

Mahatma Gandhi University
of
Medical Sciences & Technology, Jaipur

Syllabus
B.Sc. (Molecular Biology and Human Genetics)
(3Years Degree Course)

Notice

1. Amendments made by the University in Rules/ Regulations of the courses shall automatically apply.
2. The University reserves the right to make changes in the syllabus/ books/ guidelines, fee-structure or any other information at any time without prior notice. The decision of the University shall be binding on all.
3. The jurisdiction of all court cases shall be Jaipur Bench of Hon'ble Rajasthan High Court only.

SYLLABUS

B.Sc. (Molecular Biology and Human Genetics)

(3 Years Degree Course)

Rules & Regulations

1. TITLE OF THE COURSE

The title of the course shall be "B.Sc.(Molecular Biology and Human Genetics)".

2. DURATION OF COURSE/TRAINING

The course shall be of three years duration from the date of commencement of academic session.

3. MEDIUM OF INSTRUCTION

English shall be the medium of instruction.

4. ELIGIBILITY FOR ADMISSION:

- For admission a candidate should have passed the 10+2 (Senior Secondary) Examination (PCB) with 45% marks in the aggregate for General Category and 40% for SC/ST/OBC/MBC candidates or as per Govt. Guidelines.
- Candidate should have completed the minimum age of 17 years as on 31st December of the year of admission.

5. CRITERIA FOR ADMISSION

Selection shall be done by an Admission Board of the University strictly on merit. It will consist of two-step process –Written Entrance Examination followed by Counseling/Personal Interview (PI).

6. RESERVATION POLICY

Reservation shall be applicable as per policy of the State Government.

7. ENROLMENT

Every candidate who is admitted to the Course in Mahatma Gandhi Medical College shall be required to get himself/herself enrolled with the Mahatma Gandhi University of Medical Sciences & Technology after paying the prescribed eligibility and enrolment fees.

A candidate shall deposit enrolment fees along with tuition fees at the time of his/her admission to the course. Such a candidate who fails to submit, through the college Principal, duly filled enrolment form along with original documents including migration certificate required for enrolment within two months of his/her admission or up to November 30 of the year of admission whichever is later, he/she will have to pay late fee prescribed by the University.

8. MIGRATION RULES

- No student, once admitted to the course and enrolled by the University, will be permitted to migrate to any other Course/ University.
- No student will be admitted to the Course on migration from any other Course/ University.

9. ATTENDANCE

Minimum 75% attendance in each year, both for theory and practical classes separately. Student with deficient attendance will not be permitted to appear in University examination.

10. CONDUCTION OF THE UNIVERSITY EXAMINATION:

University examination shall be conducted twice in a year; that is Main and Supplementary Examination. Supplementary examination shall be conducted after 2-4 months of the main examination.

11. SCHEME OF EXAMINATION

i. Theory

- (a) Each Theory paper examination shall be of 3 hours duration and of maximum marks **70**.
- (b) Internal assessment shall be of **30** marks for each Theory Paper.

Theory Papers	Theory		Paper Set & Evaluated	
	Total Marks	Pass Marks	No. of Internal Paper Setters	No. of External Paper Setters
Ist Year: Three Theory Papers	300	150	3	-
II Ind Year: Three Theory Papers	300	150	3	-
III Ird Year: Three Theory Papers	300	150	2	1

- (c) For the First and Second year examinations – these respective above theory papers shall be set by the Internal Examiners covering their respective areas of syllabus. For each question paper there shall be a separate Internal Examiner. The answer books shall be evaluated by the concerned Internal Examiners (Papers Setters).
- (d) In Third (Final) Year examination, one of the papers shall be set and evaluated by an External Examiner. In other words, one of the Internal has to be substituted by the External Examiner. The External Examiner (Paper Setter) shall evaluate his/her paper.
- (e) The Paper Setter shall set the questions within the prescribed course of study of the concerned paper. There will be a set pattern of question papers duly approved by Academic Council. Model question paper is annexed herewith.
- (f) It is to be noted that the Internal and External Examiners of all the three years (First, Second and Third year) shall be appointed by the President of the University. This exercise shall be conducted through the office of the Controller of the Examinations of the University. The External Examiner of Third year shall also be appointed by the President out of the panel of names submitted by the Concerned Coordinator of the course through the Dean to the Controller of Examinations for appointment of Examiners by the President of the University.
- (g) Passing Marks: A candidate will have to obtain at least 50% marks in each Theory paper including internal assessment to pass. This shall include the marks obtained in Theory paper of 70 marks and internal assessment for that paper of 30 marks.

ii. Practical and Viva-Voce Examination

- (a) Each year there shall be practical and viva-voce examination of 100 marks. It shall consist of one University practical exam of 70 marks and internal assessment of 30 marks. It shall be conducted after the Theory examination is over. A candidate will have to obtain atleast 50% marks in practical and viva-voce examination inclusive of internal assessment to pass.
- (b) The pattern of practical examination shall be as follows –

B. Sc. Course	Practical		Practical Examiners
	Total Marks	Pass Marks	
First Year	100	50	Two Internal Examiner(s)
Second Year	100	50	Two Internal
Third Year	100	50	One Internal & One External Examiner

iii. Result

1. A candidate will have to obtain at least 50% marks separately in each Theory paper including internal assessment and a minimum of 50% marks in the practical examination inclusive of internal assessment for him to be declared pass.
2. A Candidate who has failed in theory paper/s will reappear in respective theory papers/s in supplementary examination.
3. Candidate who has failed in Practical examination only will reappear only in practical examination in Supplementary examination.

