

1. Genetic Engineering Principle and Methods, Setlow J. K. & Hollaender, Plenum Press, New York.
2. Biochemistry, Donald Voet, Judith 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

PAPER – V CELL AND TISSUE CULTURE

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 and History of Plant Tissue Culture: Tissue culture media, composition and preparation - Balance salt solution, simple growth medium, chemical, physical & metabolic function of different constituent of culture media. Callus culture & Suspension culture- Initiation and maintenance. Single cell clones, somaclonal variation, somatic embryogenesis. In vitro pollination: Embryo culture & embryo rescue. endosperm culture, Anther/Pollen culture: Production of haploid plants and homozygous lines.

Unit II

Clonal propagation (Micropropagation): Establishment of whole plant in soil, methods of micropropagation. Applications: Forestry, floriculture, agriculture, conservation of biodiversity and threatened plant species. Cryopreservation: Germplasm conservation, protoplast- Isolation, culture, fusion cybrids, selection of hybrid cells and regeneration of hybrid plants, symmetric and asymmetric hybrids.

Unit III

Natural products (Secondary products): Introduction. Alkaloids production in plant tissue cultures, optimization for growth and production, time course of production, selection of cells for higher yields, extraction of alkaloids / steroids. Commercially used plant alkaloids and steroids. Cloning, mechanism of production. Production of useful metabolites: Biotransformation, immobilization of cells, elicitors, hairy root culture.

Unit IV

Application of plant tissue culture in plant pathology: Development of virus free plants, growth of obligate parasite in culture, development of disease resistance, screening of germplasm. Application of biotechnology in breeding and crop improvement., somatoclonal and gametoclonal variant selection. Gene transfer and transgenic plants. Ethical issues related to transgenic plants. RFLP, AFLP, RAPD and other Molecular markers.

Unit V

Introduction to salt solution and simple growth medium, biology of culture cells, measuring parameters of growth. Basic technique of mammalian cell culture in vitro: Organ and Histotypic culture. Microcarrier culture, cell synchronization and cell culture. Application of animal culture. Animal cloning and transgenic animals. Hybridoma Technology and monoclonal bodies.

PAPER - VI ENVIRONMENTAL BIOTECHNOLOGY

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

Global environmental problems, their impact and biotechnological approaches for management: Ozone depletion, UV-B, green house effect and acid rain. Water pollution and its biological control: Water as natural resource, need for water management, sources of water pollution.

Unit II

Biological treatment processes: Water supply treatment, waste water collection, preparing potable water, removal of microbial contaminants. Aerobic treatment processes - Activated sludge, oxidation ditches, ponds, trickling filter, towers, rotating disc, rotating drums. Anaerobic treatment processes - Anaerobic digestion & anaerobic filters. Treatment schemes for waste waters of - Dairy, distillery, sugar industries & antibiotic industries.

Unit III

Scope, application & concept of cleaner technology. Solid wastes: Sources safety and management (ensilage, composting, vermiculture and biogas production). General hazardous waste, radioactive and other hazardous waste, bioscrubbing heavy metals and organic pollutant (Bioaccumulation, Biosorption).

Unit IV

Application of microbes as biofertilizers and bioinsecticides: for productivity improvement and crop protection, principles of biomonitoring and application of biosensors for detection of environmental pollutants. Biomining: Use of microbes in biohydrometallurgy and biomineralization, degradation of pesticides and other xenobiotics, genetic regulation of xenobiotic biodegradation, phytoremediation of disturbed ecosystems.

Unit V

Use and development of GEM for bioremediation, development of gene probes for environmental remediation & releasing and tracing GEMS.

Emerging technologies or environmental bioremediation: Microelectromechanical system (MEMs), genosensor technology, gene probes - nah operon, integrated treatment system with special reference to biodegradation of polychlorinated biophenyls (PCBs), PCB treatment process and design.

PAPER - VII BIOSTATISTICS, BIOINFORMATICS & COMPUTER APPLICATIONS

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

Computer and their organization: Hardware, software, firmware and firmware. Introduction to M.S. office (word, powerpoint and excel), Introduction to data structure and database concepts, introduction to internet and its application. Computer aided learning (CAL) in Biotechnology, fermentation technology, imaging, simulation and mathematical modeling. Computer oriented statistical techniques: Frequency table of single discrete variable, bubble sort.

Unit II

Biostatistics: population and sample. Statistical inference, Types of data, screening and representation of data. Measures of central tendency-Mean, mode, median, variance standard deviation, correlation coefficient and t-test, probability: definition and properties of binomial poison and normal distributions. Random sampling, selection of simple random samples from a finite population, definition of sampling distribution, sampling variance and standard error. Idea of two types of errors and level of significance, test of significance, χ^2 test of independence and homogeneity test based on Z and T statistics.

