M.Sc. (Life Science)

Eligibility: B.Sc. (under 10+2+3 scheme) with Chemistry, Botany, Zoology, Biotechnology, and Microbiology with a minimum of 50% marks.
(45% for candidates belonging to the reserved category SC/ST/OBC)

Scheme of Examination and Courses of study

1. The M.Sc. course in Life Science is a two year full time curriculum offered in the form of Choice-based Credit System organized in four semesters. The number of papers and maximum marks for each theory paper/practical have been shown in the syllabus. It will be necessary for a candidate to pass in the theory part as well as in the practical part (wherever prescribed) separately.
2. The course of study for M.Sc. (Life Science) examination shall be spread over a period of two years with examination at the end of each semester. There shall be four semesters in all.
3. Syllabus of every paper of each semester will be divided into 5 units.
4. Scheme of examination-

Semester I	Max Marks	Min Marks	Inter Asse.
Paper I	70	25	30
Paper II	70	25	30
Paper III	70	25	30
Paper IV	70	25	30
Practicals	200	72	

An aggregate of 50% marks is required to pass a semester.

Semester I

LS 01 – Cell Biology
LS 02- Molecular Biology
LS 03- Genetics
LS 04 – Biological Tools, Techniques & Research Methodology
Practicals Day 1- LS01, LS02
Day 2- LS03, LS04

Semester II

LS 05– Microbiology
LS 06- Biochemistry
LS 07- Ecology
LS 08– Evolution and Animal Behavior
Practicals Day 1- LS05, LS06
Day 2- LS07, LS08

Semester III

LS 09– Genetic Engineering & Bio-Informatics
LS 10- Biotechnology
LS 11- Biodiversity
LS 12 – Biostatistics & Biophysics
Practicals Day 1- LS09, LS10
Day 2- LS11, LS12

Semester IV

LS13– Environmental Sustainability
LS14 - Animal Physiology
LS15 - Plant Physiology
LS16 – Immunology

Practicals Day 1- LS13, LS14
Day 2- LS15, LS16

Semester I

Paper I – Cell Biology

Paper II- Molecular Biology

Paper III- Genetics

Paper IV – Biological Tools Techniques & Research Methodology

Paper - LS – 01 : Cell Biology

Min Marks: 25 Duration - 3 hrs Max Marks: 70

Unit – I

1. Cell theory, origin and evolution of cell. Evolution from primitive cell to prokaryota and leading to Eukaryotic development.
2. Cell wall – structure and function, biogenesis, Plasmodesmata, Glycocalyx.
3. Plasma - membrane - structural models and its functions Lipids and Proteins of different membranes, their fluidity, Spectrin, Glycophorin, Bacteriohodopsin, Porins, cell surface carbohydrates - selectins.
4. Membrane transport (Active & Passive) Carrier Proteins, Ion channels. Voltage gated channels.

Unit – II

1. Cell-cell interaction and Signal Transduction.
2. G Proteins and its function, Protein Kinase, Protein Phosphatase.
3. Structure and function of Endoplasmic Reticulum and Ribosomes. Signal recognition particle of E.R.
4. Lysosome – structure and function (Polymorphism, intracellular digestion, sorting of lysosomal enzymes in G.B).

Unit – III

1. Micro bodies - Peroxysomes, Glyoxysomes and Spherosomes.
2. Ultrastructure and Function of Mitochondria (cristae,oxidative phosphorylation)
3. Chloroplast. Endosymbiont concept, Genome of Mitochondria and Chloroplast, Use of mitochondrial genome in evolution.
4. Structure and function of Golgibody. GERL and its role in intracellular secretion.

Unit – IV

1. Cell vacuoles in plants, food vacuoles, air vacuoles and their importance.
2. Cytoskeleton - Microfilaments, microtubules and intermediate filaments.
3. Role of cytoskeleton in cilia, flagella and membrane ruffling movements.
4. Centriole structure and centriole cycle during cell division.

Unit – V

1. Ultrastructure of Nucleus, Nuclear membrane, Pore complex, fibrous lamina, Nucleoplasm, Nucleolus, nucleolar organizers and function.Chromatin organisation in non dividing and dividing cells. Euchromatin and heterochromatin and their importance.

2. Chromosome structure and Packing of DNA (Nucleosome and Solenoids). C - value paradox, Cot curve. Special types of Chromosomes Lampbrush, Polytene, B - Chromosotnes and Sex chromosomes. Role of Telomers. Karyotype analysis, Banding patterns, Banding techniques.
3. Cell cycle: molecular events in regulation of cell cycle, check points, role of Cyclins, Cyclin dependent Kinases (cdk).
4. Cell totipotency, Pleuripotency, determination, Specialization, differentiation and development. Mechanism of programmed cell death - Apoptosis. Apoptosis in relation with cancer.

Reference Books:

1. Molecular Cell Biology: Harvey Lodish, Arnold Berk, S Lawrence Zipursky, Paul Matsudaira, David Baltimore, and James Darnell.
2. Molecular Biology of the Cell: Alberts B., Johnson A., Lewis J., Raff M., Reberts K., and Walter P.
3. The Cell: A Molecular Approach by Geoffrey M Cooper.
4. Cell and Molecular biology by P.K.Gupta , Rastogi publication
5. Cell Biology By Dr. S.P.Singh & Dr. B.S. Tomar, Rastogi publication

Paper - LS – 02: Molecular Biology

Min Marks :25 Duration - 3 hrs Max Marks :70

Unit I

1. Nucleic acids as genetic information carriers, Experimental evidences, DNA structure, historical aspects & current concepts. Types of DNA, melting of DNA.
2. DNA replication in prokaryotes: types of polymerases, steps: initiation, elongation termination.
3. DNA replication in eukaryotes: types of polymerases, replication origins & initiation, steps involved.
4. Synthesis of telomeric DNA.