iv. Supplementary Examination

- (a) Eligibility for the failed candidates to appear at the supplementary examination shall be as below –
 - I. Failed in Theory Paper(s) and failed in Practical – shall reappear in the respective failed Theory paper(s) and Practical examination.
 - II. Failed in Theory paper/papers and passed in Practical examination – shall reappear only in the concerned failed Theory paper(s).
 - III. Passed Theory papers but failed in Practical – shall reappear only in the Practical Examination.
- (b) There shall be a supplementary examination within two months of the declaration of the result of the main examination. Internal assessment marks obtained in main examination in the concerned failed paper/papers/ practical shall be carried forward for working out the result of supplementary Theory paper(s) and or practical examination. Such candidate who has secured less than 50% marks in the internal assessment will be allowed to improve his internal assessment marks in the repeat supplementary internal assessment examination.
- (c) Marks secured by the candidate in passed main examination/supplementary examination Theory paper(s) and/or practicals, as the case may be, will be carried forward for working out his result.

(d) **Result:**

- i. A candidate obtaining at least 50% marks in the supplementary Theory paper(s) and 50% marks in the supplementary practical examination, as the case may be, shall be declared successful.
- ii. A candidate who has failed in supplementary theory paper(s) examination shall have to reappear only in the failed theory paper(s) at the subsequent examination.
- iii. A candidate who has failed in supplementary practical examination shall have to reappear both in theory (all papers) and practical at the next main examination.

v. Promotion to Second/Third Year

1. A candidate appeared in the University examination and failed in theory paper(s) /Practical examination shall be promoted to next year
2. A candidate will be allowed to appear for the Final (3rd) year examination only when the backlog of all papers (theory and practical) of first year and second year exams is cleared
3. The student is required to complete the course within 6 years from the joining of the course

vi. Result - Division: Successful candidates will be categorized as under –

1.	Those, securing 50% and above but less than 60% in the aggregate marks of First, Second & Third year taken together	-	Pass
2	Those, securing 60% and above but less than 75% in the aggregate marks of First, Second & Third year taken together	-	Pass with I Division
3	Those, securing 75% and above in the aggregate marks of First, Second & Third year taken together	-	Pass with Honours

12.GRACE MARKS

1. A student who appears in the whole examination in first attempt and obtains the required minimum pass marks in the total aggregate of an examination but fails to obtain the minimum pass marks in one subject (in theory and / or practical as the case may be) will be awarded the grace marks up to a maximum of 05 marks according to the following scale, provided the candidate passes the examination by award of such grace marks:

Marks obtained by the candidate above the required minimum aggregate pass marks		Grace marks can be given up to
Up to 6 marks	-	02
Up to 12 marks	-	03
Up to 18 marks	-	04
19 marks and above	-	05

2. No grace marks would be awarded to a candidate who appears in part/ supplementary/remand examination. Non appearance of a candidate in any part of the examination on account of any reason will make him ineligible for grace marks.

3. A candidate who passes the examination after the award of grace marks in a paper/practical or the aggregate will be shown in the marks sheet to have passed the examination by grace. Grace marks will not be added to the marks obtained by a candidate from the examiners.
4. If a candidate passes the examination but misses First or Second Division by one mark as applicable to the Faculty, he will be given one mark in the paper in which he gets the least marks and also in the aggregate of the subject as well as the complete examination to upgrade his division and make him entitled for the first or second division, as the case may be. Indication of this up-gradation will be given in the tabulation register as well as in the marks sheet of the candidate.
5. Non appearance of a candidate in any part of the examination will make him ineligible for grace marks.
6. A candidate who is awarded grace marks in any subject to pass the examination will not be entitled for distinction in any subject.
7. The place of the candidate who is awarded given grace marks to pass the examination or given one mark for up-gradation of his division in the examination merit list will, however, be determined by the aggregate marks he secures from the examiners.

13. REVALUATION / SCRUTINY

Revaluation of answer book(s) of the B.Sc. Courses is permissible in not more than 25% of the theory papers within 15 days from the date of declaration of examination result on submission of his/her application on the prescribed form alongwith the requisite fees. Such answer book(s) shall be re-evaluated as per University rules. Revaluation of answer book(s) shall not be permitted for second attempt in any paper.

Scrutiny (re-totaling) of answer book(s) of the B.Sc. Courses is permissible within 15 days from the date of declaration of examination result on submission of his/her application on the prescribed form alongwith the requisite fees as per University Rules.

Permission for revaluation / scrutiny

1. In 1st Attempt – Revaluation shall be permitted in 25% of the appeared papers. Scrutiny shall be permitted for all the papers.
2. In 2nd Attempt – Only scrutiny shall be permitted in all the papers. Revaluation shall not be permitted.
3. Revaluation shall also be permitted in 25% of such papers in which a candidate appears for the 1st time irrespective of his attempt in the whole examination.
4. Candidates passing all the subjects of one examination at different times shall be issued their mark-sheets showing actual attempts taken by them in passing the particular examination.

