Section-C
Hypothesis Testing — Sample, Population, Statistics and Parameters, Null Hypothesis, Level of significance, Definitions of Chi–square, ‘t’ and ‘F’ variates and their pdfs only, Applications of these distributions in testing of hypothesis.

Section-D
Large sample test- Testing of significance of proportion in single population, Testing of equality of proportions in two populations, Testing of significance of mean in single population, Testing of equality of means in two populations.

Analysis of Variance — Meaning of analysis variance with linear models, Analysis of variance for one-way classified data, Analysis of variance for two-way classified data with one observation for cell.
Text Books

Reference Books:
Course No. CSL-591 : COMPUTER APPLICATIONS

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Section-A

Section-B
MS-Excel – Spreadsheets, Using different types of formulae, Creating graphs and charts, Exporting charts to MS-Word, MS-PowerPoint – Creating presentations, Formatting, Adding effects and timings. Types of errors and level of significance, Tests of significance (F and t-test), Chi-square tests.

Section-C
Data analysis and database – Brief description and tabulation of data, Measure of central tendency and dispersion – Mean, Median, Mode, Range, Standard Deviation, Variance and Correlation coefficient using SPSS. Introduction to Data, Information, Database, DBMS (Advantages and disadvantages), Introduction to SQL (Data retrieval).

Section-D
Virtual library and some useful sites on Internet – Searching MEDLINE on the Pubmed system from National Centre for Biotechnology and Information. Assessing full text journals on the internet and printing articles using EndNote.
Books Recommended:


Website Links

Databases (Genes Bank), search tools and software at


Restriction enzyme site digestion webcutter2.0 at


PCR and multiplex PCR guide and troubleshooting at

http://www.med.yale.edu/genetics/ward/tavi/Trblesht.html.

Image analysis program at

Course No. MBP-422

PRACTICALS IN BASIC AND CLINICAL BIOCHEMISTRY

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Books Recommended:


Course No. MBL-451

CONCEPTS IN IMMUNOLOGY

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Course Contents

Section-A

Introduction: Types of immunity, innate and adaptive immune system, Features of immune response: memory, specificity and recognition of self and non-self, terminology and approaches to the study of immune system.

Cells and Organs of the Immune System: Cells and molecules involved in innate and adaptive immunity, Toll-like receptors, Lymphoid cells, heterogeneity of lymphoid cells, T-cells, B-cells, Null cells, Monocytes, Polymorphs, Primary and secondary lymphoid organs- Thymus, Bursa of fabricius, spleen, lymph nodes, lymphatic system, mucosa associated lymphoid tissue (MALT), lymphocyte traffic, Activation of B and T cells and their differentiation.

Section-B

Humoral Immunity:
Antigen-antibody interactions, primary and secondary immune modulation. Affinity and avidity, high and low affinity antibodies, immunoglobulins, classes and structure, complement fixing antibodies and complement cascade.

Cell Mediated Immunity:
T-cell subsets and surface markers, T-dependent and T-independent antigens, recognition of antigens by T-cells and role of MHC in antigen processing and presentation, structure of T-cell antigen receptors, TCR, BCR, cell mediated effector functions.

Section-C

Immunological Disorders:
Inflammation, Types of hypersensitivity reactions, autoimmune disorders, their underlying molecular mechanism, etiology, diagnostic, prognostic and prophylactic aspects, immunedeficiency disorders: congenital and acquired, AIDS, immune response during bacterial (tuberculosis), parasitic (malaria), and viral (HIV) infections.
Section-D

Immunodiagnostic Procedures: Antibody generation, detection of molecules using ELISA, RIA, western blot, immunoprecipitation, flow cytometry and immunofluorescence microscopy, detection of molecules in living cells, in situ localization by techniques such as FISH and GISH. Various types of immunodiffusion and immunoelectrophoretic procedure, Immunoblot, agglutination of pathogenic bacteria, hemeagglutination and hemeagglutination inhibition, cellular techniques.

Books Recommended
Course No. MBL-452
METABOLISM OF CARBOHYDRATES AND LIPIDS

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Course Contents

Section-A
Introduction to Metabolism: Types of Metabolic Pathways, Experimental approaches to study metabolism, Basic principles/mechanisms of metabolic regulation. Basic concepts and design of metabolism. Some activated carriers in metabolism. Basic principles of bioenergetics: chemical basis of large free energy of hydrolysis of some energetic compounds; coupled reactions; group transfer; biological energy transducers. Types of biological oxidation-reduction reactions.