Unit II

1. Transcription in prokaryotes: RNA polymerase, promoter, steps: initiation, elongation & termination, anti termination.
2. Transcription in eukaryotes: types of RNA polymerases (I, II & III), promoter, enhancer & silencer sites for initiation, transcription factors, and steps: initiation, elongation & termination.
3. Post transcriptional modification of mRNA: capping, polyadenylation .
4. RNA splicing, Ribozymes.

Unit III

1. Central dogma of life.
2. Protein synthesis in prokaryotes and eukaryotes; steps-details of initiation, elongation & termination, roles of various factors in the above steps,
3. Co and post translational modifications of proteins, protein folding.
4. Role of chaperones in protein folding, protein degradation and role of proteosome.

Unit IV

1. Operon concept, negative & positive regulation,
2. Instability of bacterial mRNA, inducers and co repressors, catabolite repression.
3. Negative regulation-E. coli lac operon;
4. Positive regulation- E. coli ara operon; regulation by attenuation his and trp operons.

Unit V

1. Molecular mapping of genome (genetic and physical maps, physical mapping and map based cloning, RFLP, RAPD, AFLP analysis, application of RFLP in forensic, disease diagnosis, genetic counselling.)
2. Molecular Biology of Cancer. Viral and cellular oncogene, tumor suppressor genes from humans, structure, function and mechanism of action of PRB and P53 tumor.
3. Antisense technology. Molecular mechanism of antisense molecules Application of antisense. technology.
4. Genome Projects - An overview of the genome projects of human and other model organisms, Methodology of HGP and its findings and goal.

Reference Books:

1. "Molecular Biology of the Gene" by Watson-Baker-Bell-Gann-Levine-Losick, 5 th Edn., Pearson Education
2. "Molecular Biology" by D. Freifelder, Narosa Publishing House, New Delhi.
3. "Genome" by T.A. Brown, John Wiley & Sons.
4. "Microbial Genetics" by D. Freifelder, Narosa Publishing House, New Delhi.
5. "Gene VII" by Lewin Benjamin (Oxford).
6. "Molecular Cell Biology" by J.Darnell, H.Lodhis & D.Baltimore (W.H.Freeman & Co.).
7. "DNA Repair & Mutagenesis" by E.C.Friedberg, G.C.Walker and W. Seide (ASM Publisher).
8. Molecular biotechnology- S.B. Primrose.
9. Molecular biotechnology- Glick.

PRACTICALS I & II:

1. Meiosis –grasshopper testis, Aloe vera, onion anthers.
2. Demonstration of Golgi apparatus in Buccal smears by neutral red.
3. Demonstration of mitochondria in buccal smear by janus green.
4. Demonstration of histone proteins in tissue sections.
5. Demonstration of lysosomes by acid phosphotase.
6. Demonstration of structure of different cell organelles (photos) by electron microscope.
7. Demonstration of barr bodies in buccal smear using acetocarmine.
8. Demonstration of drum sticks using acetocarmine.
9. Separation of different organelles/molecule by sucrose density gradient/differential gradient.
10. Study of cell division in plants and animals, giant chromosomes.
11. Isolation of genomic DNA and its quantitation by a spectrophotometric method.
12. Isolation of RNA and quantitation by a spectrophotometric method.
13. Isolation of Mitochondria and the activity of its markes enzyme; succinate dehydrogenase (SDH).
14. DNA gel electrophoresis, blotting and hybridization with labelled DNA probes (Southern Blot) Techniques.
15. Transformation of E.coli.
16. Restriction endonuclease digestions of DNA.
17. Haematological experiments: Preparation and staining of blood film with Leishman's stain.
18. Identification of blood corpuscles. Differential count of WBC. Total count of RBC and WBC.
19. Bleeding time, Clotting time and ESR.

Paper - LS – 03: Genetics

Min. Pass Marks - 25 Duration - 3 hrs. MM - 70

Unit I

1. Mendel's principle –Law of dominance, Principle of segregation and Independent assortment.
2. Extensions of Mendelian Principles - Incomplete dominance, co-dominance, Lethal gene, Multiple Allele, Pleotropy.
3. Chromosome Theory of Heredity (Sutton-Boveri).
4. Inheritance patterns, phenomenon of Dominance, Inheritance patterns in Human (Sex-linked, Autosomal, Mitochondrial, Unifactorial, Multi-factorial).

Unit – lI

1. Morgan's work - Morgans work on Drosophila, Similarity in Mendel and Morgan results in eye color inheritance.
2. Gene interaction - Epistasis, Complementary genes, Duplicate genes, Penetrance and expressivity. Quantitative inheritance, polygenic characters.

3. Linkage and Crossing over - Crossing over; its mechanism, cytological basis of crossing over.
4. Linkage groups, linkage maps, Tetrad analysis, Mapping with Molecular Markers.

Unit III

1. Accessory genetic elements & Maternal Inheritance - Plasmids, Transposons and Retroelements. Mechanism of Transposition and uses of Transposons.
2. Inheritance of Mitochondrial & Chloroplast Genes, Maternal Inheritance.
3. Sex determination- Sex determination in Plants and Animals, Environmental effect in sex determination,
4. Dosage compensation. Sex linked, Sex influenced and Sex limited traits, Sex reversal, free martin effect, variations of sex linkage.

