

MAHARAJA GANGA SINGH UNIVERSITY, BIKANER

**SCHEME OF EXAMINATION AND
COURSES OF STUDY**

SYLLABUS

FACULTY OF SCIENCE

M.SC.

BIOTECHNOLOGY



M.Sc. Previous Examination - 2021

M.Sc. Final Examination – 2022

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(including role of cyclic-AMP), hypothalamic control of pituitary, endocrine secretions of Pituitary, Pineal, Adrenal, Thyroid, Islets of Langerhans, Testis and Ovary.

Unit IV

Structure and properties of nucleic acids, double helical structures. Forces stabilizing nucleic acid structure. Metabolism of nucleotides: Synthesis of purine & pyrimidine nucleotides, catabolism of purines and pyrimidines.

Unit V

Enzymes: Properties, classification and nomenclature. Mechanisms of enzyme action (i.e. catalytic mechanisms). Michaelis-Menton equation. Effect of substrate, temperature, pH and inhibitors on enzyme activity. Feedback inhibition. Isozymes, Zymogens, Multienzyme complexes, Allosteric enzymes. Enzyme Isolation, purification and large scale production, immobilization, Enzymes contributing sustainable industrial development, starch processing-Textile, leather, pulp and paper manufacturing.

PAPER – II CELL BIOLOGY AND BIOPHYSICS

NOTE: There shall be three (3) sections in the question paper.

Section A (20marks) shall consist of 10 questions two from each Unit. Each question shall be of 2 (two) marks. The candidate is required to answer all the questions. The answers should not exceed 50 words.

Section B (25marks) shall consist of 5 questions (two from each unit, as internal choice). Each question shall be of 5 (five) marks. The candidate is required to answer all 5 questions. The answers should not exceed 200 words.

Section C (30 marks) shall consist of 5 questions, one from each Unit. Each question shall be of 10 (ten) marks. The candidate is required to answer any three questions. The answers should not exceed 500 words.

Unit I

Ultrastructure and Function: Cell wall, Cell membrane, Nucleus, Mitochondria, Golgi bodies, Lysosomes, Endoplasmic reticulum, Peroxisomes, Plastids, Vacuoles, Chloroplast, Structure and function of cytoskeleton and its role in motility.

Cell division and cell cycle: Mitosis and Meiosis, their regulation, steps in cell cycle and control of cell cycle.

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

Unit II

Biophysics of nerves, muscles and membranes, physics of cellular process. Attractive and repulsive forces generated within the molecules and their overall effect on molecular interactions.

Introduction to Fractional precipitation: Gel filtration, Gel Electrophoresis, tracer techniques, autoradiography, Microcalorimetry.

Unit III

Methods to elucidate structure of biochemical compounds found in living organisms: ultrafiltration, centrifugation, density gradient centrifugation, chromatography (PC, TLC, CC, GLC, HPLC).

Small and macromolecule quantification: Colorimetry, Photometry, Nephelometry, Flamephotometry, Visible, UV and Atomic absorption spectroscopy.

Unit IV

Physical techniques in proteins, nucleic acids and polysaccharides structure analysis (IR, NMR, LASER, Raman spectroscopy, Mass spectroscopy, Fluorescence spectroscopy, Mossebäuer spectroscopy, and Atomic force microscope).

Transportation across biomembranes- Passive transport, facilitated transport, active transport (Na⁺, K⁺ & ATPase pump).

Unit V

Electrophysiological methods : Single neuron recording, patch-clamp recording, ECG, Brain activity recording, lesion and stimulation of brain, pharmacological testing, PET, MRI, fMRI, CAT. Bioelectronics: Biosensors, Biochips, Biocomputers.

Cell signaling hormones & their receptor, Signal transduction pathways, second messengers, regulation of signaling pathways.

PAPER – III CONCEPT OF MICROBIOLOGY & IMMUNOLOGY

NOTE: There shall be three (3) sections in the question paper.