Section-B
Carbohydrate Catabolism: Digestion and absorption of carbohydrates, glycolysis, citric acid cycle, oxidative phosphorylation, pentose phosphate and other pathways, Degradation of di and polysaccharides.

Section-C
Carbohydrate Anabolism: Gluconeogenesis, Role of nucleotide diphosphate sugars, Biosynthesis of disaccharides and polysaccharides, Regulation of carbohydrate metabolism, photosynthesis.

Section-D
Lipid Catabolism: Digestion and absorption of lipids, transport of lipoproteins, Oxidation of fatty acids, Degradation of triacylglycerols, phosphoglycerides. Sphingolipids, Regulation of lipid Metabolism. Lipid Anabolism: synthesis of fatty acids, triacylglycerols, phosphoglycerides, sphingolipids, cholesterol, prostaglandins and other protanoids,
Books Recommended:


Course No. MBL-454

RECOMBINANT DNA TECHNOLOGY

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Section. The fifth question may be attempted from any Section.

Course Contents

Section-A

Tools of Genetic Engineering: Enzymes used in recombinant DNA technology: restriction endonucleases & other DNA modifying enzymes, plasmid, bacteriophage and cosmids, BAC, YAC and yeast based vectors as vehicles of cloning, expression vectors.

Section-B


Section-C


Section-D

Applications of Recombinant DNA Technology: In Medicine: Molecular diagnostics, vaccines, drugs, gene therapy. In Agriculture: Transgenic plants, insecticide, herbicide resistant plants and antisense technology. In Industry: Commercially available recombinant products, transgenic animals.
Course No. MBP-471

PRACTICALS IN MOLECULAR BIOLOGY

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Isolation of genomic DNA from human blood, Quantification of DNA using spectrophotometric method, Isolation of plasmid DNA from bacteria, ethanol precipitation of DNA, Digestion of DNA using restriction endonucleases, Resolution and molecular weight estimation of fragmented DNA using agarose gel electrophoresis, Construction of restriction map by single and double digestion, Ligation of DNA fragments, Preparation of competent cells using CaCl2 method, Transformation of bacteria, Designing primers for PCR, Purification of a DNA fragment by agarose gel, RNA isolation, cDNA synthesis, protocol for quantitative PCR.

Books Recommended:

Course No. MBL-502

METABOLISM OF PROTEINS AND NUCLEIC ACIDS

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Course Contents

Section-A

Metabolism of Nitrogen: Digestion and absorption of proteins, Nitrogen fixation and its mechanism, Assimilation of ammonia, Nitrogen cycle. Catabolism of Amino Acids: General reactions of amino acids metabolism i.e. transamination, deamination, decarboxylation, Urea cycle, Catabolism of individual amino acids.

Section-B

Anabolism of amino acids: Biosynthesis of essential and non-essential amino acids, Regulation of amino acid biosynthesis, Metabolism of amino acids precursors: Metabolism of Porphyrins: Biomedical importance, Heme biosynthesis, Genetic disorders of heme metabolisms catabolism of heme bilirubin: its conjugation and secretion, hyperbilirubinoemia.

Section-C

Degradation of Nucleotides: Degradation of purines and pyrimidines, Salvage pathways, Biosynthesis of Nucleotides: Biosynthesis of purine and pyrimidine nucleotides, Biosynthesis of deoxyribonucleotides, Biosynthesis of nucleotide coenzymes, Regulation of nucleotide biosynthesis.

Section-D

Integration of Metabolism: Recurring motifs in biochemistry, regulation of major metabolic pathways, metabolic fates of glucose-6-phosphohate, pyruvate and acetyl CoA, Metabolic profiles of brain, muscle, adipose tissue, liver and kidney, Hormonal regulation of metabolism, metabolic adaptations.
Books Recommended:

MBL-503 BIOPHYSICAL & BIOCHEMICAL TECHNIQUES

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Course Contents

Section-A
Basic techniques: Preparation of solutions & buffers, Methods of cell disintegration; Enzyme assays and controls. Protein purification techniques: Dialysis, Ultrafiltration and precipitation, Chromatography: Principles of chromatography, TLC and Paper chromatography; Gel permeation, Ion exchange, Hydrophobic, Reverse-phase and Affinity chromatography; HPLC and FPLC; Criteria of protein purity.