Unit IV

1. Chromosomal aberration - Addition, Deletion, Duplication, Translocation and Inversions Genetic consequences of these changes.
2. Aneuploidy and Euploidy. their genetics implications.
3. Mutations – Types, causes and detection mutant type lethal conditional biochemical loss of functions gain of functions germinal verses somatic mutants, insertional mutagenesis
4. Pedigree analysis – Symbols of Pedigree, Pedigrees of Sex-linked & Autosomal (dominant & recessive).

Unit V

1. Microbial Genetics – Methods of Genetic transfers, transformation, conjugation, transduction, and sexduction. Mapping genes by interrupted mating, fine structure analysis of genes
2. Population Genetics - Hardy-Weinberg Law, Deviation from H.W, Law; Gene frequencies, genetic drift, factors affecting H.W. Law. Founder affects Bottle neck affect.
3. Human Genetics - Human chromosomes, Karyotype, pedigree analysis
4. Eugenics, Euphenics, common genetic disorders and abnormalities due to chromosome structure and numeral change.

Reference Books:

1. Concepts of genetics by klug and cummings.
2. Genetics: From Genes to Genomes by Leland Hartwell, Leroy E. Hood, Michael L. Goldberg.
3. Genetics: Analysis and Principles (3rd Edition) by Brooker.
4. Cytology, Genetics & Molecular Biology Dr. P. K. Gupta Rastogi publication.

Paper LS – 04: Biological Tools Technique, Research Methodology

Min. Pass Marks - 25 Duration - 3 hrs. MM - 70

UNIT- I

1. Principle and Application of Light- Phase contrast, Fluorescence microscope.
2. Principle and Application of Electron Microscopy (SEM & TEM).
3. Principle and Application of Gel-Filtration, Ion-exchange and affinity Chromatography

Thin layer and Gas Chromatography, HPLC.

4. Principle and Application of Electrophoresis, Spectroscopy.

UNIT-II

1. Principle and practice of statistical method in life science.
2. Basic statistics average. Dispersion, Coefficient of variation.
3. Standard Error, probability distribution, Test of statistical significance.
4. Simple correlation and Regression analysis.

UNIT-III

1. Analysis of Variance.
2. Research Methodology- Criteria of good research, common problems encountered during research, Qualities of good research.
3. Forms in Scientific Writing – Articles, Reports, Review Article, Monographs, Conference proceedings.
4. Processes of Writing Dissertation, Gallery proofing of manuscripts ISBN and ISSN Number.

UNIT-IV

1. Research Methodology – Presentation of data, Types and Characteristics of good tables.
2. Diagrams, Graphs, Limitations of the statistical methods.
3. Difference between research Journal and science magazine, qualities of good Journal, National and International Journal in life Science.

4. Importance of journal in life science, Importance of patent in research, Process of getting patent rights.

UNIT-V

1. Use of Computers in life science. Fundamentals of Computer.
2. History of computers.

3. Software Programme for life Science. Principal and working system of Audiovisual Equipments.

4. Preparation of power point presentation.s

Reference Books:

1. Biophysics by R.N.ROY.
2. Biophysics - V. Pattabhi & N. Gautham (Narosa, New Delhi).
3. Fundamentals of Molecular Spectroscopy - C.N. Banwell, (Tata-McGraw Hill).
4. Practical Biochemistry by Wilson and Walker.
5. Research methodology by C.R. Kothari.
6. Research methodology by C.Rajendra Kumar.

Practical III & IV

1. Solving genetic problems related to monohybrid, dihybrid ratio and interaction of genes
2. Identification of mutant phenotypes. –Body shape/nature of wings/eye colour /nature of eye-Normal and Bar in Drosophila
3. Karyotype study using cytological preparation of dividing root tip cells of onion /photographs /permanent slides
4. Chromosome demonstration in bone marrow and or nerve cells
5. polytene chromosome in Drosophila, Chrinomos larvae
6. Study of Blood groups (A, B, AB, O, Rh) and problems based on multiple alleles and incomplete; dominance.
7. Culture of *Drosophila*. Study of life cycle, wild and mutant characters in *Drosophila*. Slide preparation of sex comb & wings of *Drospophila*.
8. Demonstration, Principle and use of laboratory equipments: pH Meter, Autoclave, Centrifuge Balance, Spectrophotometre,Cytophotometry and Flowcytometry
9. Collection and preparation of following:-
    a. Science notes
    b. Science Articles
    c. Review Articles
    d. Monographs
    e. Popular Science Articles
10. Submission of list of International/National Journals related to life science.
11. Preparation of one Questioner (Based on Problems Related to various field of life science) and presented it in form of writing including all step of writing processes, (with statistical Method).
12. preparation of power point presentation (Any topic).

Semester II

Paper V– Microbiology

Paper VI- Biochemistry

Paper VII- Ecology

Paper VIII – Evolution and Animal Behavior

Paper LS – 05: Microbiology

Min. Pass Marks - 25 Duration - 3 hrs. MM - 70

Unit I

1. History - The development of microbiology. Contribution of Robert Hooke, Anton Van Leeuwenhoek, Louis Pasteur, Robert Koch. Spontaneous generation and controversy.
2. Study of Microbes – Basic principles of microscope. Staining (simple, negative, Gram etc.) fixation and culture of microbes for study.
3. Microbial diversity - General principles and Classification(Haeckel's three kingdom concept. Carl Woose three domain system. Whittaker's Five Kingdom System).
4. Microbial growth - Lag phase, exponential phase, stationary phase, death phase, effect of environmental factors on growth of microbes.

