

UNIVERSITY OF KOTA

FACULTY OF SCIENCE

SYLLABUS

M.Sc. (Life Science)

Examination- 2013

M.Sc. (P)- (Life Science) Exam.- 2013

Eligibility : B.Sc. (under 10+2+3 scheme) with Chemistry, Botany, Zoology, Biotechnology, 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 number of paper 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 spread over a period of two year with an examination at the end of each year-previous in the first year and final in the second year.
3. Syllabus of Previous and final year will be divided into 5 units.
4. Scheme of examination-

M.Sc (P) - Life science

<u>Paper Code</u>	<u>Nomenclature of the Paper</u>	<u>Max.Marks</u>	<u>Min. Marks</u>
LS-01	Cell & Molecular Biology	100	36
LS-02	Biochemistry, Enzymology & Enzyme Technology and Biophysics	100	36
LS-03	Microbiology and Immunology	100	36
LS-04	Genetics, Biostatistics and Evolution	100	36
LS-05	Biotechnonology, Genetics Engineering and Cell & Tissue Culture	100	36
LS-06	Environment Biology, Biodiversity and Toxicology	100	36
	Laboratory- Practical exam. Day-1 - LS-01, LS-02, LS-03	300	108
	Day-2 – LS-04, LS-05, LS06		

M.Sc (F)- Life science

<u>Paper Code</u>	<u>Nomenclature of the Paper</u>	<u>Max.Marks</u>	<u>Min. Marks</u>
LS – 07:	Biological Tools Technique, Research Methodology	100	36
LS – 08 :	Plant Diversity	100	36
LS – 09 :	Animal Diversity	100	36
LS – 10:	Plant & Animal Physiology	100	36
LS - 11 :	Enviromental Biology I	100	36
LS - 12 :	Enviromental Biology II	100	36
	Laboratory- Practical exam. Day-1 - LS-07, LS-08, LS-09	300	108
	Day-2 – LS-10, LS-11, LS-12		

5. There will be six papers in theory, each of three hours duration, 100 marks each and two practical carrying 150 marks each. (10 marks are reserved for record, 10 for viva and 20 marks for one seminar in each examination.

6. A candidate for a pass at each of the Previous and the Final Examinations shall be required to obtain (i) at least 36% marks in the aggregate of all the papers prescribed for the examination and (ii) at least 36% marks in practical wherever prescribed at the examination,

provided that if a candidate fails to secure at least 25% marks in each individual paper at the examination and also in the Test/ Dissertation/ Survey Report/ Field works, wherever prescribed, he shall be deemed to have failed at the examination notwithstanding his having obtained the minimum percentage of marks required in the aggregate for that examination. No division will be awarded at the previous Examination Division shall be awarded at the end of the final Examination on the combined marks obtained at the Previous and the Final Examination taken together, as noted below

First Division 60% on the aggregate marks and
Second Division 48% TOGETHER IN THE Previous & Final Exam.

7. If a candidate clears any paper(s) prescribed at the Previous and/or Final Examination after a continuous period of three years. Then for the purpose of working out his division the minimum pass marks only viz. 25% (36% in the case of practical) shall be taken into account in respect of such papers(s)/ Practical(s) are cleared after the expiry of the aforesaid period of three years; provided that in case to reach the minimum aggregate as many marks out of those actually secured by him will be taken into account as would enable to make up the deficiency in the requisite minimum aggregate.

8. A total of Twelve theory papers (3 hours duration each) are prescribed in (6 in previous and 6 in final). A combined practical Examination (10 hrs. duration two days) shall be conducted each year.

9. The pattern of examination will be similar as adopted in other P.G. exams of university of Kota along with by means of dissertations / Project Report / Seminar as prescribed in the syllabus.

10. Pattern of Q. Paper will follow the adopted scheme i.e. the Q.P. will be divided in three sections A, B, & C. Section 'A' will contain 10 short answer type questions and all are compulsory. Section 'B' will contain 10 questions, 2 from each unit. Candidate is required to attempt 5 questions selecting 1 from each unit. Section 'C'

will contain 4 question set from different units. Candidate is required to attempt any 2 questions.

11. A candidate failing at M.Sc. Previous examination may be provisionally admitted to the M.Sc. Final Class provided that he passes in at least 50% papers as per provisions of 0.235(i)

12. A candidate may be allowed grace marks in only one theory paper upto the extent of 1% of the total marks prescribed for that examination.

Paper - LS – 01 - Cell and Molecular Biology

Min Pass Marks - 36

Duration - 3 hrs

MM - 100

Note : The question paper will contain three sections as under –

Section-A : One compulsory question with 10 short questions, having 2 questions from each unit. Candidates have to answer each question in 20 words.

Total marks : 10

Section-B : There will be 10 questions in all, 2 questions from each unit. Candidates have to attempt 5 questions taking at least one from each unit. Answer should be in approximately 250 words

Total marks : 50

Section-C : There will be 04 questions (question may have sub-divisions) covering all units but not more than one question from each unit. Answer should be descriptive type, in about 500 words. Any 2 questions to be attempted by the candidate.