Section A (20marks) shall consist of 10 questions two from each Unit. Each question shall be of 2 (two) marks. The candidate is required to answer all the questions. The answers should not exceed 50 words.

Section B (25marks) shall consist of 5 questions (two from each unit, as internal choice). Each question shall be of 5 (five) marks. The candidate is required to answer all 5 questions. The answers should not exceed 200 words.

Section C (30 marks) shall consist of 5 questions, one from each Unit. Each question shall be of 10 (ten) marks. The candidate is required to answer any three questions. The answers should not exceed 500 words.

Unit I

Introduction to microbiology: Scope and History, distinctive characters, classification (upto class level) and uses in agriculture, industry and environment of major groups: Fungi, Algae, Protozoa, Bacteria, Virus. Microscopy: Simple, light and compound microscope, phase-contrast, dark field, fluorescence and electron microscopy (TEM & SEM)-their principles and applications. Different fixation and staining techniques for EM, freeze-etch and freeze-fracture methods for EM, image processing methods in microscopy.

Unit II

Morphology, fine structure, elementary chemistry and function of bacteria: cell wall, cell membrane, capsule, appendages and cytoplasmic inclusions. Introduction to concept of disinfection and sterilization: Physical and chemical methods of sterilization, trophic grouping, types of media, pure culture isolation techniques.

Unit III

Microbiology of air: Atmospheric microflora, air sampling devices (impactors, impingers) Air borne diseases and control of air borne diseases. Microbiology of water: Microbiology of fresh, marine and potable water, water purification, waste water and sewage disposal. Microbiology of food: Food spoilage, food preservation, food borne pathogens, food poisoning. Microbiology of soil: Soil microflora, interaction between microorganism in soil. Role of microbes in Carbon, Nitrogen, Phosphorous, Sulphur cycle in nature.

Unit IV

Elementary account of most common diseases caused by microorganism in human, animals and plants: Tuberculosis, Syphilis, Small pox, Chickenpox, SAARS, AIDS, Ranikhet, Brucellosis, Pebrine, Rinderpest, Mastitis, TMV, Citrus canker, Tikka, Green ear. Virus: Chemical and physical properties, virus isolation, purification, cultivation, serology, plaque assay and viral replication.

Unit V

Innate and Acquired immunity, Cells of immune system: B lymphocyte, T lymphocytes, macrophages, Nk cells and killer cells. Lymphokines, Immune response, clonal selection & development of B-cells, antigens, antibody structure and functions. Antigen-Antibody reactions. Major histocompatibility complex, MHC- restriction, complement system, immunological tolerance, principles and uses of RIA, ELISA, Immunofluorescence and immunological technique in diagnostics.

PAPER – IV MOLECULAR BIOLOGY & GENETIC ENGINEERING

NOTE: There shall be three (3) sections in the question paper.

Section A (20marks) shall consist of 10 questions two from each Unit. Each question shall be of 2 (two) marks. The candidate is required to answer all the questions. The answers should not exceed 50 words.

Section B (25marks) shall consist of 5 questions (two from each unit, as internal choice). Each question shall be of 5 (five) marks. The candidate is required to answer all 5 questions. The answers should not exceed 200 words.

Section C (30 marks) shall consist of 5 questions, one from each Unit. Each question shall be of 10 (ten) marks. The candidate is required to answer any three questions. The answers should not exceed 500 words.

Unit I

Genetic material: Structure, chemical composition and organization (structure of chromatin, coding and non coding sequences, satellite DNA). DNA replication (enzymes, accessory proteins involved and mechanism), super coiled DNA, repetitive DNA, artificial chromosomes.

Recombination: Holliday junction, general and site specific recombination. Role of Rec A protein and other recombinase, DNA damage and repair. Biology of cancer: Viral and cellular oncogenes and tumor suppressor genes in man.