5. For determining the attempt, following criteria shall be followed –

S. No.	Situation	Attempt in next examination	
1.	Candidate is detained in all subjects	His attempt in all the subjects in the next examination will be treated as	1 st Attempt
2.	Candidate permitted in all subjects But did not appear in all permitted subjects	His attempt in the next examination will be treated as	1 st Attempt
3.	Candidate is detained in one / few subjects Permitted for the rest of the subjects Appeared in permitted subjects	His attempt in the detained subject(s) in the next examination will be treated as	2 nd Attempt
4.	Candidate is detained in one / few subjects Permitted in the rest of the subjects Did not appear in the permitted subjects	His attempt in the next examination In detained subject(s) will be treated as In permitted subject(s) will be treated as	1 st Attempt
5.	Candidate permitted in all subjects But did not appear in few subjects	His attempt in the permitted subjects in the next examination will be treated as	2 nd Attempt

SYLLABUS

B.Sc. (Molecular Biology and Human Genetics)

(3 Years Degree Course)

Learning Objectives:

At the end of the course, the student will be able to:

1. Know methods of sterilization, have knowledge about microscopy and staining techniques & pathogenesis of common bacterial, fungal and viral diseases.
2. Know macromolecular structure and their metabolism, transcription and translation of proteins
3. Know basic bacterial genetics, cell structure, cellular dynamics & basic knowledge of immunology.
4. Know about cultivation of viruses and molecular biology techniques & basic knowledge computational biology and informatics as well as molecular human genetics

Distribution of Teaching hours

1ST Year B.Sc. (Molecular Biology and Human Genetics)

Name of the paper	Hours
Paper I- Basic Microbiology	100
Paper-II – Basic Biochemistry	100
Paper-III – Basic Bacterial Genetics	100
Total Theory Hours	300
Practical	300
Total Hours:	600

2ndYear B.Sc. (Molecular Biology and Human Genetics)

Name of the paper	Hours
Paper - I: Microbiology (Cell structure and Dynamics)	100
Paper - II: Biochemistry (Metabolism of Carbohydrate, lipid, protein & nucleotides and Gene expression & Gene Regulation)	100
Paper - III: Immunology	100
Total Theory Hours	300
Practical	300
Total Hours :	600

3rd Year B.Sc. (Molecular Biology and Human Genetics)

Name of the paper	Hours
Paper- I: Cultivation of viruses & Molecular Biology techniques	100
Paper- II: Computational Biology & Bioinformatics	100
Paper- III: Molecular Human Genetics	100
Total Theory Hours	300
Practical	300
Total Hours:	600

First Year: Theory

Paper-I –Basic Microbiology

Paper-II –Basic Biochemistry

Paper-III –Basic Bacterial Genetics

First Year: Paper -I - Basic Microbiology

1. Overview of history of Microbiology - Biogenesis and abiogenesis Contributions of Redi Spallanzani, Needham, Pasteur, Tyndal, Joseph Lister, Koch [Germ Theory], Edward Jenner and Flemming [Penicillin], Scope of Microbiology.
2. Classification of Microbes - Systems of classification, Numerical taxonomy, Identifying characters for classification, General properties and principles of classification of microorganisms Systematics of bacteria, Nutritional types [Definition and examples]. Classification on the basis of oxygen requirement.
3. Concept of Sterilization - Definition of sterilization, dry and moist heat, pasteurization, tyndalization; radiation, ultrasonication, filtration. Physical and Chemical methods of sterilization; disinfection sanitization, antiseptics sterilants and fumigation. Determination of phenol coefficient of disinfectant.
4. Microscopy – Light microscopy, Bright & Dark Field microscopy, Fluorescence microscopy, Phase Contrast microscopy, TEM, SEM.
5. Stains and staining techniques – Definition of auxochrome, chromophores, dyes, Classification of stains, Theories of staining, Mechanism of gram staining, acid fast staining, negative staining, capsule staining, flagella staining, endospore staining.
6. Microbes in Extreme Environment – Nature, special features of the thermophilic, methanogenic and halophilic Archaea; photosynthetic bacteria, Cyanobacteria some Archaea who live in extreme conditions like cold, and space.
7. Pathogenic Microorganisms – List of common bacterial, fungal and viral diseases of human beings [Name of the disease, causative pathogen, parts affected]
8. Basic concepts of Virology - General characteristics of viruses, differences between bacteria and viruses. Classification of viruses Physical and chemical Structures of different Viruses on the basis of capsid symmetry - enveloped (Herpes virus), helical (TMV) and icosahedral (Polyoma viruses), Capsids, complex (Bacteriophage, and Virion size, enveloped (Herpes), helical (TMV) and icosahedral (Polyoma), Capsids.

First Year: Paper-II - Basic Biochemistry

1. Carbohydrates: Structural aspects – Introduction & Occurrence, Classification of Mono-, Di- and Polysaccharides, Reducing & Non-reducing Sugars, Constitution of Glucose & Fructose, Osazone formation, Pyranose & Furanose forms, Determination of ring size, Inter-conversion of monosaccharides.
2. Lipids: Structural aspects – General introduction, Classification & Structure of Simple & Compound lipids, Properties of Lipid aggregates (elementary idea), Biological membrane, Membrane protein – structural aspects, Lipoproteins (elementary idea).
3. Proteins: Structural aspects – General introduction, Classification & General characteristics, Structure of Primary, Secondary, Tertiary & Quaternary proteins (elementary idea), chains of proteins (elementary idea), Classification of Amino acids.
4. Nucleic acid: Structural aspects – Components of DNA and RNA, Nucleosides & Nucleotides (introduction, structure & bonding), Double helical structure of DNA (Watson-Crick model), various forms of DNA.
5. Hormones & Vitamins- Hormones (classification, structural features & functions in bio-systems); Vitamins (classification, functions of vitamins in bio-systems).
6. Chemical & Enzymatic Kinetics - An introduction to enzyme; How enzyme works; Reaction rate; Thermodynamic definitions; Principles of catalytic power and specificity of enzymes; Enzyme kinetics – Approach to mechanism.
7. Separation & Identification of Materials - concept of Chromatography (Partition Chromatography, Paper Chromatography, Adsorption Chromatography, TLC, GLC, Ion Exchange Chromatography, Gel Chromatography, HPLC, Affinity Chromatography); Electrophoresis (Gel Electrophoresis, Paper Electrophoresis).
8. Centrifugation – Basic Principle of Centrifugation, Instrumentation of Ultracentrifuge (Preparative, Analytical), Factors affecting Sedimentation velocity, Standard Sedimentation Coefficient, Centrifugation of associating systems, Rate-Zonal centrifugation, sedimentation equilibrium Centrifugation.