Unit II

1. Virology: General character, origin, classification, nomenclature, morphology, replication, virulence factor
2. General character and structure of viroids, virusoids and Prions.
3. Isolation and Purification of virus, cyanophage, mycophage, Bacteriophage
4. Elementary account of viral diseases in Humans.

Unit – III

1. Archaea: General character, structure and classification. Metabolism, adaptation and ecological role.
2. Bacteria: Classification, Ultra structure, Nutrition (Autotrophic and heterotrophic) and Reproduction. Genetic recombination. Conjugation, Transformation, Transduction and its Significance.
3. Elementary account of most common disease caused by bacteria in Humans.
4. Cyanobacteria- General account, cell structure, reproduction, Heterocyst: nitrogen metabolism

Unit – IV

1. Mycoplasma: Ultrastructure, Nutrition, Transmission and Reproduction. Mycoplasmal disease.
2. Protista: Ecological and evolutionary significance of each protista group.

Diatoms, dinoflagellates and slime molds- General structure, Reproduction and importance.

3. Fungi: General characters, classification, structure, reproduction and economic importance.

4. Protozoa: General Characters, structure, locomotion, reproduction and economic importance.

Unit – V

1. Control of Microorganisms - Physical and Chemical methods. Chemotherapeutic agents and Antibiotics.

2. Microbial interaction - Mutualism, Proto-Cooperation, Commensalism, Parasitism, Amensalism and Competition.

3.. Microbiology of Food, Milk and Dairy Products - Food spoilage, food Preservation, Milk spoilage, Food from microbes.

4. Role of microbes in disposal of sewage, solid waste and cleaning of oil spills (Superbugs). Use in land fills.

Reference Books:

1. Microbiology - M.J.Pelczar, E.C.S.Chan & N.R.Kreig (Tata McGraw Hill).
2. General Microbiology - R.Y.Stanier, J.L.Ingraham, M.L.Wheelis & P.R.Painter (McMillan).
3. Microbiology - L.M.Prescott, J.P.Harley & D.A.Klein (Mcgraw Hill).
4. Fundamental Principles of Bacteriology - A.J. Salle (TATA McGRAW-HILL).
5. Virology - R. Dulbecco and H.S.Gensberg.
7. Microbiology - Schaum Series.

PAPER- LS–06 -Biochemistry

Min. Pass. Marks -25 Duration - 3 Hrs. Max. Marks: 70

UNIT I

1. Elements in living system. Major, macro, minor and trace elements and their role.

2. Water, its properties favourable for living systems.

3. Acid, base, pH, and Buffers.

4. Structure and function of the water soluble and lipid soluble Vitamins Abnormalities due to deficiency of vitamins, hypervitaminosis.

UNIT II

1. Carbohydrates structure and classification

2. Carbohydrate Metabolism: Glycolysis, Kreb cycle, Electron transport system in mitochondria and chloroplasts, carbohydrate synthesis in C3 cycle, oxidative phosphorylation, Chemoosmotic theory of ATP genreation, fermentation and HMP, PPP.

3. Lipids: Properties and classitication. Role of prostaglandins, Cholesterol, Eicosanoids, sphingolipids. Lipid base hormone (Steroids).

4. Lipids metabolism: Biosynthesis of Lipids, glyoxalate cycle, oxidation of fatty acids, lipid transport and storage.

UNIT III

1. Primary, Secondary, Tertiary and Quaternary structure of proteins. Bonds maintaining their structure: Peptide bonds, disulphide bonds etc. Ramchandran plot.
2. Structure of Haemoglobin, Myoglobin, Insulin and Collagen.
3. Amino Acids and Protein metabolism: Biosynthesis of nutritionally non-essential amino acid, catabolism of protein and amino acid.
4. Nitrogen-carbon skeleton, prophyrins. Brief idea of Nitrogen fixation.

UNIT IV

1. Structure, properties, classification and Nomenclature of enzyme. Mechanism of Enzyme action.
2. Enzyme production : The use and selection of source of Enzyme, Enzyme extraction and purification.
3. Enzyme application : Enzyme immobillization, stabilization biocatalyst reactors, encapsulation, entrapping.
4. Advantages of microbial enzyme, coenzymes oxidases and oxygenase.

UNIT V

1. Purin and pyrimidines: Structure and biosynthesis (de-novo and salvage pathway),
2. various confirmations of nucleotides, glycosidic bond rotation, base - stacking.
3. DNA, RNA, energy molecules, information molecules.Structure and Properties of NAD, NADP, FAD, FMN
4. Enzyme engineering: Therapeutic use, analytical use and industrial uses.

Reference Books:

1. Wilson K. and Walker J. (2008). Principles and Techniques of Biochemistry and Molecular Biology. Cambridge University Press.
2. Nelson D and Cox MM. (2009). Principles of Biochemistry. W.H. Freeman and Company, New York.
3. Talaro K. P. & Talaro A. (2006). Foundations in Microbiology. McGraw-Hill College Dimensi.
4. Potter GWH and Potter GW (1995). Analysis of Biological Molecules: An Introduction to Principles, Instrumentation and Techniques, Kluwer Academic Publishers.
5. Voet D and Voet JG. (2003). Biochemistry. John Wiley and sons New York.
6. White A, Handler P, Smith El, Hill R and Lehman J. (1983). Principles of Biochemistry. Tata Mc-Graw Hill.
7. Zubay G (2000). Biochemistry. W. C. Brown, New York.
8. Berg J, Tymoczko J, Stryer L (2001). Biochemistry. W. H. Freeman, New York.
9. Moat AG and Foster J W (2003). Microbial Physiology. John Wiley and Sons, New York.