Total marks : 40

Unit – I- Basics and Functional Ultrastructure of Cell

1. **History of cell Biology** : cell theory, origin and evolution of cell. Evolution from primitive cell to prokaryota and leading to Eukaryotic development.
2. Cell wall - structure, biogenesis, Plasmodesmata, Glycocalyx. Plasma - membrane - structural models and its functions, Lipids and Proteins of different membranes, their fluidity, Spectrin, Glycophorin, Bacteriorhodopsin, Porins, cell surface carbohydrates - selectins. Membrane transport (Active & Passive) Carrier Proteins, Ion channels. Voltage gated channels.
3. **Cell communication** : General principle, G Proteins, Protein Kinase, Protein Phosphatase, Signal peptides, **Signal Transduction** in different cells.
4. Structure of **Endoplasmic reticulum** and **Ribosomes**. Signal recognition particle of E.R. Functional ultrastructure of **Mitochondria** and **Chloroplast**. Endosymbiont concept, Genome of Mitochondria and Chloroplast, Use of mitochondrial genome in evolution.
5. Cell organelles involved in vesicular traffic in the secretory and Endocytic pathway. Structure and function of **Golgi body**. Polysaccharide synthesis, Glycosylation and Transport from E.R. to G.B. Endocytosis, Exocytosis, SNARE proteins
Lysosome - Polymorphism, intracellular digestion, sorting of lysosomal enzymes in G.B. lysosomal storage diseases.
Microbodies - Peroxisomes, Glyoxysomes and spherosomes.
6. Cell vacuoles; in plants, food vacuoles, air vacuoles, Cytoskeleton - Microfilaments, microtubules and intermediate filaments.
Role of cytoskeleton in **cilia, flagella**, and membrane ruffling movements.

Unit – II- Nucleus, Chromosomes and Cell Cycle

1. Structure of **Interphase nucleus**, Ultrastructure of Nuclear membrane, Pore complex, fibrous lamina, Nucleoplasm, Nucleolus.
2. **Chromatin organisation** in non dividing and dividing cells. Chromosome structure and Packing of DNA (Nucleosome and Solenoids). C - value paradox, Cot curve. Special types of Chromosomes Lampbrush, Polytene, B - Chromosomes 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).
Centriole structure and **centriole cycle** during animal cell division. **Cytokinesis** and cell Plate formation.
4. **Meiosis** process and its importance in sexually reproducing diploid organisms.
5. Cell totipotency, Pluripotency, determination, Specialization, differentiation and development. Mechanism of programmed cell death - **Apoptosis**. Apoptosis in relation with cancer.

Unit – III - Nucleic acids and Gene Structure

1. Identification and Role of **DNA as genetic material**. Its superiority on RNA as genetic material. Universality of DNA as genetic material. **Gene structure**. Structure analysis, jumping genes, split genes.
2. Structure of DNA, different forms (A, B, C, Z) Supercoiling of DNA, DNA hybridization.
3. DNA replication in Prokaryota and eukaryotes. Enzymes and accessory proteins involved in DNA replications. Evidences of semiconservative replication. DNA amplification, systems that safeguards DNA, modification and restriction system, DNA damage and repair.
4. RNA structure, types (m-RNA, t-RNA, hn-RNA, Sn-RNA, Sno-RNA, antisense RNA, Si RNA and micro RNAs). Genetic code
5. RNA transcription, general Principles, types of RNA polymerase, step-initiation elongation and termination. Polycistronic and monocistronic RNA: Post transcriptional modification in RNA-Cap formation, Tail formation, RNA splicing, RNA editing.

Unit – IV - Translation and Gene Regulation

1. **Translation**, mechanism-initiation, elongation and termination difference between pro and eukaryotic translation, co. & post translational modifications of proteins, protein folding. Role of chaperones in protein folding, protein degradation and role of proteasome.
2. **Regulation of gene expression in Prokaryotes**. Inducible and repressible system, positive regulation and negative regulation. Operon concept, Lac, trp and Ara operon.
3. **Regulation of gene expression in Eukaryota**. Role of DNA methylation in development and Genomic imprinting.
4. **Gene regulatory Proteins**-different Motifs Helix-Turn-Helix motif, Zinc finger motifs, LeucineZipper motif, Homeodomains.
5. RNA interference, Riboswitches and RNA mediated repression.

Unit – V- Application : of Molecular Biology

1. **Antisense and Ribozyme technology**. Molecular mechanism of antisense molecules, Biochemistry of Ribozyme, hammer head, hairpin and other ribozyme, strategies for designing ribozymes. Application of antisense & ribozyme technology.
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. Developmental models - *Drosophila*, *C-elegans*, *Arabidopsis*.
4. **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.
5. **Genome Projects** - An overview of the genome projects of human and other model organisms, Methodology of HGP and its findings and goal.

PRACTICALS :

1. Demonstration, principle and use of lab. Equipments : Centrifuges (table top and high speed), balances (electrical and digital).
2. Demonstration, principle and use of lab. equipments : Spectrophotometer, pH meter.
3. Separation of different organelles/molecule by sucrose density gradient/differential gradient.

4. Study of cell division in plants and animals, giant chromosomes.
5. Isolation of genomic DNA and its quantitation by a spectrophotometric method.
6. Isolation of RNA and quantitation by a spectrophotometric method.
7. Isolation of Mitochondria and the activity of its marker enzyme; succinate dehydrogenase (SDH).