Section-B
Centrifugation: Basic principles: sedimentation of macromolecules, sedimentation velocity, sedimentation equilibrium and density gradient sedimentation, rpm & RCF. Types of centrifuge & rotors - Microcentrifuge, High speed & Ultracentrifuges; Preparative centrifugation; Differential & density gradient centrifugation; Applications (Isolation of cell components); Analytical centrifugation. Determination of molecular weight by sedimentation velocity & sedimentation equilibrium methods. Transport in Electric Field: Factors affecting migration rate, types of electrophoresis. Theory and application of Polyacrylamide and Agarose gel electrophoresis; Capillary electrophoresis; 2D Electrophoresis; Disc gel electrophoresis; Gradient electrophoresis; Pulsed field gel electrophoresis.

Section-C
Spectroscopic Techniques: Analysis of biomolecules using UV/visible, fluorescence, circular dichroism, NMR and ESR spectroscopy, structure determination using X-ray diffraction and NMR; analysis using light scattering, different types of mass spectrometry and surface plasma resonance methods.

Section-D
Structure determination of macromolecules: Fundamentals of X-Ray Analysis, NMR & cryo EM. Radiolabeling techniques: Properties of different types of radioisotopes normally used in biology, their detection and measurement; incorporation of radioisotopes in biological tissues and cells, molecular imaging of radioactive material, safety guidelines.
Books Recommended:


Course No. MBP-522

PRACTICALS IN IMMUNOLOGY AND MICROBIOLOGY

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Immunology
Separation of Immune cells; Identification and viability test by dye exclusion method; Techniques of immunization and use of adjuvants; Separation of hyperimmune serum and purification of antibodies; Detection of antibodies by various techniques; Complement fixation, Blood grouping. Hemagglutination assays; ELISA: Dot/Antigen/antibody capture/sandwich; Immunoprecipitation techniques: Ouchterlony double diffusion, Immunelectrophoresis, Western blotting.

Microbiology
Preparation of solid media and liquid media, pour plating, streaking plate method, serial dilution, CFU count, staining techniques like simple staining, Gram’s Staining, Differential staining, Motility test, Hanging drop, Bacterial transformation, plasmid isolation and purification, restriction digestion.

Books Recommended:
M.Sc. Molecular Biology & Biochemistry (Semester-IV)

Course No. MBP- 552

**Seminars on Current Topics**

(Topics to be decided at the start of the semester)
M.Sc. Molecular Biology & Biochemistry (Semester-IV)

Course No. MBP-556

RESEARCH PROJECT

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Students will conduct research with faculties in their respective field of interest.
Course No. MBL-555 Genomics and Proteomics

Credit hrs.  
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Section-A  
Human Genome structure: Physical structure and genetic content of Human genome, Nature of genetic variations: Single nucleotide polymorphism, Large scale variations, conserved and variable domains, Methods for studying variation: RFLPs, VNTR and minisatellites, SSCP and direct Sequencing, Genetic and physical maps of human genome: chromosome maps and markers, clone libraries and Expressed sequence Tag. Locating genes in DNA sequence

Section-B  

Section-C  
Proteomics: Introduction to proteomics, Techniques in proteomic research: Two dimensional separations of total cellular proteins, isolation and sequence analysis of individual protein spots by mass spectroscopy,

Section-D  
Protein array: Protein microarrays, Advantages and disadvantages of protein microarrays, Total expression vs functional proteomics, Application of proteomics, Oligosaccharide microarrays for glycomics, Pharmacogenomics, Introduction of metabolomics

Books Recommended:  
Course No. MBL-582

MOLECULAR IMMUNOLOGY

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Time: 3 Hours

Max. Marks: 100
Mid Semester Marks : 20
End Semester Marks : 80

Mid Semester Examination: 20% weightage
End Semester Examination: 80% weightage

Instructions for the Paper Setters:
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Section-A

Introduction: An over view of the immune system, tools to study the immune system: Inbred stains, adoptive transfer systems, SCID Mice, ScID-Human Mice, primary lymphoid cultures, coloned lymphoid cell lines, hybrid lymphoid cell lines. Antigens: Antigenicity, immunogenicity, Antigenic determinants/epitopes, properties of B-Cell epitopes, properties of T-Cell epitopes, MHC-class-II-restricted antigens, mitogens, super antigens, vaccines.

