

**MAHARAJA GANGA SINGH UNIVERSITY,
BIKANER**

**SCHEME OF EXAMINATION AND SYLLABUS
B.Sc. BIOTECHNOLOGY 2019**

13. B.SC. BIOTECHNOLOGY (VOCATIONAL) PART- I, 2019

Scheme:

Theory	Duration	Max. Marks	Min. Marks
Paper I Computational Biology & Biostatistics	3hrs	45	
Paper II Cell Biology & Genetics	3hrs	45	48
Paper III Biochemistry & Biotechniques	3hrs	45	
Practical based on paper I,II,III	5hrs	65	24

PAPER - I COMPUTATIONAL BIOLOGY & BIostatISTICS

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

Section A (15marks) shall consist of 10 questions two from each Unit. Each question shall be of 1.5 marks. The candidate is required to answer all the questions. The answers should not exceed 50 words.

Section B (15marks) shall consist of 5 questions (two from each unit, as internal choice). Each question shall be of 3 marks. The candidate is required to answer all 5 questions. The answers should not exceed 200 words.

Section C (15 marks) shall consist of 5 questions, one from each Unit. Each question shall be of 5 marks. The candidate is required to answer any three questions. The answers should not exceed 500 words.

Unit I

Introduction to computers: Hardware and Software, binary number system, flowcharts and programming techniques. Introduction to data structure and database concepts. Perverse software's (viruses).

Unit II

Introduction to M.S. Office software (M.S Word, Excel, Corel Draw) and presentation software (PowerPoint). Introduction to Internet and its application (Local Area Network and Wide Area Network).

Unit III

General account of Biostatistics: Definition, historical perspective, role and scope in Biosciences, terms and symbols used in statistics. Sample and sampling, merits and demerits of sampling, methods of samplings, Frequency distribution, bar diagrams, Histogram.

Unit IV

Measures of central tendency and partition: Values, types, mathematical averages, averages of position. Measures of dispersions: Mean, mode, median, standard deviation, and variance. Test of significance: significance of difference of means, standard errors of mean, standard deviation. Introduction, definition, formula and application of Z/F test, student t-test, Chi-square test.

Unit V

Introduction to Bioinformatics: Role of computers in taxonomy, microbiology, computation of mean, variance and standard deviation, t- test, bubble sort, introduction to nanotechnology.

PAPER - II CELL BIOLOGY & GENETICS

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

Section A (15marks) shall consist of 10 questions two from each Unit. Each question shall be of 1.5 marks. The candidate is required to answer all the questions. The answers should not exceed 50 words.

Section B (15marks) shall consist of 5 questions (two from each unit, as internal choice). Each question shall be of 3 marks. The candidate is required to answer all 5 questions. The answers should not exceed 200 words.

Section C (15 marks) shall consist of 5 questions, one from each Unit. Each question shall be of 5marks. The candidate is required to answer any three questions. The answers should not exceed 500 words.

Unit I

Historical aspects: cell size and shape, cell theory. Prokaryotic and eukaryotic cells. Ultra structure and function: Plasma membrane, cell wall, golgi apparatus, mitochondria, chloroplast, rough & smooth ER, vacuoles, ribosomes, lysosomes, peroxysomes and nucleus.

Unit II

Cell cycle and cell division: cell motility (Cilia and flagella of prokaryotes and eukaryotes), mitosis and meiosis, structure and function of chromosomes, euchromatin and heterochromatin, chromosome banding, lampbrush and polytene chromosome.

Unit III

Nucleic acids, fine structure of gene (coding and non coding sequences), gene concept, one gene one enzyme hypothesis, Mendelism: monohybrid and dihybrid crosses, gene concept, interaction of genes: incomplete dominance, codominance, epistasis, complementary genes, duplicate genes, polymeric genes, multiple alleles, lethal genes, polygenes.

Unit IV

Genetic code and mapping, linkage, crossing over, synaptonemal complex, extrachromosomal inheritance (episome, mitochondria and chloroplast), chromosomal aberrations, mutations.