Suggested Reading :

1. Lewin, B. 2004, Gene VIII, Oxford University Press, New York.
2. Alberts, B., Bray D, Lewis J, Raff M, Roberts K, and Watson J, 1999. Molecular Biology of the cell. Garland Publishing Inc. New York. .
3. Lodish H, Berk A, Zipursky S.L., Matsudaira P, Baltimore D and Darnell J. 2005. Molecular Cell Biology (5th edition). W.H. Freeman and Co., New York, USA.
4. Buchanan B.B., Gruissem W, and Jones R.L., 2000. Bio-chemistry and molecular Biology of Plants, American Society of Plant Physiologists, Maryland, USA.
5. Molecular Biology and Biotechnology. A comprehensive desk reference. R.A. Meyers (ed.) VCH Publishers Inc., New York, 1995.
6. Molecular Cloning : A Laboratory Manual Sambrook J, Fritsch E.F. and Maniatis T, Cold Spring Harbour Laboratory Press, New York, 2000.
7. Malacinski G M. and Freifelder D. 1998 : Essentials of Molecular Biology (3rd edition). Jones and Bartlett Publishers Inc., London.

PAPER- LS-02-Biochemistry, Enzymology, Enzyme Technology & Biophysics

Min Pass Marks - 36

Duration - 3 hrs

MM - 100

Note : The question paper will contain three sections as under –

Section-A : One compulsory question with 10 short questions, having 2 questions from each unit. Candidates have to answer each question in 20 words.

Total marks : 10

Section-B : There will be 10 questions in all, 2 questions from each unit. Candidates have to attempt 5 questions taking at least one from each unit. Answer should be in approximately 250 words

Total marks : 50

Section-C : There will be 04 questions (question may have sub-divisions) covering all units but not more than one question from each unit. Answer should be descriptive type, in about 500 words. Any 2 questions to be attempted by the candidate.

Total marks : 40

UNIT – I - Basics of Biochemistry and Biophysics

1. Elements in living system. Major, macro, minor and trace elements and their role.
2. Water, its properties favourable for living systems. Acid, base, pH, and Buffers.
3. Different types of Bonds - ionic, covalent, hydrogen and Van der Waals attractions – in reference to biomolecules. Optical isomerism in Biomolecules.
4. Colloidal properties of Protoplasm.
5. Bioenergetics, 1st and 2nd law of Thermodynamics, concept of free energy, enthalpy, entropy.

UNIT – II -Biomolecules - I

1. **Carbohydrates** : General classification, monosaccharides, oligosaccharides and polysaccharides. structure of starch, glycogen, cellulose, chitin, glycosaminoglycans and proteoglycans.
2. **Carbohydrate Metabolism** : Glycolysis, Krebs cycle, Electron transport system in mitochondria and chloroplasts, carbohydrate synthesis in C₃ cycle, oxidative phosphorylation, Chemiosmotic theory of ATP generation, fermentation and HMP, PPP, Synthesis of glycogen, Abnormalities of Carbohydrate metabolism.
3. **Lipids** : Properties and classification. 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.
5. **Vitamins** : Structure and function of the water soluble and lipid soluble Vitamins Abnormalities due to deficiency of vitamins, hypervitaminosis.

UNIT – III Biomolecules - II

1. **Amino Acid and Protein** : Structure, properties and classification of amino acids. Titration curves. Classification of Protein. Properties and Specificity of Protein, Protein base hormone.
2. **Primary, Secondary, Tertiary and Quaternary structure of proteins. Bonds maintaining their structure** : Peptide bonds, disulphide bonds etc. Ramchandran plot, Alpha-helix, Beta - sheet, Helix - coil transitions. 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. Nitrogen-carbon skeleton, porphyrins. Brief idea of Nitrogen fixation.
4. **Purin and pyrimidines** : Structure and biosynthesis (de-novo and salvage pathway), various conformations of nucleotides, glycosidic bond rotation, base - stacking.
5. **DNA, RNA, energy molecules, information molecules**
(NAD, NADP, FAD, FMN) : Structure and Properties

UNIT – IV - Enzymology and Enzyme Technology

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 immobilization, stabilization biocatalyst reactors, encapsulation, entrapping.
4. Advantages of microbial enzyme, coenzymes oxidases and oxygenase.
5. Enzyme engineering : Therapeutic use, analytical use and industrial uses.

UNIT – V - Biophysics

1. Mechano - chemical process of muscles contractions Molecular structure of skeletal muscles - actin, myosin, troponin, tropomyosin, role of creatin phosphate and myoglobin.
2. Physicochemical process of nerve impulse conduction across Myelinated, non -myelinated and synaps.
3. Physico - chemical 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.
5. Role and maintenance of osmotic pressure, hydrostatic pressure, influence of gravity and zero gravity on living system.

Suggested Readings:

1. Biotechnology : M.D. Trevar, et. al. Tata Mc Graw Hills.

2. Biochemistry : Harper's Lange Publication.
3. Medical Physiology : Gu-ton.
4. Review of Medical Physiology : Lang Publication, 5. Biochemistry by : Lehinger
6. Biochemistry by : Styler

PRACTICAL :

1. Estimation of Na, K, Ca, Cl in Living System (Blood, Animal/Plant Tissue)
2. pH, Analysis : Blood, Urine, water food material.
3. Quantitative and Quantities estimation of Carbohydrate (fructose, glycogen), Protein
4. Quantitative estimation of cholesterol, in Blood Serum.
5. Chromatography of Pigments.
6. Quantitative estimation of Enzymes -Acid Phosphates (Acp) LDH, GPC, in tissue sense.
7. Preparation of Solutions.