Section-B

Antibodies: Structure and functions including molecular structure of antibodies; Immunoglobulin domains; Immunoglobulin fold; variable region domains; complementarity determining regions (CDRS), CDRS and antigen binding, hinge region. Engineered Monoclonal antibodies, antibody engineering and their clinical applications. Antibody Diversity: Models of antibody diversity, multigene organization of Ig genes; λ-chain multigene family, K-chain multigene family, Heavy chain multigene family, V-J rearrangements in light chain DNA, V-D-J rearrangement in heavy chain DNA, mechanisms of variable region DNA rearrangement; recombination signal sequences, Enzymatic joining of gene segments and role of RAG-1 and rag -2 genes; Molecular Mechanism of class switching

Section-C

Molecular Organization of MHC: MHC molecules: MHC class-I, class-II and class-III genes in mouse and man, concept of MHC haplotypes. MHC molecules and genes; Organization of Class-I and class-II molecules; class-I MHC-peptide interaction; Class II MHC-peptide interaction; polymorphism of class I and class II molecules; class III molecules including heat shock proteins, MHC and infectious diseases. T-Cell Receptor: TCR for MHC-associated peptide antigen, structure of β and T-cell receptor CD3-TCR, Accessory molecules of T-cells, CD-28 and CTLA-4 as T-cell receptors for co-stimulators, integrins selections.
Section-D

**Signal Transduction and TCR-Complex:** TCR clustering, recruitment and activation of protein tyrosine kinases and adapter proteins, Ras and Rac, calcineurin and protein kinase C signaling pathways in T-cell, transcription factors regulating gene expression, Costimulators and transduction pathways.

**Signal Transduction and B-cell Receptor Complex:** Structure of B-cell receptor complex, recognition of antigen by B-cell receptor and signal transduction, complement receptors and second signal for B-cell, Antibody response to T-dependent and T-independent antigens.

**Books Recommended:**

Course No. MBL-585  Environmental Biochemistry

Credit hrs.  
L  T  P  
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Time: 3 Hours  
Max. Marks: 100  
Mid Semester Marks : 20  
End Semester Marks : 80

Mid Semester Examination: 20% weightage  
End Semester Examination: 80% weightage

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Section-A

The Environment: Physical environment; biotic environment; biotic and abiotic interactions.

Habitat and niche: Concept of habitat and niche; niche width and overlap; fundamental and realized niche; resource partitioning; character displacement.

Population ecology: Characteristics of a population; population growth curves; population regulation; life history strategies (r and K selection); concept of metapopulation – demes and dispersal, interdemic extinctions, age structured populations.

Section-B

Species interactions: Types of interactions, interspecific competition, herbivory, carnivory, pollination, symbiosis.

Community ecology: Nature of communities; community structure and attributes; levels of species diversity and its measurement; edges and ecotones.

Section-C

Ecological succession: Types; mechanisms; changes involved in succession; concept of climax. Ecosystem: Structure and function; energy flow and mineral cycling (CNP); primary production and decomposition; structure and function of some Indian ecosystems: terrestrial (forest, grassland) and aquatic (fresh water, marine, eustarine).

Biogeography: Major terrestrial biomes; theory of island biogeography; biogeographical zones of India.
Section-D

**Applied ecology:** Environmental pollution; global environmental change; biodiversity-status, monitoring and documentation; major drivers of biodiversity change; biodiversity management approaches.

**Conservation biology:** Principles of conservation, major approaches to management, Indian case studies on conservation/management strategy (Project Tiger, Biosphere reserves).

**Books recommended:**


Course No. MBL-586  Lipid Biochemistry

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Mid Semester Examination: 20% weightage  
End Semester Examination: 80% weightage

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Section-A
Introduction: Nature of lipids; Medical and biological importance of lipids, an overview of structure and function of lipids and lipoproteins.
Metabolism of Lipids: Digestion and absorption of lipids, transportation of lipids, role of apolipoproteins in lipid transport.

Section-B
Lipids of Cellular Structure: Structure of membrane lipids; phosphoglycerides, sphingolipids, glycolipids, gangliosides and sterols, biosynthesis of structural lipids, function of structural lipids.