PRACTICAL V & VI

1. Sterilization principle and methods: moist heat, dry heat and filtration methods.
2. Media preparation: Liquid media, solid media, Agar slants, Agar plates. Basal, enriched, selective media preparation
3. Pure culture techniques: Streak plate, pour plate methods.
4. Cultural characteristics of microorganisms: Growth on different media, growth characteristics and description. Demonstration of pigment production.
5. Microscopy: Description and operation of compound microscope, use of oil immersion and objective.
6. Motility demonstration: Hanging drop preparation, wet mount
7. Staining techniques: Smear preparation, simple staining, Gram's staining, Acid fast staining, staining for metachromatic granules.
8. Antibiotic sensitivity testing: Disc diffusion test - Quality control with standard strains.
9. Micrometry: Determination of size of yeast. Fungal. Filaments.
10. Physiology characteristics: IMViC test, H2S, Oxidase, catalase, urease test, Carbohydrate fermentation, Maintenance of pure culture, Paraffin method, Stab culture, maintenance of mold culture.
11. Viable count of bacteria by serial dilution and pour plating.
12. Turbidometry measurement of bacterial growth (colorimetric measurement of versus time)
13. Study of bacteria from contaminated water, study of Rhizosphere bacteria,
14. Preparation of solutions and buffers.
15. Acid- base titration, molarity, molality, normality, sensitivity, specific accuracy.
16. Biochemical test for carbohydrates, protein, Lipid
17. Reducing sugar estimation by Benedict's method and using Fehling's solutions.
18. Quantitative estimation of amino acid.
19. Quantitative estimation of cholesterol in Blood Serum
20. Quantitative estimation of Enzymes -Acid Phosphates, LDH etc
21. Saponification value of fats.
22. Thin layer chromatography of pigments, lipids, mixture of dyes.
23. Chlorophyll estimation
24. Thermal melting of DNA

Paper - LS 07 Ecology

Min Pass Marks- 25 Duration - 3 hrs MM - 70

Unit I

1. Ecology: Basics, Definition, History.
2. Levels of organization hierarchy, ecological homeostasis,
3. Organism and affecting factors: Habitat, Home Range, Territory, Major abiotic factors, (Temperature, Water, Light, Soil) Responses to the Abiotic factors (Regulate, Conform),

4. Concept of Limiting factors - Liebig s law of minimum,shelford`s law of tolerance.

Unit II

1. Ecosystem: Concept of Ecosystem, Trophic structure, Diversity, Gradients and Ecotones, Microcosms, Mesocosms and Macrocosms,
2. Food Chain, Food Web, Ecological Pyramids.
3. Laws of Thermodynamics, Concept of Productivity (Primary, Secondary, Net, Gross),
4. Energy flow in ecosystem. Biogeochemical cycles.

Unit III

1. Population: Population attributes (age pyramids, population density) population growth (Natality, Mortaliiy, Immigration, Emigration)
2. Growth Models -exponential growth and Logistic growth.
3. Population Interactions: Mutualism, Competition, Predation, Parasitism, Commensalism, Amensalism Foraging Theory.
4. Theory of Competition, Plant Animal Mutualism.

Unit IV

1. Biotic Community and its characters (structure, stratifications Diversity etc.) community interdependence, ecotone and edge effects.
2. Ecological succession - Hydrosere, Psammosere and Xerosere.
3. Biomes: Structure, characters specific flora and fauna of major biomes of world (Tundra, Forest, Grassland, Chapprral, Desert)
4. Marsh (Wetland) Estuaries and Marine Life Zones and Fresh Water bodies.

Unit V

1. Environmental Pollution : Definition, Types, Pollutants, Sources, effects and control methods of air, water and soil pollution.
2. Noise and Electromagnetic pollution.
3. Elementary idea of Radiation Hazards in reference to atomic energy reactors and nuclear test.
4. Control and Regulation with special reference of case studies related to control :
    (a) Vehicular pollution and use of CNG
    (b) River pollution - with reference to Ganga and Chambal.
    (c) Waste water treatment plants.
    (d) Solid waste, Plastic waste.

Reference Books:

1. The Ecology of Plants Gurevitch, J., S.M. Scheiner, and G.A. Fox. 2002.. Sinauer Associates,Inc. Sunderland, MA, U.S.A.
2. Plant Ecology. Crawley, M.J. 1996. 2nd ed. Blackwell Publishing. Malden, MA,
3. A Primer of Ecology. Gotelli, N.J. 2001. 3rd ed. Sinauer Associates, Inc. Sunderland.
4. General ecology, Krohne, D. T. 2001. 2nd edition. Brooks/Cole, USA.
5. Ecology by P.D. Sharma
6. Fundamentals of ecology E.P.Odum

Paper LS-08: Evolution & Animal Behavior

Min. Pass Marks - 25 Duration - 3 hrs. MM - 70

Unit –I

1. Biochemical and physiological evidences, homology, analogy and vestigial organs.
2. Evolutionary time scale, eras, periods & epoch.
3. Major events in the evolutionary time scale.
4 Stages in primate evolution including homosapiens.