Unit V

Genetic basis of sex determination, sex linked inheritance, autosomal inheritance of dominant and recessive traits, autosomal anomalies (Down's syndrome, Edward's syndrome), sex chromosome anomalies (Klinefelter's syndrome, Turner's syndrome), Biology of cancer (oncogenes and tumor suppressor genes).

PAPER - III BIOCHEMISTRY AND BIOTECHNIQUES

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

Section A (15marks) shall consist of 10 questions two from each Unit. Each question shall be of 1.5 marks. The candidate is required to answer all the questions. The answers should not exceed 50 words.

Section B (15marks) shall consist of 5 questions (two from each unit, as internal choice). Each question shall be of 3 marks. The candidate is required to answer all 5 questions. The answers should not exceed 200 words.

Section C (15 marks) shall consist of 5 questions, one from each Unit. Each question shall be of 5marks. The candidate is required to answer any three questions. The answers should not exceed 500 words.

Unit I

Chemical foundations of biology: pH, acids, bases, buffers, structure of atoms, molecules, bonds (Ionic, covalent and hydrogen), classes of organic compounds & functional groups.

Unit II

Structure, types, chemical, physical properties and metabolism of: Protein (Amino acids & peptides), lipids, carbohydrates (Mono, di, & polysaccharides), glycoprotein and peptidoglycans.

Unit III

Enzymes and coenzymes (activators & inhibitors), isoenzymes, allosteric enzymes, ribozyme, abzyme, various uses of enzymes (food processing, medicines, diagnosis, production of new compounds).

Unit IV

Basic principles & application of various biotechniques: Separation techniques (filtration, centrifugation, density gradient, chromatography- PC, TLC, GLC, HPLC), biomolecules quantification (colorimetry, photometry, nephelometry, flame photometry, Visible, UV & atomic absorption spectroscopy).

Unit V

Physical techniques in protein, nucleic acids & polysaccharide structure analysis (IR , NMR, LASER, Raman spectroscopy, Fluorescence spectroscopy, X-ray crystallography), fractional precipitation (gel filtration, gel electrophoresis, northern, western, & southern blotting), microscopy (phase contrast, Scanning Electron Microscope 'SEM' and Transmission Electron Microscope 'TEM')

SCHEME OF PRACTICAL EXAMINATION

Practical Based on Theory Papers.

Time: - 5hrs

Maximum Marks : 65

Minimum Marks : 24

Combined Practical	Marks
1. Exercise of Cell Biology	[10]
2. Genetics problem	[05]
3. Biostatistics problem	[05]
4. Computer exercise	[05]
5. Biochemical test & Enzyme activity	[10]
6. Exercise in Bio-technique	[05]
7. Spots (Five)	[10]
8. Viva-voce	[05]
9. Practical Record	[10]

List of Practical Exercises

Exercises in Biostatistics

- | | |
|--------------------|---------------------------|
| 1. Bar Diagram | 2. Histogram |
| 3. Mean | 4. Mode |
| 5. Median | 6. Standard error |
| 7. Null-hypothesis | 8. Chi ² test. |

Exercises in Computational biology

1. Type a letter or paragraph in M.S. Word Formatting by font size, Change font style, Bold, under line.
2. Alignment, Insert Page number, Footer, Header, Making tables, Creating tables, Sorting table.
3. Merge cells, Format tables.
4. Make a Data sheet, sorting, addition, formula writing , Cell address, Graphs
5. Making slides in Power point, Animation in slides.

Exercises in Cell biology and Genetics

1. Study mitosis in onion root tip by using temporary acetocarmine stain.
2. Study meiosis in flower bud.
3. Study cell permeability (crenation and hemolysis) in mammalian RBC.
4. Prepare temporary slides of mitochondria in buccal smears by vital staining.
5. Determine blood group of human blood sample.
6. Problems based on gene interactions, multiple alleles, sex- linked inheritance.