Paper - LS – 03 - Microbiology and Immunology

Min Pass Marks - 36

Duration - 3 hrs

MM - 100

Note : The question paper will contain three sections as under –

Section-A : One compulsory question with 10 short questions, having 2 questions from each unit. Candidates have to answer each question in 20 words.

Total marks : 10

Section-B : There will be 10 questions in all, 2 questions from each unit. Candidates have to attempt 5 questions taking at least one from each unit. Answer should be in approximately 250 words

Total marks : 50

Section-C : There will be 04 questions (question may have sub-divisions) covering all units but not more than one question from each unit. Answer should be descriptive type, in about 500 words. Any 2 questions to be attempted by the candidate.

Total marks : 40

Unit – I – Basics of Microbiology and Virology

1. **History** - The development of microbiology. Landmark discoveries, Work of Robert Hooke Anton Van Leeuwenhoek, Louis Pasteur, John Snow, Robert Koch, Ronald Ross, Martinus Beijerinck and others. Theory of spontaneous generation and Koch Postulates.
2. **Study of Microbes** - General idea of microscope used, staining (simple, negative, Gram etc.) fixation and culture of microbes for study. (only introductory knowledge)
3. **Microbial diversity** - General Principles and classification, Haeckel's three kingdom concept. Carl Woese three domain system. Whittaker's Five Kingdom System.
4. **Virvlogy-I** - Origin, classification, Nomenclature, General Characters, Morphology, animate and in-animate properties of virus Virulence factor, Replication, chemistry of virus.
5. **Virology-II** - Properties, Replications and chemistry of viroids; Virosoids and Prions. Isolation and Purification of virus. Bacteriophage (T-lambda, P-Satellite, MU and defective MU Phage). Elementary account of Viral diseases in animals, Humans, Plants, and their transmission modes.

Unit – II - Bacteria, Cyanobacteria and Myconlasma

1. **Archaeabacteria** - Introduction, Habitat, types, cell wall structure, membrane lipid structure methanogens, thermoacidophiles, halophiles their distribution, metabolism, adaptation and ecological role.
2. **Structure and classification of Bacteria** - General classification of Bacteria, New approaches to bacterial taxonomy (including Ribotyping, Ribosomal RNA sequencing, characteristics of Primary domains).
3. **Eubacteria** - Classification, distribution, Ultrastructure of Bacterial cell, Nutrition (Autotrophic and heterotrophic) Reproduction.

4. **Bacterial genetics and diseases** - Genetic recombination Conjugation, Transformation , Transduction and its Significance.
Elementary account of most common disease caused by bacteria in Humans, Animals and Plants.
4. **Cyanobacteria** - General account, occurrence, cell structure, Reproduction, Heterocyst structure and functions, Movements; Ecological Importance.
5. **Other related Prokaryota** - General characters of L-form variants, Rickettsias, Spirochaetes. **Mycoplasma** : Classification,, Ultrastructure, Nutrition, Transmission and Reproduction. Mycoplasmal disease in Plants and Animals and

Unit – III - Protista and Fungi

1. **General Idea of Protista** - Ecological and evolutionary significance of each protista group. Brief idea of Diatoms, Dinoflagellata and Slime moulds - General structure and Reproduction.
2. **Fungi-I** - General characters, classification, structure and Reproduction in fungi.
Economic importance of fungi : fungi as food use in medicine, industry, agriculture. Fungi as test organism.
3. **Fungi-II** - General structure and Reproduction of Yeast, Penicillium, Neurospora and Lichens and their use.
4. **Protozoa-I** - General structure and classification of Protozoa. Economic importance of Protozoa.
5. **Protozoa-II** - Special reference of structure, Life cycle and Pathogenicity of *Plasmodium*, *Trypanosoma*, *Entamoeba* and *Leshmania*.

Unit – IV- Microbial Growth, Control, Ecology and Economic Importance

1. **Microbial growth** - Lag phase, exponential phase, stationary phase, death phase, effect of environmental factors on growth of microbes.
2. **Control of Microorganisms** - Physical methods - Heat, low temperature, filtration, Radiation - U.V. etc.
Chemical methods - Phenols, alcohol, Heavy metals etc. Chemotherapeutic agents and Antibiotics.
3. **Microbial ecology** - Microbial interaction - Mutualism, Proto-Cooperation, Commensalism, Parasitism, Amensalism and Competition.
Role of microbes in nutrient cycles, metal toxicity, Biofilms and Microbial mats.
Microflora of soil, Air and water and their role and interactions.
4. **Microbiology of Food, Milk and Dairy Products** - Food spoilage, food Preservation, Milk spoilage, Food from microbes.
5. **Role of microbes** in disposal of sewage, solid waste and cleaning of oil spills (Superbugs).
Use in landfills.