First Year: Paper-III -Basic Bacterial Genetics

1. Basic principles of bacterial genetics – DNA, structure of DNA, DNA replication, mutational change of DNA sequence, gene codes, DNA recombination.
2. Mutation – Occurrence, kinds of Mutation, spontaneous & induced Mutation, Mutagens, detection of Mutation, Lethal Mutations, Biochemical Mutations, Phenotypic effects of Mutation, Molecular basis of Mutation, Significance & Practical applications of Mutation.
3. Expression of genetic information: from Transcription to Translation – The Relationship between genes and protein, the transcriptions: The basic process, Transcription and RNA Processing in Eukaryotic Cells, encoding genetic information, Decoding the codons: the role of transfer RNAs.
4. Regulation of mRNA stability – capping, polyadenylation, pre-mRNA splicing, formation of commitment complex, creation of catalytic sites, trans-esterification reactions, mRNA surveillance.
5. Prokaryotic Genomes - Physical organization of bacterial genomes (Structure of the bacterial nucleoid, Replication and partitioning of the bacterial genome and Genome of Archaea).
6. Mechanism of genetic exchange: Plasmid and bacterial sex, Types of plasmids (F Plasmid : a Conjugate plasmid', Mobilization of Non-conjugative plasmid, R plasmid, Col plasmid Copy number and incompatibility), Episomes. Transposable elements (Insertion sequence and transposons, Integrons and Antibiotic-Resistance cassettes, Multiple Antibiotic Resistant bacteria, Mu-virus); Bacterial Genetics (Mutant phenotype, DNA mediated Transformation; Conjugation (Cointegrate Formation and Hfr Cells, Time-of-Entry Mapping, F' Plasmid); Transduction (Generalized transduction, Specialized Transduction)- gene mapping.
7. Molecular Mechanism of gene regulation in prokaryotes - Transcriptional regulation in prokaryotes (inducible and repressible system, positive regulation and negative regulation); Operon concept – lac, trp, Ara operons.
8. Bacteriophages: Stages in the Lytic Life Cycle of a typical phage, Properties of a phage infected bacterial culture, Specificity in phage infection, E. coli Phage T4, E.coli Phage T7, E.coli phage lambda, Immunity to infection, Prophage integration, Induction of prophage, Induction & Prophage excision, Repressor, Structure of the operator and binding of the repressor and the Cro product, Decision between the lytic and lysogenic Cycles, Transducing phages, E.coli phage phiX174, filamentous DNA phages, Single stranded RNA phages, The lysogenic Cycle.
9. Bacteriophage Genetics - Benzer's fine structure of gene in bacteriophage T4 : Plaque Formation and Phage Mutants, Genetic recombination in the lytic cycle, (concept of recon, muton, cistron).

Second Year: Theory

Paper - I: Microbiology (Cell structure and Dynamics)

Paper - II: Biochemistry (Metabolism of Carbohydrate, lipid, protein & nucleotides and Gene expression & Gene Regulation)

Paper - III: Immunology

Second Year: Paper - I: Microbiology (Cell structure and Dynamics)

1. Basics of Cell Biology (structure & function) – Discovery of cell and Cell Theory; Comparison between plant and animal cells; Cell wall; Plasma membrane; Modification of plasma membrane and intracellular junctions; Cytoskeleton; Protoplasm; Mitochondria; Chloroplast; ER; Golgi complex; Lysosome, endosome and microbodies; Ribosome; Centriole; Nucleus; Chemical components of a cell; Catalysis and use of energy by cells.
2. Biogenesis of Cellular organelles – Biosynthesis of mitochondria, chloroplast, ER, Golgi complex; Biosynthetic process in ER and golgi apparatus; Protein synthesis and folding in the cytoplasm; Degradation of cellular components.
3. Structure and function of Prokaryotic cell & its components - The Slime and the cell wall of bacteria containing peptidoglycan and related molecules; the outer membrane of Gram-negative bacteria, the cytoplasmic membrane. Water and ion transport, mesosomes, flagella, Pilus, fimbriae, ribosomes, carboxysomes, sulfur granules, glycogen, polyphosphate bodies, fat bodies, gas vesicles; endospores, exospores, cysts. Mycelia of fungi and Actinomycetes, Cytoskeleton filament, heterocysts and akinets of Cyanobacteria, Gliding and motility.
4. Membrane structure & transport – Models of membrane structure, Membrane lipids, proteins and carbohydrates; Solute transport by Simple diffusion, Facilitated diffusion and Active transport
5. Cell cycle - An overview of cell cycle; Components of cell cycle control system; Intracellular and Extra-cellular control of cell division, Programmed cell death (Apoptosis), intrinsic & extrinsic pathways of cell death, Apoptosis in relation with Cancer, Viral disease (AIDS) & Organ transplant.