Exercises in Biochemistry

1. Preparation of standard solution of acids and bases.
2. Molisch test for carbohydrate.
3. Fehling test for carbohydrate.
4. Benedict's qualitative test for reducing sugars.
5. Lead acetate test for carbohydrate.
6. Iodine test with given carbohydrate solution.
7. Biuret test (group test for protein).
8. Test amino acid with ninhydrin.
9. Determine pH of a solution using pH meter.
10. Demonstrate catalase activity.
11. Demonstrate salivary amylase activity.
12. Solubility test for lipids.
13. Grease-spot test for lipids.

Exercises in Bio-techniques

1. Separation using filtration, centrifugation, density gradient, chromatography.

Spotting

- Mouse, C.P.U., C.D., Floppy, Keyboard, Monitor.
- Prokaryotic cell, Plant cell, Animal cell, Bacterial cell, Mycoplasma, Cyanobacteria, Microscope.
- Electrophoresis, Chromatography, Centrifuge, Spectrophotometer, Water Bath

References

1. Computational Statistics, Rao, MJM, Himalaya Publishing House
2. Biostatistics, Arora and Malhan, Himalaya Publication
3. Statistics, S. P. Gupta, Rastogi Publication
4. Computer Fundamentals, Pradeep K. Sinna et al, BPB Publications
5. Essential of Cytology, Powar, C. B., Himalaya Publishing House
6. Essential Cell Biology, Alberts, Bray Johnson Lewis, Raff, Robberts, Walter, Panima Publications
7. Genetics, B. D. Singh, Himalaya Publication
8. Genetics, Veer Bala Rastogi, Rastogi Publication
9. Principles of Biochemistry, Lehninger A. L., Nelson D. K. and Cox M. M., CBS Publishers & Distributors, New Delhi.
10. Fundamentals of Biochemistry, J. L. Jain, Sanjay Jain & Nitin Jain, S. Chand
11. Biochemistry (Chemistry of Life), David T. Plummer, Mc Graw Hill Book Company
12. Cell and Molecular Biology, E D de Roberties & E M F de Roberties (Jr) Lippincott Williams & Wilkins, Phiadelphia
13. Introduction to plant biochemistry, T W Goodwin and E I Mercer. Pergaman Press, Oxford, NY, Toronto, Sydney, Paris, Frankfurt.
14. Principles and Techniques of Practical Biochemistry, K Wilson and J Walker (eds.) Cambridge Univ. Press.

10. B.SC. BIOTECHNOLOGY (VOCATIONAL) PART- II, 2019

Schemes	Duration	Max.	Min.
		Marks	Marks
Paper I Microbiology & Immunology	3hrs	45	
Paper II Molecular Biology and Genetic Engineering	3hrs	45	48
Paper III Environmental Biotechnology & Bioinformatics	3hrs	45	
Practical based on paper I,II,III	5hrs	65	24

PAPER – I MICROBIOLOGY & IMMUNOLOGY

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

Section A (15marks) shall consist of 10 questions two from each Unit. Each question shall be of 1.5 marks. The candidate is required to answer all the questions. The answers should not exceed 50 words.

Section B (15marks) shall consist of 5 questions (two from each unit, as internal choice). Each question shall be of 3 marks. The candidate is required to answer all 5 questions. The answers should not exceed 200 words.

Section C (15 marks) shall consist of 5 questions, one from each Unit. Each question shall be of 5 marks. The candidate is required to answer any three questions. The answers should not exceed 500 words.

Unit I

Introduction to microbiology: scope of microbiology, microbiology research after year 1980, microbiology in India. Prokaryotic and Eukaryotic microbial cell . Concept of sterilization (dry heat, wet heat, radiation, chemical and filtration), Modern classification of microorganisms.

Unit II

Ultra structure of microbes (mycoplasma, viruses, bacteria and cyanobacteria). Some common human diseases: Influenza, Herpes, Pox, AIDS, SAARS, Dengue and Meningitis: causes, symptoms, prevention and control.