Unit III

Standard curves, correlation, testing significance of correlation coefficient. Statistical basis of biological assays. Response - dose metameter - Dilution assays. Direct and indirect assays. Quantal responses. Probit, logit, LD 50, ED 50, PD 50 standard line interpolation assay. Parallel line assay (4point, 6point assays), stope ratio assay. Statistical modeling. Ordination techniques and their uses. Resource utilization models.

Unit IV

Bioinformatics: Introduction, objectives, bioinformatics and data analysis. Data base concept, Biological, microbiological and virology databases, cell gene banks related sites, biodiversity information databases. Genome analysis. DNA / Genome sequencing. Finding and retrieving sequences. Sequence data base. Protein and nucleic acid sequence database. Structural database. Identifying protein sequence from DNA sequence.

Unit V

Phylogenetic analysis: prediction method using protein and nucleic acid sequences. Computer tools for sequence analysis. Finding and retrieving sequences. Introduction to sequence alignment . Alignment of pairs of sequences. Multiple sequence alignments. Homology algorithms (BLAST, FASTA) for proteins and nucleic acids. Optimal alignment methods. Substitution scores and gap penalties. Annotations of genes. DNA and Protein micro array. Analysis of single nucleotide polymorphism using DNA chips. Proteome analysis: Two dimensional separation of total cellular proteins, isolation and sequence analysis of individual protein spots by mass spectroscopy.

PAPER - VIII INDUSTRIAL BIOTECHNOLOGY

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

Isolation, preservation and maintenance of industrial microorganisms, microbial growth kinetics, media for industrial fermentation, media sterilization. Fermentation, Types of fermentation, Bioreactors : Design, operation and control, Types (batch, fed-batch, continuous bioreactor pulse, fluidized and photobioreactors). Downstream processing (Recovery of microbial cells, cell disruption. Chromatography, membrane processes, drying and crystallization), whole cell immobilization and industrial applications.

Unit II

Industrial production of alcohol (ethanol), Alcoholic beverages: Beer, wine and whisky. acids (citric acid and gluconic acid), solvents (glycerol, acetone, butanol), antibiotics (Pencillin, Streptomycin, Tetracycline), amino acids (Lysine, Glutamic acid), steroids, hormones and vaccines. Introduction to food technology: food preservation (drying, freezing, sterilization, pasteurization and irradiation of food products. Elementary idea of canning and packing, Production of mushroom, yoghurt, cheese, single cell protein and single cell oil

Unit III

In vitro approaches to genetic manipulation of plants. Application of plant protoplast culture in somatic hybridization and cybridization. Current status and commercial opportunities for genetically engineered plants for: Insect tolerance, virus tolerance, herbicide tolerance, pesticide tolerance, stress tolerance, Improvement of crop yield and quality, Development of male sterile plants.

Unit IV

Synthetic seeds: Progress and potential. Scaling up production and automation in plant propagation. Use of robotics in plant production. Mass scale plant production , molecular farming, benefits and risks; Principles of green chemical biotechnology, green synthesis, green extraction, green reactors and green technology for the production of Biomolecules, edible vaccines.

Unit V

Hardening and acclimatization: Success and bottle necks, Green house and green home technology, green house management and operations, quality control, packaging and shipment, cost benefit analysis. Global market, commercial opportunities in plant tissue culture with special reference to plant tissue culture industries in India.

M. SC. FINAL BIOTECHNOLOGY Scheme of Practical Examination

Combined Practical Exam Based on Theory papers

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

Min. Marks 54

- | | |
|----------------------------------------------------------------------|------|
| 1- Experiment in Cell and tissue culture | |
| (a) Major | (15) |
| (b) Minor | (10) |
| 2- Experiment in Industrial biotechnology | |
| (a) Major | (15) |
| (b) Minor | (10) |
| 3- Exercise in Environment biotechnology | |
| (a) Major | (15) |
| (b) Minor | (10) |
| 4- Exercise in Biostatistics, Bioinformatics & Computer Applications | |
| (a) Biostatistics problem | (15) |
| (b) Computer exercise | (10) |
| 5. Spots (5) | (10) |

6- Viva-voce	(10)
7- Project Report	(20)
8- Practical Record	(10)

Practical Exercises
Experiments in Cell and Tissue culture

Major

1. Initiation & maintenance of callus.
2. Cyto differentiation of tracheary elements in cultured explants.
3. Identification of secondary metabolites by TLC
4. Anther Pollen culture
5. Isolation, Purification & culture of protoplast
6. Somatic embryoids from vegetative cells of mature plants/ hypocotyl & Cotyledons of embryo.
7. Micro-propagation with shoot apex cultures.
8. Embryo development: Chick developmental stages and Gastrulation.