Unit II

1. Basics & Origin of Life – Definition, Theories of Evolution and microevolution work theories of Lamarck ,Weismann and Darwin.
2. Pre –Darwinian, prebiotic environment, Oparin –Haldane concept of origin, Miller-Urey experiment.
3. Molecular evolution of DNA, RNA, Proteins.
4. Characters of prototronts Microspheres or coacervates.

Unit III

1. Population genetics- population gene pool, gene frequency, Hardy Weinberg law.
2. Migration and genetic drift.
3. Adaptive radiation and modifications, Mimicry and colouration.
4. Speciation – The concept of species, mechanism of speciation, allopatric and sympatric speciation.
5. Isolation –Role and mechanism.

Unit IV

1. Approaches and methods in study of behavior: Definition and forms of learning behavior, development & mechanism of learning.
2. Habituation, Imprinting.
3. Patterns of behavior – Individual behavior pattern.
4. Homing behavior, reproductive behavioral pattern.

Unit V

1. Social Organization – Dominance hierarchies, social competition, territoriality.
2. Social behavior and individual social interactions.
3. Animal communications, aggregation, migration, orientation.
4. Behavioral changes and parental care.

Reference Books:

1. Evolution V.B. Rastogi
2. Evolution by Mark Ridley
3. Evolution by Jonathan A. Eisen
4. Animal behavior by John Alcock
5. Principles of Animal Behavior Lee Alan Dugatkin

Semester III

Paper IX – Genetic Engineering & Bio-Informatics
Paper X- Biotechnology
Paper XI- Biodiversity
Paper XII – Biostatistics & Biophysics

PAPER- LS–09 Genetic engineering and Bioinformatics

Min. Pass. Marks -29 Duration - 3 Hrs. Max. Marks: 80

UNIT 1

1. Definition, Steps, Restriction endonucleases and essential Enzymes used in r-DNA technology
2. Cloning Vectors [Plasmid, Bacteriophage, Cosmid, Phasmid, Artificial chromosomes (BAC, YAC, Shuttle Vector)]
3. Identification and analysis of recombinant DNA clones.
4. Applications of r-DNA technology- Requirement and production of recombinant molecules in pharmaceutical, health, agricultural and industrial sectors and research laboratories.

UNIT II

1. DNA Sequencing method: Dideoxy and chemical method, sequence assembly.
2. Gene amplification. PCR types and its applications.
3. Molecular marker – PCR based or non PCR based markers.
4. Gene library: genomic library and c-DNA library.

UNIT III

1. Genetic engineering of plants: Gene transfer in plants – Vector mediated gene transfer (Ti plasmid) and direct gene transfer. Genetically transformed plants. T-DNA and transposon mediated gene tagging, chloroplast, transformation.
2. Methods of gene transfer in animals Transgenic animals (Sheep and Goat) Gene Therapy.
3. Genetic Counseling, DNA finger printing.
4. Human Genome Project: History and current status. Safety of recombinant DNA technology, IPR and patenting. Basic patent rules ethical issues. Bio safety regulations and its utility.

UNIT IV

1. Bioinformatics: Definition, Introduction, Historical resume, Bioinformatics Career – future prospects and ethical issues.
2. Basic Components of computers and their functions Hardware and Software, Input Output devices. Network: Definition and types (LAN,WAN).
3. Basic Concepts about data and information: Representation of data in Computer in binary, bits and bytes. Conceptual understanding of assemblers and Compilers operating system.

4. Biological Databases: Primary sequence databases (Protein and DNA databases), Secondary databases, Composite databases.

UNIT V

1. Nucleic acid sequence analysis, alignment, similarity searches including remote similarity searches, secondary structure element, motifs.
2. Protein sequence analysis, alignment, similarity searches including remote similarity searches, secondary structure element, motifs.
3.Genomics and annotation Evolutionary analysis; use of the PHYLIP package, tree construction.
4. Role of bioinformatics in Pharmaceuticals industry Challenges of Commercialization of Bioinformatics and its future prospects.

Reference Books:

1. Bioinformatics (2002) Bishop Martin.
2. Molecular database for protein & Sequence & Structure Studies: Sillince A. and Sillince M.
3. Sequence analysis Primers: Gribskov, M. & Devereux, J.
4. Molecular biotechnology: S.B. Primrose.
5. 'Gene VII' by Lewin Benjamin (Oxford).
6. 'Genome' by T.A. Brown, John Wiley & Sons.
7. 'Molecular Biology of the Gene' by Watson-Barker-Bell-Gann-Levine-Losick, 5th Edn. Pearson Education.

Paper - LS –10 Biotechnology

Min. Pass. Marks: 29 Duration - 3 Hrs. Max. Marks:80

UNIT I

1. General introduction: Meaning, brief history, biotechnology in India, Scope and importance.
2. Recombinant DNA and Gene Cloning, Molecular Probes.
3. Site directed mutagenesis.
4. DNA Chip Technology and Microarrays.

UNIT II

1. Plant tissue culture: Introduction, history, Scope, concept of cellular Differentiation totipotency.
2. Organogenesis and somatic embryo-genesis and Somatic hybridization, applications of plant tissue cultures

3. Micro-propagation, Virus free plants, artificial or encapsulated seeds, embryo rescue,
4. Production of androgenic haploids, production of triploids, soma clonal variations,. germplasm preservation, Cryopreservation and gene bank.