Second Year: Paper-II: Biochemistry (Metabolism of Carbohydrate, lipid, protein & nucleotides and Gene expression & Gene Regulation)

1. Lipid Metabolism – Structures and roles of Fatty acids & Glycerols, beta oxidation of saturated fatty acids, oxidation of unsaturated fatty acids, oxidation of odd chain fatty acids, energy yield, ketone bodies.
2. Carbohydrate Metabolism – Aerobic & Anaerobic glycolysis, sequence of reactions in glycolysis, regulation in glycolysis, citric acid cycle, glycogenesis, glycogenolysis (sequence of reactions & regulation), Pentose-phosphate pathway (sequence of reactions & regulation), extraction of energy from food sources.
3. Amino acid Metabolism – Amino acid breakdown (amino acid deamination, Urea cycle, metabolic breakdown of individual amino acids – glucogenic & ketogenic amino acids), amino acids as biosynthetic precursors (haem biosynthesis & degradation, biosynthesis of epinephrine, dopamine, serotonin, GABA, histamine, glutathione); biosynthesis of essential & non-essential amino acids.
4. Nucleotide Metabolism – biosynthesis of purine & pyrimidine (de novo & salvage pathway); degradation of purine & pyrimidine.
5. Transcription: Enzymatic Synthesis of RNA Basic features of RNA synthesis, E.coli RNA polymerase, Classes of RNA molecules, processing of tRNA and rRNA in E.coli, Transcription in Eukaryotes, Eukaryotic rRNA genes, formation of eukaryotic tRNA molecules, RNA Polymerases of eukaryotes, RNA polymerase II Promoters, Eukaryotic Promoters for RNA polymerase III, Hypersensitive sites, Upstream activation sites and enhancers, Splicing mechanisms, Splicing of tRNA precursors, Splicing of rRNA precursors, Splicing without a protein enzyme.
6. Translation: Outline of Translation, The Genetic Code, The Decoding System, Codon Anticodon interaction, The special properties of the prokaryotic Initiator tRNA^{fMet} Transfer RNA genes, suppressors, Ribosomes, Protein Synthesis, Complex Translation units, Some numerical parameters of Protein synthesis, Inhibitors and Modifiers of protein synthesis, Protein Synthesis in Eukaryotes.
7. Regulation of activity of Genes and Gene products in Prokaryotes: General aspects of Regulation, The lactose system and the operon model, The Galactose operon, The Arabinose operon, The Tryptophan operon, Relative positions of Promoters and Operators, Regulons, Regulation of Translation, Regulation of the synthesis of Ribosomes, Unregulated changes in gene expression, Feedback Inhibition.
8. Regulation in Eukaryotes: Regulatory strategies in Eukaryotes, Gene alteration (Gene loss, Gene amplification, Gene rearrangement: the joining of coding sequences in the immune system) Transcriptional Control by hormones, Regulation mediated through Transcription factors, Regulation of enhancer activity, Methylation, Regulation of processing, Translational control, Regulation of gene expression in plant cells by light.

Second Year: Paper- III: Immunology

1. Immune Response - an overview, components of mammalian immune system, molecular structure of Immunoglobulins or Antibodies, Humoral & Cellular immune responses, T lymphocytes & immune response (cytotoxic T-cell, helper T-cell, suppressor T-cells), T-cell receptors, genome rearrangements during B-lymphocyte differentiation, Antibody affinity maturation class switching, assembly of T-cell receptor genes by somatic recombination.
2. Regulation of immunoglobulin gene expression – clonal selection theory, allotypes & idiotypes, allelic exclusion, immunologic memory, heavy chain gene transcription, genetic basis of antibody diversity, hypotheses (germ line & somatic mutation), antibody diversity, alternate pathways of transcript splicing, variable joining sites & somatic mutation, role of antibody (alone, in complement activation & with effector cells), monoclonal antibodies.
3. Major Histocompatibility complexes – class I & class II MHC antigens, antigen processing.
4. Immunity to infection – immunity to different organisms, pathogen defense strategies, avoidance of recognition, inactivation of host-immune effector mechanisms.
5. Immuno-techniques - Blood grouping, Antigen-Antibody reactions: agglutination, precipitation, immuno-electrophoresis, Coomb's test, ELISA, RIA.
6. Vaccines & Vaccination – adjuvants, cytokines, DNA vaccines, recombinant vaccines, bacterial vaccines, viral vaccines, vaccines to other infectious agents, tumor vaccines, principles of vaccination, passive & active immunization, immunization programs & role of WHO in immunization programs.
7. Auto-immune diseases – autoimmunity & auto-immune diseases, factors contributing development of auto-immune diseases, mechanism of development, breakdown of self-tolerance, rejection of transplants, molecular mimicry, diagnosis & treatment of auto-immune diseases, replacement therapy, suppression of autoimmune processes, nature of auto-antigens, immunodeficiency, AIDS.

Third Year: Theory

Paper- I: Cultivation of viruses& Molecular Biology techniques

Paper- II: Computational Biology & Bioinformatics

Paper- III: Molecular Human Genetics

Third Year: Paper- I: Cultivation of viruses& Molecular Biology techniques

1. Cultivation of viruses- Animal inoculation, embryonated egg inoculation and tissue culture.
2. Purification and Separation of nucleic acids – Extraction and Purification of nucleic acids, Detection and Quantitation of Nucleic acids, Gel Electrophoresis.
3. Cutting and Joining DNA – Restriction Endonucleases, Ligation, Alkaline Phosphate, Double Digest, Modification of Restriction Fragments ends, Other Ways of joining DNA Molecules.
4. Vectors – Plasmid vectors, Vectors based on the lambda Bacteriophage, Cosmids, M13 vectors, Expression vectors, Vectors for cloning and expression in Eukaryotic cells, Super vectors: YACs and BACs.
5. Amplifying DNA: PCR and Cell based DNA Cloning – The importance of DNA Cloning, PCR: basic features and application, Principles of Cell-based DNA Cloning, Cloning System for amplifying different sized fragments, Cloning System for producing single-stranded and mutagenized DNA.
6. Nucleic Acid Hybridization: Principle and application - Preparation of nucleic probes, Principle of Nucleic acid hybridization, Nucleic acid hybridization assays, and microarrays.
7. Western Blot assay