Unit III

Role of microbes in: Agriculture: Nitrogen fixation, phosphate stabilization, pest control; Medical: pharmaceutical industry including vaccines and antibiotics; Environment: waste treatment and biogeochemical cycles.

Unit IV

Immunity: Types of immunity, nature of antigens and antibodies, antigen antibody reactions: Complement and lytic reaction, precipitation, agglutination reaction and neutralizing reaction.

Unit V

Cells of immune system (A brief account): B-lymphocytes, T-lymphocytes, macrophages and natural killers. Measurement of antigens and antibodies: Radio Immuno Assay (RIA), Enzyme Linked Immuno Sorbant Assay (ELISA), fluorescent antibody technique, hypersensitivity.

PAPER - II MOLECULAR BIOLOGY AND GENETIC ENGINEERING

Note: The paper is divided into five units. Two questions will be set from each unit. The candidates are required to attempt 5 questions in all, selecting one question from each unit. Each question will comprise of a, b, c, d and e parts of 1,1,2,2 and 4 marks respectively.

Unit I

History and concept of molecular biology, Genetic material: Structure, chemical composition, replication, reverse transcription, satellite DNA, DNA damage and repair, Proteomics - definition, scope and technology.

Unit II

Transcription and translation in prokaryotes & eukaryotes, processing of eukaryotic m-RNA, post translational modifications of protein. Inhibitors of transcription and translation.

Unit III

Regulation of gene expression, recombination in prokaryotes: transformation, conjugation and transduction. Brief history and development of genetic engineering, recombinant DNA technology: Basic principles and method. Restriction endonuclease (types, classification and application) and other enzymes needed in genetic engineering.

Unit IV

Cloning vectors: Plasmid vectors, bacteriophage vectors, cosmid vectors, phasmid vectors, shuttle vectors, YAC & BAC. Integration of DNA insert into the vector, introduction of the vector into the suitable host. Transposons and their uses in genetic manipulation.

Unit V

Molecular cloning, selection of recombinant clone, construction of cDNA and genomic library, PCR, DNA sequencing, DNA probes methods of gene transfer. Application of genetic engineering in agriculture and human welfare. A brief account of transgenic plants and animals.

PAPER - III ENVIRONMENTAL BIOTECHNOLOGY & BIOINFORMATICS

Note: The paper is divided into five units. Two questions will be set from each unit. The candidates are required to attempt 5 questions in all, selecting one question from each unit. Each question will comprise of a, b, c, d and e parts of 1,1,2,2 and 4 marks respectively.

Unit I

Natural resources : Conventional and alternate sources of energy and their environmental impacts,. Methanogenic bacteria and biogas, microbial hydrogen production, conversion of sugars to ethanol, gasohol. Solar energy, biodiesel, biodegradable plastics.

Unit II

Waste water treatment: Treatment of municipal waste and industrial effluents, BOD and COD, Ground water remediation. **Solid waste treatment:** organic compost and process of composting, vermiculture technology. **Aeromicrobiology:** aeroallergens and aeroallergy.

Unit III

Application of microbes: Biofertilizers, Biopesticides, degradation of pesticides, Bt toxin as natural pesticide, biological control of insect pests, microbes and their genetic engineering for degradation of pollutants, enrichment of ores by microorganisms, use of super bugs for removal of oil spills.

Unit IV

Biotechnology in pollution monitoring: Principles and applications of biosensors for detection of pollutants, Bioindicators, **Biotechnology in pollution abatement:** reduction of CO₂ elimination, O₂ production by algae, eutrophication, biomagnifications, biomethylation, phytoremediation metal chelation and detoxification, Biosorption..

Unit V

Introduction to Bioinformatics: Definition, objectives, biological databases, types (primary, secondary, composite) and examples(gene bank, prosite, swissport), principles of sequence similarity determinate FASTA and BLAST.