Unit II

Gene Expression: Prokaryotic & eukaryotic transcription (RNA polymerase, transcription factors, regulatory elements, mechanism). Post transcriptional modification: RNA processing (capping, polyadenylation, splicing, editing). Prokaryotic and eukaryotic translation, mechanism of initiation, elongation, termination and regulation. Co and post-translational modifications of proteins. Regulation of gene expression: Operon concept, positive and negative control-lac operon, trp operon, catabolic repression, antitermination, attenuation.

Unit III

Principles and methods of genetic engineering: Restriction endonucleases (types, classification and application), DNA ligases, Topoisomerases, Gyrase, Methylases, Nucleases and other enzymes needed in genetic engineering. Cloning vectors: Plasmids- organization, replication and incompatibility of plasmids, construction of plasmid vector, Ti plasmid. Phages: Characteristics of single and double phages, construction of phage vectors, cosmids, expression vector and other vectors (YAC & BAC), screening of recombinants.

Unit IV

Molecular cloning: Construction of cDNA and genomic library, principles and practice of nucleic acid hybridization - southern, northern and western blotting techniques, colony hybridization gel retardation, DNA finger printing and foot printing, chromosome walking, sequencing of DNA, site directed mutagenesis, polymerase chain reaction (PCR) and its application, gene therapy & its application, gene and protein targeting, antisense RNA technology & its application.

Unit V

Linkage maps, tetrad analysis, mapping with molecular markers & Physical maps- Fish, STS & restriction mapping Transposons, Transgenic animals. Methods of their production, ethics & morality. DNA probes and their applications in molecular diagnosis of genetic and other human disorders. Application of genetic engineering in agriculture, medical and industry. Biosafety regulations: Physical and biological containment. Intellectual property rights, patenting of biological materials, patenting laws in India.

SCHEME OF THE PRACTICAL EXAMINATION

M.SC. PREVIOUS BIOTECHNOLOGY

Combined Practical Exam Based on Theory papers

Time: - 5 hrs. (Each day) Max. Marks- 150

Min. Marks 54

1. Biochemistry and enzyme technology	
(A) Major	(15)
(B) Minor	(10)
2. Exercise in Cell biology & Biophysics	
(A) Major	(15)
(B) Minor	(10)
2. Exercise in Microbiology & Immunology	
(A) Major	(15)
(B) Minor	(10)
3. Exercise in Molecular & Genetic Engineering	
(A) Major	(15)
(B) Minor	(10)
4. Spots (5)	(10)
5. Practical record	(10)
6. Review assignment	(20)
7. Viva-voce	(10)

List of Practical Exercises

Biochemistry and Enzyme technology

A. Major

1. Protein content in the given sample by Lowry method
2. Chlorophyll estimation
3. Total sugar by anthrone reagent
4. Estimation of free amino acid by spectrophotometer
5. Extraction and identification of amino acid by paper chromatography
6. Isolation and identification of steroid (TLC)
7. Estimation of total lipid
8. Quantitative estimation of catalase activity from leaf sample
9. Estimation of Glycogen from liver sample

B. Minor

1. Preparation of standard solution of acid and bases
2. Determination of pH of buffer
3. Precipitation of protein
4. Biurete test
5. Pka value and dissociation constant of acid
6. Total reducing sugar (Nelson and Somogyi method)
7. Starch hydrolytic activity
8. Casein hydrolytic activity
9. Catalase test
10. Lipid hydrolytic test

11. Citrate test
12. Nitrate reduction test

Cell biology & Biophysics

A. Major

1. Identification of different stages of mitosis from suitable plant material. (onion root tips, garlic root tips).
2. Identification of meiosis from suitable plant material (Onion floral buds).
3. Identification of cell organelles: Mitochondria, Chloroplast, Nucleus.
4. Study of mitotic index from suitable plant material.
5. Chromatographic Separation of biomolecules
6. To verify the Lambert Beer's law.

B. Minor

1. Study of cyclosis in cells of suitable plant material.
2. To determine the osmotic fragility of RBC.
3. Calibration of pH meter.