Third Year: Paper-II: Computational Biology & Bioinformatics

1. Introduction to Genomics - information flow in biology, DNA sequence data, Experimental approach to genome sequence data, genome information resources.
2. Functional Proteomics - protein sequence and structural data, protein information resources and secondary data bases.
3. Computational Genomics - Internet basics, biological data analysis and application, sequence data bases, NCBI model, file format.
4. Sequence alignment & data base search - Protein primary sequence analysis, DNA sequence analysis, pair wise sequence alignment, FASTA algorithm, BLAST, multiple sequence alignment, DATA base searching using BLAST and FASTA.
5. Structural data bases - Small molecules data bases, protein information resources, protein data bank.

Third Year: Paper-III: Molecular Human Genetics

1. Gene Recombination and Gene transfer: Bacterial Conjugation, Transformation, Transduction, Episomes, Plasmids.
2. Genetic engineering- & its applications
3. Genome –types of genomes, genomes & genetic variation, comparison of different genomes, genome evolution.
4. Genomics – about the genomics, history, comparative genomics, comparative genomic hybridization, functional genomics.
5. Human Genome Project (HGP) – an overview of the project, goals of the project, major scientific strategies & approaches used in HGP, expected scientific & medical benefits of this project, about the organizations behind this project. Mapping of Human genome.
6. Molecular biology of Cancer – Activation of oncogenes, Inactivation of tumor suppressor genes, Inappropriate expression of micro RNAs in cancer, Chromosomal rearrangements and cancer, Viruses and cancer, Chemical carcinogenesis.
7. Gene therapy - Vectors for somatic cell gene therapy, Enhancement genetic engineering, Gene therapy for inherited immunodeficiency syndromes, Cystic fibrosis gene therapy, HIV-1 gene therapy. Retroviral mediated gene transfer.
8. Stem cells & therapeutic cloning - Embryonic stem cells and therapeutic cloning, multi-potent adult stem cells, pluripotent adult stem cells, transgenic stem cells, Regeneration therapy.

PRACTICALS

Practical: First Year

1. Microscopy – Light microscopy: principles, parts & function and operation.
2. Preparation of culture media
3. Sterilization: principles & operations – Autoclave, Hot Air Oven, Filtration, Laminar Air Flow
4. Principles & operations of Incubators & Shakers
5. Principle & operation of Centrifuge
6. Principle & operation of pH meter
7. Preparation of Slides
8. Staining of Slides (Gram's, AFB staining, Negative staining, capsule & endospore staining)
9. Sampling and quantification of microorganisms in air and water.
10. Isolation of bacteria (Streak plate, spread plate, pour plate, serial dilution)
11. Tests for Motility
12. Observation of morphology - shape and arrangement of cells.
13. Methods of inoculation of different microbes in media.
14. Testing of Blood Sugar
15. Testing of Liver Function Test (Bilirubin, SGOT, SGPT, Alkaline Phosphatase, Albumin, Globulin, Total Protein)
16. Testing of Renal Function Test (Urea, Uric acid, Creatine, Creatinine)

Practical: Second Year

1. Antigen-Antibody reactions eg. Widal, TRUST (Modified VDRL), ELISA & Rapid diagnostic tests (HIV, HBsAg, HCV, Malaria Ag)
2. Staining of Slides (Gram's, AFB staining, Negative staining, capsule & endospore staining)
3. Tests for Motility
4. Observation of morphology - shape and arrangement of cells.
5. Methods of inoculation of different microbes in media.
6. Testing of Blood Sugar
7. Testing of Liver Function Test (Bilirubin, SGOT, SGPT, Alkaline Phosphatase, Albumin, Globulin, Total Protein)
8. Testing of Renal Function Test (Urea, Uric acid, Creatine, Creatinine)

Practical: Third Year

1. Bacterial antibiotic sensitivity testing
2. DNA/RNA extraction
3. Polymerase Chain Reaction & its applications
4. Antigen-Antibody reactions eg. Widal, TRUST (Modified VDRL), ELISA & Rapid diagnostic tests (HIV, HBsAg, HCV, Malaria Ag)
5. Staining of Slides (Gram's, AFB staining, Negative staining, capsule & endospore staining)
6. Tests for Motility
7. Observation of morphology - shape and arrangement of cells.
8. Methods of inoculation of different microbes in media.
9. Testing of Blood Sugar, Liver Function tests and Renal Function tests.
10. Internet basics
11. Introduction to NCBI Model
12. Introduction to Data bases
13. BLAST
14. FASTA

REFERENCE BOOKS

1. Life Sciences: Fundamentals and Practice Part I & II: P. Kumar & Mina U. (latest edition)
2. Molecular biology: A Laboratory Manual by S.K. Gakhar, Monika Miglani & Ashwani Kumar (latest edition)
3. Prescott's Microbiology: Joanne Willey and Linda Sherwood and Chris Woolverton, McGraw Hill (latest edition)
4. Microbiology: Gerard J Tortora and Berdell R Funke and Christine L Case, Pearson (latest edition)
5. Molecular Biology by Dr. P.S. Verma & Dr. V.K. Agarwal (latest edition)
6. Genetics and Molecular Biology by Dr. Kishor P. Pava (latest edition)
7. Biostatistics, Computer application and Bioinformatics by R. Sundaralingam, N. Arumugam, V. Kumaresan, A. Gopi & A. Meena (latest edition)
8. Computational biology and Bioinformatics by Ka-Chun Wong (latest edition)
9. Biochemistry for students by V.K. Malhotra (latest edition)
10. Lehninger's Principles of Biochemistry, publishers: McMillan (latest edition)
11. The Science of Genetics : by Alan G. Atherly, Jack R. Girton, John F. McDonald (latest edition)
12. Human Molecular Genetics by Strachan & Read, publishers: Wiley (latest edition)
13. Ananthanarayan and Paniker's Textbook of Microbiology (latest edition)
14. Koneman's Color Atlas and Textbook of Diagnostic Microbiology (latest edition)