Unit - V - Immunology

1. **Basic concept of Immunology** - Innate and Acquired Immunity. Active and Passive immunity, Specific and non-specific defence mechanism.
2. **Organs and cells of immune system** - B and T cell lymphocytes, Macrophages, Lymphokines, Activated killer cells. Mechanism and genetic control of immune response (immunogenetics).
3. **Antigen and Antibody** - Concept of antigens, heptans, Properties of antigens, Antigen-Antibody reactions.
Immunoglobulins - Structure, Properties of types of Immunoglobulins, Complement system. Production and use of monoclonal antibodies.
4. **Organ transplantation** - Basic idea of transplantation grafting (auto, allo and xenograft) Major histocompatibility complex, immunosuppressors.
5. **Immune disorders** - Hypersensitivity, its types; Allergy, Autoimmune and Immune deficiency disorders.

Suggested Reading

1. Microbiology : M.J. Pelezer C.E.C. Sun and N.R. Krieg 1993 Tata Mc graw Hill, New Delhi.
2. Introductory Microbiology : E.C. Ross , IV 2004 Colombus Charles E. Merrill. hill publisher
3. Essential of Immunology : W.H. Hildemaau.
4. Immunology : Kuby, John Wiley and Sons. 2002 W.H. freeman and Co. New York.
5. Principles of Cellular and Molecular Immunology : J.M. Austin and K.J. Wood, Oxford University Press.
6. Cellular and Molecular Immunology : Abdul K . Abbas 2002

Practical Exercises

1. Demonstration of laboratory equipments - pH meter , Colorimeter, Spectrophotometer, Autoclave Microscope etc.
2. Media preparation Washing of glassware Sterlization, Culturing methods, Dilution techniques in Microbiology.
3. Staining techniques in Microbiology :
(i) Simple staining.
(ii) Negative staining.
4. Isolation of pure culture, culture ; Characteristics of Microbes. Detection of Coliform for demonstration of purity of water.
5. Isolation and purification of Bacterial DNA.
6. Chromatography - Principle and Methodology of Chromotographic techniques -
(a) paper (b) Thin larger (c) HPLC
7. Isolation and enumeration of microbes from air/soil by serial dilution/agar plating methods.
8. Leaf area damage by air pollutants : Measurement of stomatal index.

Paper - LS – 04 Genetics, Biostatistics and Evolution

Min Pass Marks - 36

Duration - 3 hrs

MM - 100

Note : The question paper will contain three sections as under –

Section-A : One compulsory question with 10 short questions, having 2 questions from each unit. Candidates have to answer each question in 20 words.

Total marks : 10

Section-B : There will be 10 questions in all, 2 questions from each unit. Candidates have to attempt 5 questions taking atleast one from each unit. Answer should be in approximately 250 words

Total marks : 50

Section-C : There will be 04 questions (question may have sub-divisions) covering all units but not more than one question from each unit. Answer should be descriptive type, in about 500 words. Any 2 questions to be attempted by the candidate.

Total marks : 40

Unit – I- Basics, History, Mendel and Morgan's work

1. **History** - Preformation theory; Theory of epigenesis, Pangenesis, Theory of germplasm. Idea of sexuality in Plants and Animals. Premendelian experiments of crossing. Theory of Sutton and Boveri.
2. **Basics** - Definition of Heredity, Variation, Gene, Allel, Locus, Monohybrid, Dihybrid cross, Homozygous, Heterozygous and, Hemizygous, Dominant and Recessive character Test Cross, Back cross, Reciprocal cross, Gamete formation for cross, use of symbols. Probability theory.
3. **Mendel's work** -Life and work of G J. Mendel, selection of Pea and experiment process. Principle of segregation and Independent assortment. Present status of Mendelism.
4. **Morgan's work** - Morgans work on *Drosophila*, selection of fruit fly, life cycle and culture of *Drosophila*. Inheritance of eye colour gene and other important characters. Similarity in Mendel and Morgan results in eye colour inheritance.

5. **Variation from Mendels work** - Incomplete dominance, co-dominance, Lethal gene, Multiple Allele, Pleotropy.

Unit – II- Genetic Interaction, Linkage and Genetics of Sex

1. **Genetic interaction** - Epistasis, Complementary genes, Duplicate genes, Penetrance and expressivity. Quantitative inheritance, Polygenic characters.
2. **Linkage and Crossing over** - Crossing over in Meiosis, its mechanism, cytological basis of crossing over. Linkage groups, linkage maps, Tetrad analysis.
3. **Maternal Inheritance, Accessory genetic elements** - Plasmids, Transposons and Retroelements. Mechanism of Transposition and uses of Transposons.
4. **Genetics of Sex-I** - Sex determination in Plants and Animals, Environmental affect in sex determination in Reptiles, Dosage compensation.
5. **Genetics of Sex-II** - Sex linked, Sex influenced and Sex limited Traits. Sex reversal, free martin effect, variations of sex linkage.

Unit – III- Chromosomal abberation, Mutation, Population Genetics and Eugenics

1. **Chromosomal abberation - Structural changes** - Addition, Deletion, Duplication, Translocation and Inversions Genetic consequences of these changes.
Numerical changes - Aneuploidy and Euploidy. Their affects.
2. **Mutations - Types** - Frameshift Silent, Missense, and Nonsense mutations. Induced Mutations Mutagens. Role of mutation in Agriculture and Evolution.
3. **Mutations - Molecular mechanism** of mutations. Inborn error of metabolism, One-gene-one enzyme theory.
4. **Polulation Genetics** - Hardy-Weinberg Law, Deviation from H.W, Law; Gene frequencies, genetic drift, factors affecting H.W. Law. Founder affect, Bottel neck affect.
5. **Human Genetics** - Human chromosomes, Karyotype, pedegree analysis, Eugenics, Euphenics, common genetic disorders and abnormalities due to chromosome structure and numeral change.