Microbiology and Immunology

A. Major

1. Determination of antigen-antibody reaction by radial immuno diffusion method.
2. Determination of antigen-antibody reaction by Ouchterlony double diffusion method
3. Isolation of Microorganisms from soil by the serial dilution agar plating method.
4. Obtain pure cultures of microorganisms by streak plate method
5. Isolation and Enumeration of microorganisms from leaf/milk/soil/sample
6. Bacteriological examination of water by multiple-tube fermentation

B. Minor

1. Preparation of Basic solid media for the routine cultivation of microorganisms
2. To perform the simple staining
3. To perform the gram staining procedure
4. Extraction and identification of dyes by TLC
5. Preparation of 0.2M acetate buffer
6. Indole test
7. MR-VP test
8. Bacterial spore staining
9. Capsule staining
10. Negative staining

Molecular and Genetic engineering

A. Major

1. Plant DNA isolation and RNase treatment
2. Plasmid isolation
3. Agarose gel electrophoresis of DNA
4. Plot absorption spectrum for DNA & find out ? max.
5. Determine concentration of DNA/RNA in sample by spectrophotometer.
6. Determine molecular weight of DNA by viscometer
7. Preparation of competent cells of the E. coli host.
8. Amplification of DNA through PCR

B. Minor

1. Preparation and examination of agarose gel
2. To make different types of electrophoresis buffer
3. Preparation of gel loading dyes/buffer
4. Plot standard curve for DNA by colorimeter method.
5. Plot standard curve for RNA by colorimeter method.
6. Determine purity of DNA in sample by UV method

SPOTS

Scanning electron microscope, Transmission electron microscope, Autoclave, Electrical drying oven, Electrical bacteriological incubator, Electrophoresis apparatus, Laminar air flow, pH meter, Centrifuge machine, Spectrophotometer, UV Transilluminator, BOD Incubator, Bright field microscope, Dark field microscope, Phase contrast microscope, Fluorescent microscope, Electron microscope and all other equipments available in the laboratory and used by the student. Slide of different microorganisms.

Submission: A review assignment has to be submitted by each candidate followed by seminar.

REFERENCES :

1. Genetic Engineering Principle and Methods, Setlow J. K. & Hollaender, Plenum Press, New York.
2. Biochemistry, Donald Voet, Judtin E. Voet; Panima Publication
3. Advances in Biotechnology, Manjula K. Saxena and B.B.S.Kapoor, Madhu publications
4. Microbiology, P. D. Sharma, Rastogi Publications
5. Immunology, Richard A., Goldsby, Kuby et al, W. H. Freeman & Company, New York
6. Biophysics, Vasantha Pattabhi, N. Gautham, Narosa Publishing House
7. Essential of Biophysics, P. Narayanan, New Age International Publication
8. An Introduction to Molecular Biotechnology- Molecular Fundamentals, Methods and Applications in Modern Biotechnology, Edited by Michael Wink, Wiley
9. Molecular Biology of the Cells, Alberts et al., Garland Publications Inc NY and London
10. Cell and Molecular Biology, E D de Roberties & E M F de Roberties (Jr) Lippincott Williams & Wilkins, Philadelphia
11. Biochemistry, Lubert Stryer, W H Freeman and Co., San Fransisco.
12. Immunology, Janis Kuby, W H Freeman and Company, USA
13. Essential Immunology, Ivan Roitt, Blackwell Science Ltd.
14. Microbiology, Michael J Pelczar (Jr) ESC Chan, N R Kreig, Tata McGraw Hill.
15. Fundamentals of Enzymology, Nicholas C Price and Lewis Stevens, Oxford Univ Press.

M.SC. FINAL BIOTECHNOLOGY – 2022

Total Marks of M.Sc. Final **450**

A. Theory Papers	Maximum Marks
11. Cell and Tissue Culture	75
2. Environmental Biotechnology	75
3. Biostatistics, Bioinformatics & Computer Applications	75
4. Industrial Biotechnology	75
Total	300
B. Combined practical exam	150