SCHEME OF PRACTICAL EXAMINATION

Practicals Based on Theory Papers.

Time: - 5hrs

Maximum Marks : 65

Minimum Marks : 24

Combined Practical

Marks

- | | |
|--|------|
| 1. Exercise in Microbiology | [10] |
| 2. Exercise in Immunology | [5] |
| 3. Exercise in Molecular Biology & Genetic Engineering | [10] |
| 4. Exercise in Environmental Biotechnology | [10] |
| 5. Exercise in Bioinformatics | [05] |
| 6. Spots (Five) | [10] |
| 7. Viva-voce | [05] |
| 8. Practical Record | [10] |

List of Practical Exercises

Exercises in Microbiology

1. General instructions for microbiology laboratory.
2. Study of construction, care and use of a compound microscope.
3. To demonstrate the importance of concept of asepsis and methods of sterilization.
4. Isolation of bacteria from the soil sample in Nutrient broth
5. To become familiar with preparation of bacterial smears for the microscopic visualization of bacteria.
6. To perform the monochrome staining for the given bacterial samples (*E. coli*, *Bacillus cereus*, *Staphylococcus aureus*) to compare morphological shapes and arrangement of bacterial cells using crystal violet stain.
7. To perform the Gram staining procedure for the given bacterial samples (*E.coli*, *Lactobacillus spp.*, *Rhizobium*) and to differentiate two groups of bacteria gram-positive and gram-negative.

Exercises in Immunology

1. Purification of antigens
2. Raising polyclonal antibodies
3. Purification of antibodies
4. Conjugation and labeling of antibodies
5. Enzyme linked immunoassay
6. Antigen-antibody reactions
7. Diagnosis of an infection diseases by an immunoassay

Exercises in Molecular Biology

1. Preparation of buffers
2. DNA isolation
3. Isolation plasmid
4. Agarose gel electrophoresis.
5. Quantification of DNA.
6. Working of instruments- Thermocycler, Transilluminator, Spectrophotometer, and Electrophoresis

Exercises in Genetic engineering

1. To perform restriction digestion of plant genomic DNA and its visualization.
2. To check the presence of insert in the recombinant plasmid.
4. Preparation of competent cells of *E. coli* (strain DH5 a) using CaCl₂ treatment.
5. Demonstration of polymerase chain reaction.
6. Preparation of protein samples for profiling on polyacrylamide gel.
7. Running of gel, staining, destaining and analysis of protein profiles using standard protein markers.

Exercises in Environmental Technology

1. Detection of coliforms for determination of the purity of potable water.
2. Determination of biological oxygen demand (BOD) of a sewage sample.
3. Determination of chemical oxygen demand (COD) of sewage sample.
4. Isolation of bacteria from various polluted sites (waste water, distillery waste) and their identification.
5. Isolation and identification of Mycorrhizal fungi from soil samples.
6. Isolation and identification of nitrogen fixing bacterium Rhizobium from root nodules.
7. Estimation of dissolved oxygen in water sample.
8. Estimation of chloride in water sample.

Exercises in Bioinformatics

1. Use of internet, Making slides using Power point, Plotting Graphs, Tables, Animation in slides, drug designing.

Spots:

Different Laboratory Instruments, Thermocycler, Transilluminator, Spectrophotometer, and Electrophoresis, Slides of Gram+ve rods, Gram-ve rods, Gram+ve cocci, Gram-ve cocci, Endospore; CTAB, Lyophilized sample, Cuvette, Taq DNA polymerase, LB Agar, Combs, Micropipette, pH electrode, Standard buffer, Eppendorff tube.