Unit - IV - Biostatistics

1. **Biostatistic Introduction**, Statistical Terms and Symbols, Sample and Sampling Techniques.
2. Collection, classification and Tabulation of Data. Frequency distribution, Diagramatic and graphical presentation of Data.
3. Measures of Central tendency (Mean, Mode and Median) standard deviation and standard errors. Measures of Variability or dispersion.
4. Probability and its application. Theoretical distribution – Binomial and Normal distribution. Correlation and Regression, Coefficient of correlation.
5. Test of Significance, levels of significance, student 't' test, chi-square test analysis of variance (ANOVA).

Unit – V - Evolution

1. **Basics and origin of life** - Definition, Theories of Evolution. Pre-Darwinian, Prebiotic environment, Oparin-Haldane concept of origin. Miller-Urey experiment. Molecular evolution of DNA, RNA world, Proteins. Characters of protobionts, Microspheres or coacervates.
2. **Theories of Evolution and Microevolution** - Work and theories of Lamark, Weisman and Darwin. Theory of Natural selection by Darwin and Wallance. Stabilising, directional and disruptive Natural selection. Lederberg plating experiment.
3. **Evidences of Evolution** - Various evidences of evolution Homology, Analogy, Vestigial organs, Biochemical and Physiological evidences, Adaptive radiation with special reference to Galapagos islands and Australian flora and fauna. Convergent evolution, Mimicry and colouration.
4. **Speciation** - The concept of species, Mechanism of speciation, Parapatric, Allopatric and Sympatric Speciation, **Isolation** - Role and mechanism.

PRACTICAL
(Based on LS - 04)

1. Exercise based on Monohybrid and Dihybrid cross.
2. Study of Blood groups (A, B, AB, O, Rh) and problems based on multiple alleles and incomplete; dominance.
3. Culture of *Drosophila*. Study of life cycle, wild and mutant characters in *Drosophila*. Slide preparation of sex comb & wings of *Drosophila*.
4. Study of Human Karyotype (normal, Klinefelter, Down and Turner syndrome)
5. Study of Human Gene Map on Chromosome 1, 2, 21, X and Y.
6. Exercise based on Classification of Data, Frequency and Frequency distribution.
7. Exercise based on Presentation of Data, Simple and Complex Table, Graphs, Pie Charts.
8. Numerical problems based on measures of central Tendency - Mean, Mode and Median.

Paper - LS – 05 BIOTECHNOLOGY, GENETIC ENGINEERING & BIOINFORMATICS

Min Pass Marks - 36

Duration - 3 hrs

MM - 100

Note : The question paper will contain three sections as under –

Section-A : One compulsory question with 10 short questions, having 2 questions from each unit. Candidates have to answer each question in 20 words.

Total marks : 10

Section-B : There will be 10 questions in all, 2 questions from each unit. Candidates have to attempt 5 questions taking atleast one from each unit. Answer should be in approximately 250 words

Total marks : 50

Section-C : There will be 04 questions (question may have sub-divisions) covering all units but not more than one question from each unit. Answer should be descriptive type, in about 500 words. Any 2 questions to be attempted by the candidate.

Total marks : 40

UNIT - I

1. **General introduction :** Meaning, brief history, Devices of biotechnology, biotechnology in India, Scope and importance, branches of biotechnology. Future Prospects of Biotechnology.
2. **Genetic engineering :** Definition, Steps, Restriction endonucleases and other essential enzymes, Vectors [Plasmid, Bacteriophage, Casmid, Phasmid, Artificial chromosomes as Vector, shuttle vector] gene library (genomic library and c-DNA library), analysis of cloned genes [Southern blotting Probes, RFLP, PCR, DNA, sequencing] achievements of genetic engineering. Basic patent roles ethical issues and Biosafety regulations.

UNIT - II

1. **Plant Biotechnology :**
 - (i) **Plant tissue culture :** Introduction, history, Scope, concept of cellular differentiation totipotency, organogenesis and somatic embryogenesis and Somatic hybridization, applications of plant tissue cultures, micropropagation, Virus free plants, artificial or encapsulated seeds, embryo rescue, production of androgenic haploids, production of triploids, soma clonal variations, germplasm preservation, Cryopreservation and gene bank.
 - (ii) **Genetic engineering of plants :** Gene transfer in plants - Vector mediated gene transfer (Ti plasmid) and direct gene transfer, genetically transformed plants or transgenics, T-DNA and transposon mediated gene tagging, chloroplast transformation and its utility.

Arabidopsis as a model plant for Genetic Engineering, Genetically Modified foods and Hazards.

2. **Animal Biotechnology :**

Primary culture, cell lines and cloning.

Tissue and Organ Culture, IVF, embryo transfer.

Transfection methods and Transgenic animals (Sheep , Goat).

Development of vaccins for immunity, synthetic peptides as vaccins.

Diagnosis of disease.

Gene therapy, Genetic Counselling, DNA finger printing.

Human Genome Project : History and current status.