Section-C
Dietary Lipids  
Role of dietary lipids, assimilation of lipid by body; lipids in growth and development, disorders in lipids metabolism.
Lipid Function: Lipids as hormones and vitamins, structure and functions of eicosanoids, role of membrane lipids in adaptations, role of dolichol in glycosylation, lipids and membrane fusion, liposomes and drug delivery systems, role of lipids in signal transductions, immunity, lipids and skin diseases, lipid storage diseases.

Section-D
Techniques to Study Lipid Biochemistry: Extraction of lipids from natural samples, chromatographic techniques for purification and characterization of lipids.

Books Recommended:
Course No MBL-589

MOLECULAR GENETICS

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Time: 3 Hours

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Mid Semester Marks : 20
End Semester Marks : 80

Mid Semester Examination: 20% weightage
End Semester Examination: 80% weightage

Instructions for the Paper Setters:
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Section-A

Mendelian principles: Dominance, segregation, independent assortment, deviation from Mendelian inheritance. Concept of gene: Allele, multiple alleles, pseudoallele, complementation tests. Extensions of Mendelian principles: Codominance, incomplete dominance, gene interactions, pleiotropy, genomic imprinting, penetrance and expressivity, phenocopy, linkage and crossing over, sex linkage, sex limited and sex influenced characters.

Section-B

Gene mapping methods: Linkage maps, tetrad analysis, mapping with molecular markers, mapping by using somatic cell hybrids. Extra chromosomal inheritance: Inheritance of mitochondrial and chloroplast genes, maternal inheritance.

Section-C

Microbial genetics: Methods of genetic transfers – transformation, conjugation, transduction and sex-dution, mapping genes by interrupted mating, fine structure analysis of genes. Human genetics: Pedigree analysis, lod score for linkage testing, karyotypes, genetic disorders. Quantitative genetics: Polygenic inheritance, heritability and its measurements, QTL mapping.

Section-D


Books Recommended:
Course No MBL-590  

MEDICAL BIOCHEMISTRY

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Mid Semester Examination: 20% weightage  
End Semester Examination: 80% weightage

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Course Contents

Section-A  

Section-B  
Acid Base Balance: Production of acids and bases by the body, maintenance of body pH, disorders of acid base balance. Disorders of carbohydrate metabolism: Disorders of carbohydrate metabolism: Diabetes mellitus, ketoacidosis, hypoglycemia, glycogen storage diseases, galactosemia, lactose intolerance, and lactic acidosis. Disorders of lipids: lipid mal-absorption and steatorrhea, sphingolipidosis, clinical interrelationships of lipids, lipoproteins and apolipoproteins; Disorders of amino acid metabolism: inborn errors of amino acid metabolism-alkaptonuria, phenylketouria, albinism, gout, hyperglycemia, phenylalaninemia, homocystineuria, tyrosinemia, aminoacidurias; Disorders of nucleic acid metabolism (Purine and Pyrimidine metabolism); Disorders of iron, porphyrin and mineral metabolism; Metabolism under stress conditions.

Section-C  

Section-D  
Books Recommended


Course No. MBL-591  APPLIED AND MEDICAL MICROBIOLOGY

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Max. Marks: 100
Mid Semester Marks : 20
End Semester Marks : 80

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End Semester Examination: 80% weightage

Instructions for the Paper Setters:
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Section-A

Section-B
Food Microbiology: Microbiology of dairy industry and beverage fermentation. Role of microorganisms in beverages tea and coffee fermentations. Vinegar Fermentation, microbiology of wine industry. Genetically modified foods. Biosensors in food.

Section-C
Antibiotics and their Mechanism of action, Molecular principles of drug targeting. Bacterial resistance to antibiotics. New vaccine technology, DNA vaccines, synthetic peptide vaccines, multivalent subunit vaccines, Vaccine clinical trials.

Section-D
Medical Microbiology: Diseases caused by Gram positive bacteria, Diseases caused by Gram negative bacteria, Disease caused by toxigenic bacteria, Diseases caused by Gram negative bacteria of family Enterobacteriaceae, sexually transmitted diseases, Overview of medical mycology, Overview of medical parasitology.

References:
Course No MBL-592

MOLECULAR CELL BIOLOGY

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Time: 3 Hours

Max. Marks: 100
Mid Semester Marks : 20
End Semester Marks : 80

Mid Semester Examination: 20% weightage
End Semester Examination: 80% weightage

Instructions for the Paper Setters:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Section-A

Membrane structure and function: Structure of model membrane, lipid bilayer and membrane protein diffusion, osmosis, ion channels, active transport, ion pumps, mechanism of sorting and regulation of intracellular transport, electrical properties of membranes.