UNIT III

1. Animal tissue culture: Introduction, Primary culture, cell lines and cloning. Tissue and Organ Culture, IVF, embryo- transfers.
2. Brief discussion on the chemical, Physical and metabolic functions of different constituents of culture medium.
3. Basic technique of mammalian cell cultures in – vitro. Microcarrier culture, cell Synchronization and cell culture..
4. Application of animal cell culture. Hybridoma technology and monoclonal antibodies.

UNIT IV

1. Environmental Biotechnology Current status: Water pollution management solid Waste management, bioindicators of biosurfactants, biofilms etc.Current status of Biotechnology in environmental protection, concept of cleaner technology.
2. Biotechnology for pollution abatement: Bio scrubbers and Biofilters, Biotechnology for air and water pollution abatement.
3. Bio-magnifications: Biomagnification of Pesticides and heavy metals.
4. Bio-insecticide: Brief account, application for productivity improvement and crope protection. Microbial pesticides, Bt. insecticides, Neem insecticide. Bio Sensor, Biomining, Bioremediation, Bio surfactant and Bio film.

UNIT V

1. Industrial Biotechnology: Alcohol and Beverages production, food products - cheese and bread, acid production, vitamin, enzyme production, Antibiotics, Amino acid production. Biotransformation and Bioleaching.
2. Agricultural biotechnology: Biofertililzers, Biotechnology of Nitrogen fixation, Biopesticides, production of Biogas and ethanol.
3. Medical Biotechnology: Synthesis of proteins and hormones, production of interferons and other immunoproteins.
4. Production of vaccines, antibodies, Steroids.

Reference Books:

1. Freshney, Culture of Animal Cells, 5th Edition, Wiley-Liss, 2005.
2. Ed. John R.W. Masters, Animal cell Cultures- Practical Approach, 3rd Edition, Oxford University Press,2000.
3. Plant tissue Culture by M.K. Razdan & S.S. Bhojwani (1996) Elsevier.
4. Plant tissue culture Concepts and laboratory Exercises, Second Edition, Robert N. Trigiano, Dennis J. Gray, CRC Press, November 1999.
5. Environmental Biotechnology By S.N. Jogdand, Himalaya Publishing.

6. Prescott & Dunn (2002) Industrial Microbiology, Agrobios (India) Publishers.
7. S.N. Jogdan (2006) Industrial Biotechnology, Himalaya Publishing House

Practical Exercises IX & X

1. Isolation of plant DNA.
2. Estimation of RNA by Orcinol method.
3. Restriction, Digestion of plant DNA, its separation by Agarose gel elcctrophoresis and visualization by ethidium bromide staining:
4. Isolation of protoplasts from different tissues using commercially enzymes.
5. Separation of Cell organelle by sucrose gradient.
6. Extraction and estimation al phenol based secondary metabolites.
7. Principle and use of laboratory equipments: pH Metre, Autoclave, Centrifuge Balance, Spectrophotometer.
8. Acquaintance with tissue culture laboratory.
9. Preparatory techniques: Washing of Glassware, Dry and Steam sterilization, sterilization techniques.
10. Preparation of Culture media.
11. Demonstration of the technique of Micropropagation by using different explants eg. Shoot Meristem, axillary bud, callus induction, regeneration.
12. Demonstration of the technique of anther culture.
13. Sequence alignment.
14. Homology finding by using BLAST,FASTA.
15. Database sequencing.

Paper - LS 11 Biodiversity

Min. Pass. Marks -29 Duration - 3 Hrs. Max. Marks: 80

Unit – I

1. Algae in diversified habitat, classification of Algae, Evolutionary trends in Algae.
2. Algal blooms, algae as brofertilizers, food, fuel and uses in industries, algae in symbiotic association and pollution indicator.
3. General account of fungi and classification. Role of fungi in industries and medicines. Lichenology: General account on lichens.
4. Mycorrhizal application in agriculture and plant growth, mycorrhiza as biocontrol agent.

Unit - II

1. Bryophyta : Salient features, classification, origin and distribution of Bryophytes.
2. Pteridophyta : Salient features, classification of pteridophytes. Evolution of stele, heterospory.

3. Gymnosperms: Salient features, Evolution, classification and their distribution in India.
4. Angiosperms: Classification, The species concept, principles used in assessing. relationship. International code of Botanical nomenclature.General account on botanical gardens and herbaria, BSI.

Unit -III

1. Principles of Taxonomy and classification of non-chordates and chordates upto orders with salient features and examples.
2. Protozoans and helminthes of medical importance; Origin of Metazoa, metamerism and symmetry; sponge industry; Polymorphism in coelentrates; Coral reefs; Parasitic adaptations in helminthes. Types and significance of coelom with examples.
3. Economic importance of insects (including lac-culture, sericulture and Apiculture); social insects and their life cycle.

Unit – IV

1. Origin of Chordates; Affinities of Hemichordata, Urochordata and Cephalochordata; Retrogressive metamorphosis.
2. General characters, habit, habitat and distribution of Agnatha. Migration and economic importance of fishes.
3. Exotic fishes; Adaptations and parental care in fishes and amphibians; Amphibians as biological control agents; living reptiles; Salient features of Dinosaurs and Archaeopteryx;
4. Aerial adaptations and migration in birds; Salient features and affinities of Prototheria and Metatheria. Ecolocation in Bats; Adaptive radiations in mammals; Evolution of man.