References :

1. Molecular Biology, Kumar H D
2. Genetic Engineering Principle and Methods, Setlow J. K. & Hollaender, Plenum Press, New York.
3. Molecular Biotechnology, Bernard R. Glick, Jack J. Pasternak, ASM Press, Washington DC
4. Microbiology, R. C. Dubey, D. K. Maheshwari, S. Chand & Company Ltd.
5. Microbiology, P. D. Sharma, Rastogi Publications
6. Cell and Molecular Biology, P. K. Gupta, Rastogi Publication
7. Genetic Engineering and its Applications, P. Joshi, Agrobios India
8. Environmental Biotechnology, Alan Scragg, Oxford University Press
9. Introduction to Environmental Biotechnology, A. K. Chatterji, Practice Hall Of India, 2005.
10. Biotechnology Expanding Horizons, B. D. Singh, Kalyani Publishers
11. Bioinformatics, Baxevanis Ouellette, Wiley-Less Publication
12. Advances in Biotechnology, Manjula K. Saxena and B.B.S.Kapoor, Madhupublications
13. Cell and Molecular Biology, E D de Roberties & E M F de Roberties (Jr) Lippincott Williams & Wilkins, Philadelphia
14. Microbiology, Michael J Pelczar (Jr) ESC Chan, N R Kreig, Tata McGraw Hill.
15. Immunology, Janis Kuby, W H Freeman and Company, USA
- 16.. Essential Immunology, Ivan Roitt, Blackwell Science Ltd.

10. B.SC. BIOTECHNOLOGY (VOCATIONAL) PART- III, 2019

Schemes	Duration	Max. Marks	Min. Marks
Paper I Animal Cell Culture & Biotechnology	3hrs	50	
Paper II Plant Tissue Culture & Biotechnology	3hrs	50	54
Paper III Industrial Biotechnology	3hrs	50	

SCHEME OF PRACTICAL EXAMINATION

Practicals Based on theory Papers

Time :- 5hrs

Maximum Marks :- 75

Minimum Marks :-27

Combined Practical

Marks

Q.1 Exercise in Animal Biotechnology	
(a) Major	[10]
(b) Minor	[05]
Q.2 Exercise Plant Tissue Culture	
(a) Major	[10]
(b) Minor	[05]
Q.3. Exercise in Industrial Biotechnology	
(a) Major	[10]
(b) Minor	[05]
Q.4. Spots (Five)	[15]
Q.5. Viva-voce	[05]
Q.6. Practical Record	[10]

PAPER - I ANIMAL CELL CULTURE & BIOTECHNOLOGY

Note : The paper is divided into five units. Two questions will be set from each unit. The candidates are required to attempt 5 questions in all, selecting one question from each unit. Each question will comprise of a, b, c, d and e parts of 1,1,2,2 and 4 marks respectively.

Unit I

History of development of cell cultures, equipment and materials for animal cell culture technology. Stimulating natural conditions for growing animal cells. Primary and established cell line cultures. Animal cell lines - their culturing and maintenance. Commonly used animal cell lines - their origin and characteristics.

Unit II

Introduction to balanced salt solution and simple growth medium. Brief discussion on the chemical, physical & metabolic functions of different constituents of culture medium. Serum and protein free defined media and their application. Primary culture anchorage dependence of growth, non anchorage dependent cells, secondary culture. Stem cell cultures.

Unit III

Biology and characterization of the cultured cells, measuring parameters of growth. Basic technique of mammalian cell culture in vitro, disaggregation of tissue and primary culture, maintenance of cell culture, cell separation. Growth factors promoting proliferation of animal cells: DGF (Derived Growth Factor), EGF (Epidermal Growth Factor), IL-1 (Interleukin-1), IL-2 (Interleukin-2), NGF (Nerve Growth Factor), Erythropoietin.

Unit IV

Organ culture, whole embryo culture, Histotypic culture, Cell synchronization, cell transformation, transfection of animal cells, selectable markers, HAT, selection, antibiotic resistance etc., cell fusion, differentiation of cultured cells, transplantation of cultured cells. Differentiation of cells, culture of animal mycoplasma.

Unit V

Apoptosis, measurement of cell. Application of animal cell culture for studies on gene expression, cell culture based vaccines, scaling-up of animal cell cultures and production of recombinant gene products. Growth kinetics of cells in culture, Cloning of cell lines, three-dimensional culture and tissue engineering (artificial skin and artificial cartilage), In vitro fertilization in humans, super ovulation, embryo transfer in humans and livestock.