MODEL PAPER

B.Sc. (Mol. Bio. & Human Genetics)-I

Code

B.Sc. (Molecular Biology and Human Genetics)

Part-I (Main) Examination Month Year

Paper - I Basic Microbiology

Time: Three Hours

Maximum Marks: 70

Students shall be allowed to take only one supplementary copy along with one main answer book. All the parts of one question should be answered at one place. Different parts of one question should not be answered at different places in the answer book
Draw diagrams wherever necessary

Attempt all questions

- Q.1 Define sterilization and disinfection. Enumerate the methods of sterilization and disinfection. Explain the principle, procedure and applications of autoclave. 15
- Q.2 Write down the various staining techniques. Explain the Gram's staining with the principle, procedure & interpretation. 15
- Q.3 Long Answers Types
- a) General characteristics of viruses with its classification. 10
 - b) Different types of microscopy. 10
- Q.4 Short Notes (any 4 out of 6) 4x5=20
- a) Extremophiles/ Archaeobacteria
 - b) Contributions of Louis Pasteur
 - c) Acid fast staining
 - d) Pasteurization
 - e) Difference between bacteria and viruses
 - f) Classification of microbes on the basis of oxygen

MODEL PAPER

B.Sc. (Mol. Bio. & Human Genetics)-I

Code

B.Sc. (Molecular Biology and Human Genetics)

Part-I (Main) Examination Month Year

Paper - II Basic Biochemistry

Time: Three Hours

Maximum Marks: 70

Students shall be allowed to take only one supplementary copy along with one main answer book. All the parts of one question should be answered at one place. Different parts of one question should not be answered at different places in the answer book
Draw diagrams wherever necessary

Attempt all questions

- | | | |
|-----|---|--------|
| Q.1 | Explain the double helical structure of DNA with neat and labelled diagram. | 15 |
| Q.2 | Define enzymes. Explain the effect of temperature & pH on enzyme activity. | 15 |
| Q.3 | Long Answers Types | |
| | a) Classification of amino acids. | 10 |
| | b) Classification, structural features and functions of hormones. | 10 |
| Q.4 | Short Notes (any 4 out of 6) | 4x5=20 |
| | a) Functions of carbohydrates | |
| | b) HPLC | |
| | c) Basic principle of centrifugation | |
| | d) Difference between saturated and unsaturated fatty acids | |
| | e) Paper chromatography | |
| | f) Electrophoresis | |

MODEL PAPER

B.Sc. (Mol. Bio. & Human Genetics)-I

Code

B.Sc. (Molecular Biology and Human Genetics)

Part-I (Main) Examination Month Year

Paper - III Basic Bacterial Genetics

Time: Three Hours

Maximum Marks: 70

Students shall be allowed to take only one supplementary copy along with one main answer book. All the parts of one question should be answered at one place. Different parts of one question should not be answered at different places in the answer book
Draw diagrams wherever necessary

Attempt all questions

- | | | |
|-----|--|--------|
| Q.1 | Discuss in detail lac operon system and its regulatory components. | 15 |
| Q.2 | Explain the different stages in transcription. Add a note on regulation of transcription in prokaryotes. | 15 |
| Q.3 | Long Answers Types | |
| | a) Post transcriptional modification of eukaryotic mRNA | 10 |
| | b) Illustrate detailed structure of DNA with suitable diagram. | 10 |
| Q.4 | Short Notes (any 4 out of 6) | 4x5=20 |
| | a) Mutations | |
| | b) DNA replication in E. coli | |
| | c) Plasmids | |
| | d) Transduction | |
| | e) Lytic & lysogenic life cycle | |
| | f) Genetic recombination in bacteria | |

MODEL PAPER

B.Sc. (Mol. Bio. & Human Genetics)-II

Code

B.Sc. (Molecular Biology and Human Genetics)

Part-II (Main) Examination Month Year

Paper - I

Microbiology (Cell structure and Dynamics)

Time: Three Hours

Maximum Marks: 70

Students shall be allowed to take only one supplementary copy along with one main answer book. All the parts of one question should be answered at one place. Different parts of one question should not be answered at different places in the answer book
Draw diagrams wherever necessary

Attempt all questions

- | | | |
|-----|---|--------|
| Q.1 | Explain the structure and various functions of Endoplasmic reticulum. | 15 |
| Q.2 | Explain the structure of prokaryotic cell with well labelled diagram. | 15 |
| Q.3 | Long Answers Types | |
| | a) Write a note on cell theory. | 10 |
| | b) Explain the fluid mosaic model of cell membrane. | 10 |
| Q.4 | Short Notes (any 4 out of 6) | 4x5=20 |
| | a) Active transport | |
| | b) Difference between prokaryotes and eukaryotes | |
| | c) Mitochondria | |
| | d) Bacterial flagella | |
| | e) Apoptosis | |
| | f) Protein synthesis & folding in cytoplasm | |

MODEL PAPER

B.Sc. (Mol. Bio. & Human Genetics)-II

Code

B.Sc. (Molecular Biology and Human Genetics)