Unit-V

1. Biodiversity : Definition, Magnitude of Biodiversity Levels of Biodiversity (Genetic diversity, species diversity and community and ecosystem diversity.
2. Biodiversity of India and World: Ten bio-geographical regions of India, their specific flora and fauna. Brief idea of hot spots of india and the world.
3. Loss of Biodiversity: Various causes of loss of Biodiversity, Habitat loss & fragmentation, over-exploitation, IUCN Red list categories.
4. Conservation of Biodiversity. : In-situ conservation – (Protected area, Biosphere reserve etc.) ex-situ conservation – cryopreservation, zoological parks.
5. Convention on biodiversity, Habitat loss, IPR patent, PBR (Peoples biodiversity register), Biodiversity act of india 2002.

Reference Books:

1. Myres Biodiversity.
2. V.N. Naik; Taxonomy of Angiosperm.
3. Singh, Jain: Taxonomy of Angiosperm.
4. Pandey, Angiosperm: taxonomy, Anatomy, Economic Botany and Embryology.
5. Dr. S.G. Date,: Key to Family of Angiosperm.
6. Kotpal &S Khetrapal, Invertebrates.
7. S.H. Prater, The book of Indian animal.
8. Ashlock, Principle of Animal taxonomy.

Paper - LS 12 Biostatistics and Biophysics

Min. Pass. Marks -29 Duration - 3 Hrs. Max. Marks: 80

UNIT I

1. Biostatistics Introduction, Statistical Terms and Symbols, Sample and Sampling Techniques.
2. Collection, classification and Tabulation of Data. Frequency distribution, Diagrammatic and Graphical presentation of Data.
3. Measures of Central tendency: Mean, Mode and Median.
4. Measures of Variability or dispersion: range, mean deviation standard deviation.

Unit II

1. Probability and its application. Theoretical distribution: Binomial and Normal distribution.
2. Correlation: types, methods, Coefficient of correlation. Regression analysis: Regression Line, regression equations- of X on Y and Y on X. regression in a bivariate grouped frequency distribution. Multiple regressions.
3. Test of Significance, levels of significance, standard errors, chi-square test.
4. Student `t' test, f – test. Analysis of variance (ANOVA).

Unit III

1. Bioenergetics: Basic bioenergetics. Law of bioenergetics, whole body bioenergetics. Entropy and evolution relationship. Gibbs free energy.
2. Bioenergetic pathways. Bioenergetics and biocommunication. Control of bioenergetics.
3. Molecular interaction: Intra- molecular and Inter- molecular interaction, Attractive and repulsive forces operating within molecules and their overall effects on molecular interactions.

Unit IV

1. Mechano chemical process of muscles contractions Molecular structure of skeletal muscles - actin, myosin, troponin, tropomyosin, role of myoglobin.
2. Physicochemical process of nerve impulse conduction across Myelinated, non myelinated and synaps.
3. Physicochemical process of vision, colour determination and sound perception by animal, echo location.

4. Biophysics of circulation in animal and water transport and nutrient translocation in plants.

Unit V

1. Methods to elucidate structure and biochemical compounds found in living organisms-Centrifugation, Electrophoresis, Tracer techniques, autoradiography.
2. Chromatography (Paper, Thin layer and column chromatography), Spectrophotometry (UV, VIS, IR, NMR and ESR), Electron microscopy (TEM,SEM) X- ray diffraction.
3. Chemical fingerprinting: Basic problems in chemical finger printing of plants.
4. Bioelectronics: Biological manipulation of Cellular engineering. Biologically inspired computing.

Reference Books:

1. Biostatistics: P.N. Arora, P.K. Malha.
2. Biostatistics: S.K. Gupta.
3. Introductory Statistics for Biology: S.K. Mahajan.
4. Biophysics by N. Roy.
5. Biophysics- V. Pattabhi & N. Gautham (Narosa, New Delhi).
6. Biophysical Chemistry Vol.II- C.R. Cantor & P.R. Schimmel,(W.H. Freeman & Co.).

Practical Exercises XI & XII

1. Exercise based on presentation of Data, Simple and Complex Table, Graphs, Pie Charts.
2. Exercise based on Classification of Data, Frequency and Frequency distribution.
3. Numerical problems based on measures of central Tendency-Mean, Mode and Median
4. Chi square and Student t-test.
5. Morphological study of representative members of algae, fungi, bacteria, bryophytes and pteridophytes:Microcystis, pediastrum, Hydrodictyon, Ulva, pithophora, Sitgeoclonium, Drapranldiopsis, Closterium, Cosmarium, Chara,peronospora, Albugo, Mucor, pilobolus, yeast, Chaetomium, Pleospora, Morchella, Melampspora, Phallus, Polyporus, Drechslera, Phoma, Penicillium, Aspergillus, Colletotrichum, Marchantia, Anthoceros, Polytrichum, Psilotum, Lycopodium, Selaginella, Equisetum, Gleichenia, pteris, Ophioglossum, Isoetes.
6. Symptomology of some diseased specimens: White rust, downy mildew, powdery mildew, rusts, smuts, ergot, groundnut leaf spot, red rot of sugarcane, wilts, paddy blast, citrus canker, bacterial blight of paddy, leaf curl of papaya, tobacco mosaic, little leaf of brinjal, seasame phyllody, mango malformation.
7. Description of various species of a genus; location of key characters and preparation of key generic level.
8. Field trips within and around the campus; compilation of field notes and preparation of herbarium sheets of such plants, wild or cultivated, as are abundant.

9. Identification of specimens described in the class.
10. Culture preparation: Paramecium and Euglena Study of response of paramecium/ earthworm to different stimuli.
11. Economic importance of any two animals of each phyla.
12. Mouth parts of insects: cockroach, honeybee, mosquito, house-fly and butterfly.