PAPER - II PLANT TISSUE CULTURE & BIOTECHNOLOGY

Note : The paper is divided into five units. Two questions will be set from each unit. The candidates are required to attempt 5 questions in all, selecting one question from each unit. Each question will comprise of a, b, c, d and e parts of 1,1,2,2 and 4 marks respectively.

Unit I

History of Plant tissue culture, introduction to cell and tissue culture, terms and definitions. Tissue culture media, types (composition, preparation and role of different constituents). Role of growth regulators. Sterilization techniques, equipments. Initiation and maintenance of callus.

Unit II

Suspension culture, single cell culture, protoplast isolation, culture, fusion, Somatic hybridization, selection of hybrid cells and regeneration of hybrid plants, symmetric and asymmetric hybrids, cybrids.

Unit III

Anther/pollen culture for production of haploid and homozygous lines. Ovary, embryo, endosperm cultures for *in vitro* pollination and embryo rescue. Micropropagation, shoot tip and meristem culture, somatic embryogenesis, cryopreservation.

Unit IV

Secondary metabolites: Introduction, alkaloid production in plant tissue culture, cell selection for higher yield, optimized conditions for higher production. Biotransformation. Immobilization of cells, elicitors. Root formation using *A. rhizogenes*.

Unit V

Application of tissue culture in selection of variants / mutants, haploid cultures, in tumor formation in plants using *A. tumefaciens* (Monocot & dicot), genetic transformation. Transgenic Plants: techniques and practical application of genetic transformation. Ethical issues related to transgenic plants.

PAPER - III INDUSTRIAL BIOTECHNOLOGY

Note : The paper is divided into five units. Two questions will be set from each unit. The candidates are required to attempt 5 questions in all, selecting one question from each unit. Each question will comprise of a, b, c, d and e parts of 1,1,2,2 and 4 marks respectively.

Unit I

Introduction to industrial biotechnology, History and scope. Isolation and screening of microorganisms for industrial products. Strategies for Strain improvement (mutation, selection, recombination). Maintenance and Preservation of industrial microorganisms. Fermentation Technology: Basic principles of fermentation technology, Types of fermentation processes. Fermentation Medium, Formulation and sterilization of fermentation media.

Unit II

Kinetics of microbial growth and death. Fermentor: Basic design, operation control and applications. Types of fermentors (Stirred tank, airlift, photobioreactor). Downstream processing : extraction, separation, concentration, recovery & purification,

Unit III

Industrial production of organic acids (citric acid, acetic acid) amino acids (glutamic acid, lysine, tryptophane), solvents (ethanol, glycerol), vitamins (Vitamin C, A, B2, B12), antibiotics (penicillin, streptomycin, tetracycline), steroids and alkaloids.

Unit IV

Introduction to food technology: Basic concept and production of food products: Cheese, Yoghurt, SCP, Mushroom and beverages. Sterilization, pasteurization, canning and packaging of different food products.

Unit V

Commercial production of genetically engineered plants for resistance to insects, viruses, herbicides and pesticides and stress. Development of male sterile plants, synthetic seeds. Production of vaccines.

SCHEME OF PRACTICAL EXAMINATION

Practicals Based on theory Papers

	Time: - 5hrs	Maximum Marks: - 75	Minimum Marks: - 27
Q.1 Exercise in Animal Biotechnology			
(a) Major		[10]	
(b) Minor		[05]	
Q.2 Exercise Plant Tissue Culture			
(a) Major		[10]	
(b) Minor		[05]	
Q.3. Exercise in Industrial Biotechnology			
(a) Major		[10]	
(b) Minor		[05]	
Q.4. Spots (Five)		[15]	

Q.5. Viva-voce
Q.6. Practical Record

[05]
[10]

List of Practical Exercises

Exercises in Animal Biotechnology

Major

1. Preparation of media for animal cell culture (Undefined media: Chick embryo extract, chick plasma, chick serum).
2. In vitro animal cell culture.
3. Fusion of cells by polyethylene glycol (PEG).
4. Culture of lymphocytes from blood samples.
5. Preparation of single cell suspension from spleen and thymus.
6. Preparation of Hank's Balanced Salt Solution (BSS).
7. Culture of animal cells (embryo cells) on undefined media.