Part-II (Main) Examination Month Year

Paper - II

Biochemistry (Metabolism of Carbohydrate, lipid, protein & nucleotides and Gene expression & Gene Regulation)

Time: Three Hours

Maximum Marks: 70

Students shall be allowed to take only one supplementary copy along with one main answer book. All the parts of one question should be answered at one place. Different parts of one question should not be answered at different places in the answer book
Draw diagrams wherever necessary

Attempt all questions

- | | | |
|-----|--|--------|
| Q.1 | Explain de novo synthesis of pyrimidine & purine. | 15 |
| Q.2 | Describe pentose-phosphate pathway and its regulation. | 15 |
| Q.3 | Long Answers Types | |
| | a) Citric acid cycle | 10 |
| | b) Structure & functions of different types of RNA. | 10 |
| Q.4 | Short Notes (any 4 out of 6) | 4x5=20 |
| | a) Nucleosides & Nucleotides | |
| | b) RNA polymerase | |
| | c) Gene expression in prokaryotes | |
| | d) Genetic code | |
| | e) Translation | |
| | f) Clover leaf structure of tRNA | |

MODEL PAPER

B.Sc. (Mol. Bio. & Human Genetics)-II
Code

B.Sc. (Molecular Biology and Human Genetics) Part-II (Main) Examination Month Year

Paper - III **Immunology**

Time: Three Hours
Maximum Marks: 70

Students shall be allowed to take only one supplementary copy along with one main answer book. All the parts of one question should be answered at one place. Different parts of one question should not be answered at different places in the answer book
Draw diagrams wherever necessary

Attempt all questions

- Q.1 Explain the structure of immunoglobulins and write a brief note on humoral and cell mediated responses. 15
- Q.2 Define antigen-antibody reactions. Explain the principle and applications of ELISA in detail. 15
- Q.3 Long Answers Types
- a) Viral vaccines 10
 - b) Agglutination 10
- Q.4 Short Notes (any 4 out of 6) 4x5=20
- a) Autoimmune diseases
 - b) Cytokines
 - c) MHC
 - d) Monoclonal Antibodies
 - e) Active & passive immunization
 - f) Radioimmunoassay

MODEL PAPER

B.Sc. (Mol. Bio. & Human Genetics)-III

Code

B.Sc. (Molecular Biology and Human Genetics)

Part-III (Main) Examination Month Year

Paper - I

Cultivation of viruses & Molecular Biology techniques

Time: Three Hours

Maximum Marks: 70

Students shall be allowed to take only one supplementary copy along with one main answer book. All the parts of one question should be answered at one place. Different parts of one question should not be answered at different places in the answer book
Draw diagrams wherever necessary

Attempt all questions

- | | | |
|-----|--|--------|
| Q.1 | Explain the different methods of cultivation of viruses. | 15 |
| Q.2 | Describe in detail the role of enzymes in DNA replication. | 15 |
| Q.3 | Long Answers Types | |
| | a) Principle & applications of nucleic acid hybridization | 10 |
| | b) DNA cloning | 10 |
| Q.4 | Short Notes (any 4 out of 6) | 4x5=20 |
| | a) PCR | |
| | b) Vectors | |
| | c) Cosmids | |
| | d) Gel electrophoresis | |
| | e) Western Blot assay | |
| | f) Purification and separation of nucleic acid | |

MODEL PAPER

B.Sc. (Mol. Bio. & Human Genetics)-III

Code

B.Sc. (Molecular Biology and Human Genetics)

Part-III (Main) Examination Month Year

Paper - II

Computational Biology & Bioinformatics

Time: Three Hours

Maximum Marks: 70

Students shall be allowed to take only one supplementary copy along with one main answer book. All the parts of one question should be answered at one place. Different parts of one question should not be answered at different places in the answer book

Draw diagrams wherever necessary

Attempt all questions

- | | | |
|-----|--|--------|
| Q.1 | Write a detailed account on database mining tools. | 15 |
| Q.2 | Give an account on the methods of submitting DNA sequences to the databases. | 15 |
| Q.3 | Long Answers Types | |
| | a) Features and importance of NCBI. | 10 |
| | b) Protein sequences and its structural data. | 10 |
| Q.4 | Short Notes (any 4 out of 6) | 4x5=20 |
| | a) BLAST | |
| | b) FASTA | |
| | c) Genebank | |
| | d) Genomes | |
| | e) Structural databases and its importance | |
| | f) Secondary structural prediction and its importance. | |

MODEL PAPER

B.Sc. (Mol. Bio. & Human Genetics)-III

Code

B.Sc. (Molecular Biology and Human Genetics)

Part-III (Main) Examination Month Year

Paper - III Molecular Human Genetics

Time: Three Hours

Maximum Marks: 70

Students shall be allowed to take only one supplementary copy along with one main answer book. All the parts of one question should be answered at one place. Different parts of one question should not be answered at different places in the answer book

Draw diagrams wherever necessary

Attempt all questions

- | | | |
|-----|--|--------|
| Q.1 | Write a detail note on Gene Therapy. | 15 |
| Q.2 | Explain stem cells and discuss in detail about various types of cloning vectors. | 15 |
| Q.3 | Long Answers Types | |
| | a) Human Genome Project | 10 |
| | b) Tools of Genetic engineering | 10 |
| Q.4 | Short Notes (any 4 out of 6) | 4x5=20 |
| | a) Transduction | |
| | b) Plasmid | |
| | c) Functional genomes | |
| | d) Application of genetic engineering | |
| | e) Regeneration Therapy | |
| | f) Retroviral mediated gene transfer | |