UNIT - III

1. **Microbial genetic Manipulation :** Bacterial transformation, selection of recombinants and transformant, genetic improvement of industrial microbes and nitrogen fixes. Biodegradation of xenobiotics and toxicwastes by *Pseudomonas capacia*, *E.coli*.
- 2.. **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.
Biotechnology for pollution abatement : Bio scrubbers and Biofilters, Biotechnology for air and water pollution abatement.
3. **Biomegnifications :** Biomagnification of Pesticides and heavy metals, Consequences of biomagnification.
4. **Bioinsecticide :** 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 - IV

1. **Industrial Biotechnology :** Alcohol and Bevarages production, food products - cheese and bread, acid production, vitamin, enzyme production, Antibiotics, Aminoacid production, Biotransformation and Bioleaching, oil industry.
2. **Agricultural biotechnology :** Biofertililzers, Biotechnology of Nitrogen fixation, Biopesticides, production of Biogas and ethanol.
3. **Medical Biotechnology :** Synthesis of propeins and harmones, production of interferons . and other immunoproteins, production of vaccines, antibodies, Sterodies; Dextrans, Monoclonal antibodies, gene therapy

UNIT - V

1. **Bioinformatics :** Definition, Introduction, Historical resume, Bioinformatic Career - future prospects and ethical issues.
2. **Basic Components of computers and their functions** Hardware and Software, Input Output devices.
3. **Basic Concepts about data and information :** Representation of data in Computer in binary, bits and bytes. Conceptual understanding of assemblers, Compilers operating system.
4. **Biological Databases :** Primary sequence databases (Protein and DNA databases), Secondary databases, Composite databases.
Role of bioinformatics in Pharmaceuticals industry Challenges of Commercialization of Bioinformatics and its future prospects.

Suggested Reading

1. Molecular cell Biology : Lodish , H el. al. 2005. W.H. Freeman & Co. V Edition, New York. USA.
2. The Cell - A molecular Approach : Cooper 2006 Sinauer Associats sunderland Washington D. C.
3. Methods in plant molecular biology and biotechnology : Glick , B.R. and Thompson , J.E. 1993 CRC press BOCA Raton Florid. A.
4. Molecular Bilyog of the cell : Bruce Albert , et. al. 2002, Garland Publilcation , Ine. New York.

5. Vasil , I.K. and Thorpe , T.A. : **Plant Cell and Tissue culture** : Kluwler Academic Publishers, The Netherland 1994.
6. Cell and Molecular Biology : P K. Gupta 2008 Rastogi Pul~ic~ions. Memxt India
7. Molecular Biotechnology : B.R. Glick and J.J. Pasternak , ASM Press, Washington USA.
8. Mulecular Clonning Press Sambrook, Russell and Maniatis Vol 1 , 2 and 3 Coldspring Harber laboratory 2001.
9. Introduction to Bioinformatics : Parrysmith and Attwood.
10. **Bioinformatics** : David, Mount.
11. **Introduction of Bioinformatics** : S . S . Rajan 2005 Himalayan Publishing House.

Practical Exercises

1. Demonstration, Principle and use of laboratory equipments : pH Metre , Autoclave, Centrifuge Balance, Spectrophotometre.
2. Acquaitance with tissue culture laboratory.
3. Preparatory techniques : Washing of Glassware , Dry and Steam sterlization , Mairitenance of conditions. Sterlization techniques.
4. Preparation of Culture media.
5. Demonstration of the technique of Micropropagation by using differents explants eg. Shoot Meristem, axillary bud : callus induction, regeneration.
6. Demonstration of the technique of anther culture.
7. Isolation of plant DNA.
8. Estimation of RNA by Orcinol method.
9. Restriction, Digestion of plant DNA, its separation by Agarose gel. electrophoresis and visualization by ethidium bromide staining:
10. Isolation of protoplasts from different tissues using commercially enzymes.
11. Separation of Cell organcellel by sucrose gradient.
12. Extraction and estimation al phenol based secondary metabolites.

Paper - LS – 06 Environmental Biology, Biodiversity and Toxicology

Min Pass Marks - 36

Duration - 3 hrs

MM - 100

Note : The question paper will contain three sections as under –

Section-A : One compulsory question with 10 short questions, having 2 questions from each unit. Candidates have to answer each question in 20 words.

Total marks : 10

Section-B : There will be 10 questions in all, 2 questions from each unit. Candidates have to attempt 5 questions taking atleast one from each unit. Answer should be in approximately 250 words

Total marks : 50

Section-C : There will be 04 questions (question may have sub-divisions) covering all units but not more than one question from each unit. Answer should be descriptive type, in about 500 words. Any 2 questions to be attempted by the candidate.

Total marks : 40

Unit – I- Basics, Organisms and Population Ecology

1. **Ecology** : Basics, Definition, History, Indian (vedic) view on environment. Levels of organisation hierarchy, ecological homeostasis, emergent propety principle, transcending functions and control processes.
2. **Organism and affecting factors** : Habitat, Home Range, Territory, Major abiotic factors, (Temperature, Water, Light, Soil) Responses to the Abiotic factors (Regulate, Conform), Concept of Limiting factors - Liebig s law of minimum.
3. **Population** : Population attributes (age pyramids, population density) population growth (Natality, Mortaliyy, Immigration, Emigration) Growth Models -exponential growth and Logistic growth.