Minor

1. Acquaintance with tissue culture laboratory.
2. Washing and cleaning of glass wares.
3. Sterilization of glassware by moist air.
4. Sterilization by dry heat method.
5. Observation of various developing stages of chick embryo.

Exercises in Plant Tissue Culture

Major

1. Sterilization of plant material.
2. Preparation of aseptic plant.
3. Anther culture on M.S. media under aseptic condition.
4. Shoot apical meristem culture for obtaining virus free plants.
5. Principle and working of various instrument used in plant tissue culture.
6. Methodology and preparation of M S media containing various plant growth regulators of different concentrations.
7. Preparation of cell suspension culture and determination of cell count by Haemocytometer.
8. Test of cell viability in cell suspension culture.

Minor

1. *In vitro* seed germination.
2. Preparation of various types of explants from the aseptically raised seedling.
3. Methodology and preparation and sterilization of nodal explant for establishment of culture.
4. To study the characteristics of callus on the basis of following parameters:
 - (i) Colour and texture
 - (ii) Packed and volume
 - (iii) Fresh weight and dry weight
 - (iv) Cell viability test
5. Preliminary tests of secondary metabolites.
6. Inoculation technique

Exercises in Industrial Biotechnology

Major

1. Isolation of industrially important microorganisms for microbial processes.
2. To test the production of enzymes: Amylase, proteinases, lipases and celluloses by microorganisms.
3. Demonstration of citric acid production by *Aspergillus niger*, *Penicillium citrianum*.
4. Demonstration of production of antibiotics (penicillin) by microbes.
5. Isolation of pure cultures of Industrial microorganism.
6. Preparation of niacin by lactic acid bacteria.
7. Demonstration of fermenters.

Minor

1. Preparation of Yoghurt by lactic acid bacteria.
2. To study general methods of food preservation (e.g. Temperature, Salt, Moisture).
3. Testing of milk by MBRT.
4. Turbidity test for milk.
5. Test for pasteurization of milk.
6. Coliform test for milk.
7. Culture preservation.
8. Study of food-spoilage microorganisms in fresh, canned, fermented food and meat.

Spots

Slides of Microorganisms, Organized Culture, Callus Culture, Steroids, Laminar flow, Fermenters Homozygous lines, Effect of hormones on organogenesis (Auxins & Kinetins).

References

1. Plant Cell and Tissue Culture, Narayanaswami, Tata Mc Graw Hill
2. Plant Biotechnology, K. G. Ramawat, S. Chand and Company Ltd.
3. Introduction to Plant Biotechnology, H. S. Chowla, Oxford and IBH Publishing Co. Pvt. Ltd.
4. Animal Biotechnology, M. M. Ranga, Agrobios India.
5. Animal Cell Culture, John R. W. Masters, Oxford University Press
6. Culture of Animal Cell - A Manual of Basic Techniques, Freshney, Wiley-Liss Publication
7. Industrial Biotechnology, G. Read, Presscott and Dunns, Chapman and Hall
8. Industrial Microbiology, L. E. Casida, John Wiley and Sons Inc.
9. Principles of Fermentation Technology, A. Whitaker, Second Edition, Butterworth-Heinemann.
10. Industrial Microbiology, A. H. Patel, Macmillan India Ltd.
11. Advances in Biotechnology, Manjula K. Saxena and B.B.S.Kapoor, Madhupublicationss
11. Biotechnology Expanding Horizons, B. D. Singh, Kalyani Publishers