Minor

1. Basic Knowledge of a Tissue Culture Laboratory
2. Preparation of Murashige and Skoog (MS) stock solutions
3. Preparation of M.S. medium
4. Measurement of growth/ differentiation in plant tissue culture by fresh weight & dry weight.
5. Determination of mitotic index (MI) in callus/ suspension cultures.
6. Preparation of different solutions of Plant Growth Regulators

Exercises in Industrial Biotechnology

Major

1. Yogurt preparation using suitable bacterial isolates /dairy starter culture
2. Microbiological quality of given food item.
3. Production of spawn from button mushroom.
4. Cultivation of mushroom.
5. Production of Lactic acid.
6. Antimicrobial activity of tissue extracts against gram+ & gram- bacteria.
7. Production of single cell proteins from algae.
8. Demonstration of production of antibiotics (penicillin) by microbes.
9. Production of pectinase by *Aspergillus niger* using wheat bran coffee pulp using small scale fermenter and its assay.
10. Production of α amylase using *Aspergillus oryzae*/ *Bacillus licheniformis* using bran in small scale solid state fermentation and its assay.
11. Production of microbial polysaccharides and yield estimation.

Minor

1. Quality test of given milk sample by standard plate count method
2. Determination of quality of milk sample by methylene blue reductase test.
3. Role of Yeast in Bread making.
4. Production of curd from microorganisms.
5. To study general methods of food preservation (e.g. Temperature, Salt, Moisture).
6. Study of food-spoilage microorganisms in fresh, canned, fermented food and meat.

Exercises in Environmental Biotechnology

Major

1. Chloride content of water samples using arginometric method.
2. Estimation of dissolved oxygen and BOD in water & wastewater.
3. Determination of MPN in wastewater.
4. Determination of chemical oxygen demand (COD) of sewage sample.
5. Study on biogenic methane production in different habitats.
6. Test of heavy metals (Zn, Cu, Pb) tolerance in some identified bacteria.
7. Isolation of bacteria from various polluted sites (waste water, distillery waste) and their identification.

Minor

1. Sampling of water (Dussart flask water sampler)
2. pH of water using pH meter
3. Acidity/alkalinity of water samples.
4. Vam staining
5. Detection of coliforms for determination of the purity of potable water.
6. Baculovirus stock- preparation and titration using plaque colony.
7. Demonstration of methods for waste water treatment.
8. Standardization of pH medium
9. pH of soil using pH meter

Exercises in Biostatistics, Bioinformatics & Computer applications

1. Bar graph of growth index from given data.
2. Biostatistics problems based on Mean, Mode, Median, Standard deviation, Variance, t-test, Chi square test.
3. Introduction to M.S. office (Software covering M.S. word, M.S. Excel, M.S. Power point animation technique).
4. Corel draw
5. Use of internet.

Spots based on: Laboratory instruments, Microscopes and Techniques

Project Report: Submission of a Project report based on visit to Research Centre/Institution/ Industry

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. Plant Cell and Tissue Culture, Narayanaswami, Tata Mc Graw Hill
6. Plant Biotechnology, K. G. Ramawat, S. Chand and Company Ltd.
7. Animal Biotechnology, M. M. Ranga, Agrobios India.
8. Industrial Biotechnology, G. Read, Presscott and Dunns, Chapman and Hall
9. Environmental Biotechnology, Alan Scragg, Oxford University Press
10. Introduction to Environmental Biotechnology, A. K. Chatterji, Practice Hall Of India.
11. Biotechnology Expanding Horizons, B. D. Singh, Kalyani Publishers
12. Bioinformatics, Baxevanis Ouellette, Wiley-Less Publication
13. Introduction to Informatics, Attwood, Parrt, Smith, Pearson Education
14. Westhead, Parish and Tuxjman, Instant Notes in Bioinformatics, Viva Book Pvt Ltd
15. Advances in Biotechnology, Manjula K Saxena and B.B.S.Kapoor, Madhu publications
16. An Introduction to Computational Biochemistry, Tsai, C. Stan, John Wiley & Sons
17. Industrial Biotechnology, Shekar
18. Elements of Biotechnology, P. K. Gupta, Rastogi & Company

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