4. **Population Interactions** : Mutualism, Competition, Predation, Parasitism, Commensalism, Amensalism Foraging Theory, Theory of Competition, Plant Animal Mutualism.
5. **Population Study** : Tools and techniques of population study, concept of carrying capacity. Population fluctuation and cyclic oscillations, patterns of Dispersion.

Unit – II - Synecology : Communities, Biomes and Life Zones

1. **Biotic Community** and its characters (structure, stratifications Diversity etc.) community interdependence, ecotone and edge effects. Ecological succession - Hydrosere, Psammosere and Xerosere.
2. **Ecosystem** : Concept of Ecosystem, Trophic structure, Diversity, Gradients and Ecotones, Microcosms, Mesocosms and Macrocosms, Food Chain, Food Web, Ecological Pyramids.
3. **Ecosystem - Cybernetics** : Laws of Thermodynamics, Concept of Productivity (Primary, Secondary, Net, Gross), Energy flow in ecosystem. Biogeochemical cycles.
4. **Biomes** : Structure, characters specific flora and fauna of major biomes of world (Tundra, Forest, Grassland, Chappral, Desert) Marsh (Wetland) Estuaries and Marine Life Zones and Fresh Water bodies.
5. **Natural Resources** : Types and importance (water, soil, forests, wetland, wild life, conventional and non-conventional energy sources). Conservation of Natural resources.

Unit – III - Problems, Challenges and Laws

1. **Environmental Pollution** : Definition, Types, Pollutants, Sources, effects and control methods of air, water and soil pollution. Noise and electromagnetic pollution. Elementary idea of Radiation Hazards in reference to atomic energy reactors and nuclear test.
2. **Global Environmental Issues** : Global warming, Green house effects, green house gases, its effects and possible remedies. Ozone Layer depletion its causes, effects and control. Acid Rain, El-nino affect.
3. **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.
4. **Peoples Participation** : Role of Local communities in environmental protection (with Special reference of Amrita Devi' Bishnoi), Chipko movement, Silent Vally movement. Joint forest Management (JFM) concept introduced by Govt. of India-1980. Environmental Ethics, Ecotourism.
5. **Environmental Conventions, Programmes and Laws** : Montreal Protocol, Earth summit, Kyoto Protocol, Environmental Organisation, BP, MAB etc. various Laws to control Pollution and Forest.

Unit – IV - Biodiversity

1. **Biodiversity** : Definition, Magnitude of BD Levels of BD (Genetic diversity, species diversity and community and ecosystem diversity -- Alpha, Beta and Gamma diversity) Patterns of BD - longitudinal gradient and species area relationship.
2. **BD of India and World** : Ten bio-geographical regions of India, their specific flora and fauna. Brief idea of global Hot spots of BD developed by Norman Mayers.
3. **Use of B.D.** : B.D. as a source of food, Improved Varieties, Drugs, Medicines, Aesthetic and Cultural Benefits, Ecosystem Services.

4. **Loss of B.D. :** Various causes of loss of B.D. - Habitat loss & fragmentation, over-exploitation, alien sps. Invasion, introduction co-extinctions, disturbance and pollution Anthropogenic extinction. IUCN Red list categories,
5. **Conservation of B.D. :** *In-situ* conservation - (Protected area, Biosphere reserve etc.)
ex-situ conservation - cryopreservation, zoological parks.

Unit – V -Toxicology

1. **Definition, Tools and Techniques of Analysis :** Toxic level of Pollutants, concepts and use of LD-50.
2. Biomagnification and Bioaccumulation of toxicants toxicology of heavy metals, agrochemicals (Pesticides, Herbicides, Rodenticides, Fungicides, Fertilizers)
3. **Mutagenicity of Toxicants.**
4. **Carcinogenicity of toxicants.**
5. Dietary remedies of toxicants, Industrial toxicology Research Centre (CSIR) Lucknow and its role.

PRACTICAL (Based on LS - 06)

Exercise No.1 Analysis of Water Sample for Estimation of

(1a) pH	(1b) Alkalinity	(1c) Acidity
(1d) Dissolved CO ₂	(1e) Dissolved O ₂	(1f) Salinity (as Cl)

- | | |
|----------------|--|
| Exercise No. 2 | Analysis of soil sample for pH estimation. |
| Exercise No. 3 | Qualitative estimation of phytoplanktons and zooplanktons. |
| Exercise No. 4 | Field visit to Biodiversity rich area and submission of report of this field study (suggested site : K.N.P., Bharatpur, Ranthambhore tiger reserve, Durrh (Mukundara Hills) Sanctuary etc. |
| Exercise No. 5 | Study of various pesticides (specially insecticides), their signs & symptoms of acute poisoning. |
| Exercise No. 6 | Localized & systemic effects study of insecticides. |
| Exercise No. 7 | Visit to a toxicological Laboratory (such as ITRC of CSIR, Lucknow).
Submission of report of work done. |
| Exercise No. 8 | Preparation of a collection of published articles, photographs, research papers and account of Locally available biodiversity. (Both floral & faunal) |

BOOKS :

1. E. P. Odum : Fundamentals of Ecology.
2. P. K. Gupta : Environmental Biology
3. J. A. Timbrell : Introduction to Toxicology
4. Arumungam, and Kumar Sen : Environmental Studies (Based on UGC Syllabus)
5. Pandey & Kulkarni : Biodiversity and Environment.