Structural organization and function of intracellular organelles: Cell wall, nucleus, mitochondria, Golgi bodies, lysosomes, endoplasmic reticulum, peroxisomes, plastids, vacuoles, chloroplast, structure & function of cytoskeleton and its role in motility.

Section-B


Section-C

Cellular communication: Regulation of hematopoiesis, general principles of cell communication, cell adhesion and roles of different adhesion molecules, gap junctions, extracellular matrix, integrins, neurotransmission and its regulation.

Section-D

Microscopic techniques: Visualization of cells and subcellular components by light microscopy, resolving powers of different microscopes, microscopy of living cells, scanning and transmission microscopes, different fixation and staining techniques for EM, freeze-etch and freeze-fracture methods for EM, image processing methods in microscopy.

Books Recommended:

Course No MBL-593

ADVANCED MOLECULAR BIOLOGY

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Mid Semester Marks : 20
End Semester Marks : 80

Mid Semester Examination: 20% weightage
End Semester Examination: 80% weightage

Instructions for the Paper Setters:
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Section-A

Molecular Biology of Cell cycle:
Cell division and cell cycle: Mitosis and meiosis, their regulation, steps in cell cycle, and control of cell cycle. Regulation of Cell cycle progression: Maturation promoting factors (MPF), Cyclins and Cyclins dependent kinases, growth factors and growth inhibitory factors. Cell death and apoptosis.

Section-B

Cancer: Genetic rearrangements in progenitor cells, oncogenes, tumor suppressor genes, cancer and the cell cycle, virus-induced cancer, metastasis, interaction of cancer cells with normal cells, therapeutic interventions of uncontrolled cell growth.

Section-C

Control of Gene Expression at transcription and translation level in Prokaryotes:
Constitutive, Inducible and Repressible gene expression, Positive and Negative control of gene expression, Lac, Tryptophan, arabinose operons; Concept of attenuation, Lytic cascade and lysogenic repression in lambda bacteriophage.

Section-D

Control of Gene Expression at transcription and translation level in Eukaryotes:
Eukaryotic genome organization, Proteins involved in the control of transcription, Protein, protein interactions, Post-translational control, DNA methylation, Cell Signaling, Ligand binding to membrane receptors and its role in regulating transcription, phosphorylation cascade and amplification of signal. Role of chromatin in regulating gene expression and gene silencing.
Books Recommended


Course No MBL-595 : SPORTS BIOCHEMISTRY

Credit hrs.  
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Time: 3 Hours

Max. Marks: 100
Mid Semester Marks : 20
End Semester Marks : 80

Mid Semester Examination: 20% weightage
End Semester Examination: 80% weightage

Instructions for the Paper Setters:
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SECTION- A
General Physiology: Cardiovascular system- anatomy of heart and blood vessels, Normal ECG, Cardiac cycle, cardiac output and blood pressure. Respiratory system-anatomy, mechanism of respiration, lung volume and capacities, external and Internal respiration, transport of \(O_2\) and \(CO_2\), Muscular System: Anatomy of skeletal muscle, mechanism and energetics of contraction, muscle action potential, excitation-contraction coupling.

SECTION- B
Energy production in Sports and Exercise: Overview of energy production and metabolic regulation in high-intensity exercise, Definition of high-intensity exercise, Energy production during high-intensity exercise, Overview of energy production and metabolic regulation in endurance exercise.

SECTION- C
Metabolic Regulation in Sport and Exercise: How are catabolic and anabolic reactions controlled, Peptide hormones, neurotransmitters and regulation, Adrenaline activation of glycogenolysis, lipolysis, Insulin activation of glycogen synthase, Insulin inhibition of lipolysis, Insulin stimulation of protein synthesis, Steroid hormones and regulation.

SECTION- D
Pharmacologic and Nutritional Substances to Enhance Performance or Produce Weight Loss: Adaptogenic Herbs, Amino Acids, Anabolic Steroids, Caffeine, Ephedrine, Erythropoietin—Blood Doping, Levothyroxine, Metreleptin, Sibutramine, Vitamins and Minerals, World Anti-Doping Agency Testing Program

References: