M.Sc.- Biotechnology
Exam.-2017

UNIVERSITY OF KOTA
MBS Marg, Swami Vivekanand Nagar,
Kota - 324 005, Rajasthan, India
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University of Kota, Kota

M.Sc. (P/F) Biotechnology-2017

Eligibility: B.Sc. under the 10+2+3 scheme with Chemistry, Zoology, Botany/Microbiology/Biotechnology/Medicine/Pharmacy/Agriculture with a minimum of 50 % marks.

(45% for candidates belonging to the reserved category SC/ST/OBC)

Selection: Common Entrance Test to be conducted by Scheme of Examination and Courses of Study

1. The number of papers and the maximum marks for each paper/practical are shown in the syllabus. It will be-necessary for a candidates to pass in the theory part as well as in the practical part (wherever prescribed) separately.
2. 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(s) / 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 not withstanding 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 Examinations taken together, as noted below:

   First Division 60% On the aggregate mark taken together in the Prev. & Final Exam.
   Second Division 48%
3. 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 paper(s)/Practical(s) are cleared after the expiry of the aforesaid period of three years; provided that in case where a candidate requires more than 25% marks in order to reach the minimum aggregate as many marks out of those actually secured by him will be taken into account as would enable him to make up the deficiency in the requisite minimum aggregate.
4. A total of eight theory papers (3 hours duration each) are prescribed (4 in previous and 4 in final).A combined Practical Examination (10 hrs. duration in two days) shall be conducted each year. Paper setter shall be asked to set total 9 questions for each theory paper (which have been divided into three sections) or 10 questions for each theory paper (which have no sections) out of which the examinee shall be asked to attempt any five questions. The list of papers is as below:

1. 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)

   A candidate may be allowed grace marks in only one theory papers up to the extent of 1 % of the total marks prescribed for that examination.

Teaching and Examination Scheme for
M. Sc. (Previous) Biotechnology, 2014

A.	**Theory Papers**		**Max. Marks**
1.	Biochemistry & Enzyme Technology		100
2.	Biophysics & Bioelectronics		100
3.	Concepts of Microbiology & Immunology		100
4.	Molecular Biology & Genetic Engineering		100
	Combined Practical		200
	a. Major Exercise (2) 30 marks each	60	
	b. Minor Exercise (2) 15 marks each	30	
	c. Preparation (Slide/Mounting)	10	
	d. Spotting (4) 05 marks each	20	
	e. Project work (Experimental Study/Review)	30	
	f. Record	20	
	g. Viva-voce	30	
	Total		**600**

Teaching and Examination Scheme for
M.Sc. (Final) Biotechnology, 2016

B.	**Theory Papers**	**Max. Marks**	
5.	Cell and Tissue Culture		100
6.	Environmental Biotechnology		100
7.	Biostatistics, Bioinformatics & Computer Application		100
8.	Industrial Biotechnology		100
9.	Combined Practical		200
	a. Major Exercise (2) 30 marks each	60	
	b. Minor Exercise (2) 15 marks each	30	
	c. Preparation (Slide/Mounting)	10	
	d. Spotting (4) 05 marks each	20	
	e. Project work (Experimental Study/Review)	30	
	f. Record	20	
	g. Viva-voce	30	
	Total		**600**

M. Sc. Previous Biotechnology Exam - 2017

Paper -I Biochemistry & Enzyme Technology

Min. Pass Marks: 36 **Duration: 3 Hours** **Max. Marks: 100**

Note: Attempt any five questions, taking atleast one question from each unit. Each question carries equal marks.

Unit- I

Biochemical evolution: Chemogeny, Biogeny and evolution of chromosome. Organisation and genetic regulatory mechanism, time factor in evolution. Evolution of enzyme systems.

Amino Acids and Peptides: Structure, Function, methods of characterisation, Separation techniques based on their structure and properties, Biosynthesis.Nucleic Acids: Nucleic acids and Polynucleotides, Classification, Structure, Function, Separation and Characterization techniques.

Unit- II

Carbohydrates: Mono and Polysaccharides, Classification, Structure, Function, Separation and Characterization techniques, Biosynthesis. Vitamins, Micro and Macro-Nutrients: Classification. Structure, Function, Separation and Characterization techniques. Catabolism and the Generation of Chemical Energy.

Unit- III

Metabolic Strategies : General principles of intermediary metabolism. Regulation of pathways, Strategies for pathway analysis. Lipids: Classification, Structure, Function, Separation and characterization techniques. Metabolism of Fatty Acids: Fatty acid degradation, Biosynthesis of saturated fatty acids, Regulation of fatty acid metabolism.

Unit- IV

Glycolysis, Gluconeogenesis and the Pentose Phosphate Pathway and Regulation . Tricarboxylic Acid Cycle: Steps in TCA cycle, Aspects of TCA cycle reaction, ATP stoichiometry of TCA cycle, Thermodynamics of TCA cycle, Amphibolic nature of TCA cycle, oxidation of other substrates by TCA cycle, Regulation of TCA cycle activity.

Unit-V

Enzymes: Classification. Nomenclature .and General Properties of Enzymes, Effects of substrate, Temperature, pH and inhibitors on enzyme activity. Enzyme Isolation, Purification and Large scale Production. Mechanism of Enzyme Action and Regulation: Active and regulatory sites, Chemical Modification. General Mechanistic Principles, feed back inhibition. Isozymes, Enzyme Activation. Zymogens, Multi-Enzymes complexes and multifunctional enzymes. Steady State Kinetics: Methods of estimation of rate of enzyme catalysed reaction with special reference to Michaelis-Menton Kinetics.

Reference Books:

1. Biochemistry Ed Lubert Stryer. W.H. Freeman and Company, New York.
2. Principles of Biochemistry. Ed Lehninger, Nelson and Cox. CBS publishers and distributors.
3. Harper's Biochemistry. Ed. R.K. Murray, D.K. Granner, P.A. Mayes and V.W. Rodwell. Appleton and Lange, Stanford, Connecticut.
4. Textbook of Biochemistry with Clinical Correlations. Ed. Thomas M. Devlin.Wiley-Liss Publishers
5. Principles and techniques of practical biochemistry. Ed Keith Wilson and John Walker. Cambridge University Press.
6. Biochemistry. Ed Donald Voet and Judith G. Voet. John Wiley & sons, Inc

Paper II Biophysics and Bioelectronics

Min. Pass Marks: 36 **Duration: 3 Hours** **Max. Marks: 100**

Note: Attempt any five questions, taking atleast one question from each unit. Each question carries equal marks.

Unit- I

Bioenergetics: Basic bioenergetics. Cellular bioenergetics, whole body bioenergetics. Entropy. Gibbs free energy. Bioenergetic pathways. Bioenergetics and biocommunication. Control of bioenergetics.

Molecular interactions: Molecular interactions of primary importance. Strong and weak interactions. Biomolecular interactions- DNA protein interactions, Elementary account of DNA drug interaction. Molecular interaction forces-intermolecular and intramolecular forces. Attractive and repulsive forces generated within molecules and their overall effect on molecular interactions.

Unit- II

Sensory receptors: Common senses. Classification of sense organs- nature, stimulus or location . General properties of sensory receptors. Sense detection. Mechanorecetion, Chemoreception, Photoreception, Thermoreception.

Photoreceptors: Types of photoreceptors in plants and animals. Human vision and colour perception.Comparison of human vision and machine vision. Causes and control of vision loss. Eye chip vision sensors and Dobelle artificial vision system.

Phonoreceptors: Types of phonoreceptors in animals. Human ear and auditory function. Resonance theory and Telephone theory. Causes and control of hearing loss.Hearing aids and their basic components.

Unit- III

Methods to elucidate structure and biochemical compounds found in living organisms- Centrifugation, Electrophoresis, Tracer techniques, autoradiography, Chromatography (Paper, Thin layer and column chromatography), Spectrophotometry (UV, VIS, IR, NMR and ESR), Electron microscopy (TEM,SEM)
X- ray diffraction.

Unit- IV

DNA fingerprinting:. Principle of DNA fingerprinting, technique for DNA fingerprinting, Uses of DNA fingerprints- disorder diagnosis, establish paternity and personal identification.

Chemical fingerprinting: Basic problems in chemical finger printing of plants. State of the art in the finger printing of plants- Lichens, mosses.

Bioelectronics: Biological sensing. Biological manipulation of Cellular engineering. Biologically inspired computing.Importance of bioelectronics technology and future of Bioelectronics.

Unit-V

Biosensors: Bioreceptors and transducers. Transducers used. Need for biosensors. Considerations in biosensor development. Requirement for biosensors. Application of biosensors-health care, industrial process control, military application ,environmental monitoring and future prospects.

Biochip: Biochip principle. Microfluidic chips; silicon chips and biochips; Molecular chips. Biocomputers: What is biocomputing. Genetic discrimination and biocomputing. Sound and image processing with optical biocomputers. Future of Biocomputer.

Reference Books:

1.Introduction to Electron Microscopy - S. Wischnitzer.
2. Electron Microscopy in Biology - J.R.Harris (ed.).
3.Biophysics by R.N.ROY
4. Biophysics - V. Pattabhi & N. Gautham (Narosa, New Delhi).
5.Fundamentals of Molecular Spectroscopy - C.N. Banwell, (Tata-McGraw Hill)
6.Biological Spectroscopy- I.D. Cambell & R.A. Durk, (Benjamin Cummings)
7. Physical Biochemistry - D. Freifelder (W.H. Freeman & Co.)
8.Physical Biochemistry - K.E. Van Holde (Prentice Hall)
9. Biophysical Chemistry, Vol.II - C.R. Cantor & P.R. Schimmel, (W.H. Freeman &Co.)

Paper III Concept of Microbiology & Immunology

Min. Pass Marks: 36 **Duration: 3 Hours** **Max. Marks: 100**

Note: Attempt any five questions, taking atleast one question from each unit. Each question carries equal marks.

Unit-I

Introduction to microbiology-scope and history

Physical and chemical methods of sterilization.Culture media and methods of their preparation.

Ultrastructure, Broad classification, isolation, cultivation and uses in agriculture, industry and environment of fungi, algae, protozoa, bacteria and prions. Elementary account of most common diseases caused by microorganisms in human (Typhoid, Tuberculosis, Diptheria, Polio, Hepatitis, Malaria, Amoebiasis), animals (Fowl pox, brucellosis, Rinderpest, Foot and mouth disease of cattle and rabies) and plants (citrus canker,TMV,potato mosaic, green ear disease)

Unit-II

Role of microbes in carbon, Nitrogen, Phosphorus and Sulphur cycle in nature and the biochemistry of these conversions. Viruses: History, classification, phylogeny, chemical and physical characteristics,virus isolation, purification, cultivation and replication, serology and plaque assay. Microscopy: Simple, Light and compound microscopes dark field, fluorescence and electron (TEM and SEM) microscopy-their principles and applications.

Unit-III

Immune system: Innate and acquired immunity. Clonal nature of immune response. Nature of antigens and super antigens. Antibody structure and function. Antigen-Antibody Interaction:-Precipitation reaction, Immunoelectrophoresis, Immunofluorescence, Agglutination, Radioimmunoassay, ELISA. Cells of Immune System: Hematopoiesis and differentiation, Lymphocytes trafficking, B and T Lymphocytes, Natural killer cells, Mononuclear phagocytes, Granulocytic cells.

Unit-IV

Major Histocompatibility Complex: General structure and function of MHC class I & class II , MHC restriction . Complement: The complement components, function, complement activation-Classical, Alternate and lectin pathways (characteristics & functions) and its biological consequences.

Regulation of Immune response: Antigen processing and presentation, generation of humoral and Cell mediated immune response, Activation of B and T lymphocytes. Cytokinin and their role in immunoregulation.

Unit-V

Hypersensitive reactions :Type I, II, III and delayed type (DTH). Cell-mediated Cytotoxicity: Mechanism of T cell and NK cell mediated lysis. Antibody dependent cell mediated cytotoxicity, macrophage mediated cytotoxicity,Transplantation. Tumour immunology. AIDS and other Immunodeficiency Diseases.Hybridoma technology and Monoclonal Antibodies.

Reference Books:

1. Microbiology - M.J.Pelczar, E.C.S.Chan & N.R.Kreig (Tata McGraw Hill)
2. General Microbiology - R.Y.Stanier, J.L.Ingraham, M.L.Wheelis & P.R.Painter (McMillan)
3. Microbiology - L.M.Prescott, J.P.Harley & D.A.Klein (Mcgraw Hill)
4. Fundamental Principles of Bacteriology - A.J. Salle (TATA McGRAW-HILL)
5. Virology - R. Dulbecco and H.S.Gensberg
6. Molecular Biology - D. Freifelder (Narosa Publishing House)
7. Microbiology - Schaum Series
8. Immunology - Goldsby-Kindt-Osborne –Kuby, W.H Freeman & Co.
9. Cellular and Molecular Immunology - Abbas-Lichtman-Pober, W.B SAUDERS
10.Immunology - Roitt
11. Immunology and Immunotechnology - A.K Chakraborty, Oxford University Press, 2006

Paper IV Molecular Biology and Genetic Engineering

Min. Pass Marks: 36 **Duration 3 hrs.** **Max. Marks: 100**

Note: Attempt any five questions, taking atleast one question from each unit. Each question carries equal marks.

Unit- I

Genetic Material: Structure, Chemical composition and organization of DNA. DNA super coiling, Different forms of DNA, artificial chromosomes (BAC, YAC, HAC). Repetitive DNA and satellite DNA. experimental proof of DNA as genetic material.

DNA Replication – Mechanism of Replication, Initiation, Elongation and Termination, Enzymology of Replication.

DNA Repair –Types of DNA damage, Types of DNA Repair. Mutation- Types and various Mutagens.

Unit- II

Molecular Genetics -DNA Recombination- Holliday Model, Site specific Recombination. Transposons – Transposable Elements, classification of Transposons, examples in Eukaryotes.Transcription – Mechanism in Prokaryotes and Eukaryotic Post Transcriptional Modification , Modifications in RNA - 5'-cap Formation, 3' end Processing and Polyadenylation, Ribozymes.

Unit- III

Gene Regulation – Prokaryotic Gene Regulatory Mechanism; Operon Concept: Lac and Trp operons. Gene Regulation in Eukaryotes – Attenuation control, Regulation by DNA Methylation, Transcription Factors, Enhancer Element.

Genetic Code – Salient Features and Wobble Hypothesis, Initiation and Termination Codon.

Proteins Synthesis: Mechanism in Prokaryotes – Translation:- initiation, elongination, Termination.

Unit- IV

Basic principles of genetic engineering. Scope of genetic engineering. Basic tools: restriction and modifying enzymes, Gene cloning vectors:Plasmids, Bacteriophages, Phagmids, Cosmids.

Recombinant screening and selection–markers, nucleic acid hybridizations: colony, plaque, dot blot, southern, northern and western blotting. cDNA and genomic libraries.

Unit- V

DNA sequencing techniques, Sanger- Coulson method, Maxam Gilbert method. PCR -steps, Types of PCR and its applications. Transgenic and gene Knockout technologies, Gene therapy: Vectors and gene delivery, Biosafety: Introduction, General Concerns, Hazards of environmental engineering, Biosafety Guidelines and regulations. Patent Guidelines and regulations.

Reference Books:

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

PRACTICALS

Min. Marks: 72 Duration: 10 Hrs. (2 days) Max Marks: 200

1. pH meter: Buffering capacity of a buffer, indicators. To determine the pKa value and hence the dissociation constant of a given acid by using pH meter.
2. Colorimetry: To determine the association constant of a. given indicator colorimetrically and to prepare the buffer solutions in pH range of 2.2 to 8.0.
3. Potentiometry : Redox potential of Fe^{+2} and Fe^{+3}.
4. Viscometry:
   (a) Radius determination: Glycerol molecule
   (b) Molecular weight determination - Proteins and DNA
5. Spectrophotometry: To find out absorption spectrum of given chromophore and /or oxidised and reduced forms (sodium nitrate and borohydrate).
   (a) Haemoglobin and Methaemoglobin
   (h) NAD and NADH
6. Double beam and recording spectrophometry, Derivatives and difference spectra Indicators, cytochromes, haemoglobin.
7. Estimation of protein: Lowry, Biuret and Bradford methods, standard curves, linear regression and assessment of ranges and reliability.
8. Enzyme assays (LDH, beta galactosidase, acid phosphate, arginase, succinic dehydrogenase) Time, Temperature, Protein concentration, cofactors. LDH: K_m and V_{max} various kinetic plots: Use of computer packages for parametric and non-parametric methods and non-linear regression.
9. Protein purification: Amonium sulphate, acetone, TCA pptn. dialysis, concentration.
10. Thin layer chromatography: lipids, mixture of dyes.
11. Chlorophyl estimation: spectrum and turbidity correction in chloroplasts.
12. Polyacrylamide gel electrophoresis of proteins.
13. Microscopy: a) simple, compound, phase contrast b) Micrometry: Calibration of stage and. ocular micrometer and measurement of the given biological sample c) Haemocytometer d) Photography and videotaping (motility, morphometry).
14. Subcellular fractionation: a) Isolation: chloroplast, mitochondria, nuclei etc. b) Centrifugation: differential, density gradient (sucrose. $CsCl_2$), c) Spectrophotometer: absorption spectrum, activity of the fraction of 260/280 ratio etc.
15. Endonuclease digestion of nuclei and analysis of thc DNA fragments by agarose electrophoresis.
16. Thermal melting of DNA.
17. DNA: a) Isolation of DNA (nuclear and Mt) b) Agarose gel electrophoresis
    c) Detection of DNA modifications: d) Restriction endonuclease digestions and separation of fragments by gel chromatography and density gradient centrifugation e) Base composition analysis of DNA.
18. To find out the capacity and nature of the given ion- exchange resin (Ion Exchange Chromtography).
19. Gel filtration chromatography.
20. DEAE cellulose chromatography of DNA.
21. 2-D gel electrophoresis of proteins and isolectrofocusing.
22. Study of sex linked gene inheritance. Estimating gene frequencies in human population, estimation of heterozygotes frequencies. Isolation / identification of auxotroph mutants in bacteria, recombination in Bacteria. Pedegree analysis, analysis of human karyotes, chromosomal aberrations.
23. Micronucleus test for detecting genotoxins.
24. AME's test for screening genotoxins.
25. Isolation of plasmid DNA - i) minipreparation ii) large scale isolation.
26. DNA ligation, transformation of E.coli.
27. Chararterisation of transformants: DNA gel electrophoresis, blotting and hybridization with labelled DNA probes (Southern Blot) Techniques .
    a) DNA blotting technique b) DNA hybridization.
28. Isolation of cytoplasmic RNA. Electrophoresis of RNA on denaturing gels. Northern blot techniques. In situ detection of RNA in embryos / tissue.
29. Separation of poly A tRNA on oligo-dt columns.

30. cDNA synthesis and cloning.
31. Sequencing and computer analysis.
32. PCR/RFLP technique.
33. In-vitro translation.
34. Cleanliness, media preparation, sterilization, culture methods, dilution techniques in microbiology.
35. Staining techniques in microbiology i) simple staining ii) negative staining iii) Differential staining iv) spore staining v) capsule staining and identification.
36. Isolation of pure culture. Culture: characteristics of microbes.
37. Bacterial growth curve-serial dilution, plating and turbidity measurement.
38. Competent cell preparation. Replica plating, Isolation of auxotrophic mutants in bacteria, recombination in bacteria.
39. Isolation and purification of bacterial DNA. Extracellular enzymatic activities of microbes.
40. Standard qualitative analysis of water (microorganisms).
41. Antibiotic sensitivity test, LD_{50}, Potency of drug/antibiotics and biotransformation.
42. Identification of unknown bacteria by biochemical tests.
43. Immobilization of *Saccharomyces cerevisiae* and alcohol production.
44. Immunodiffusion, Immunoelectrophoresis and ELISA. Radioimmunoassay.
45. Development of monoclonal antibodies by hybridoma technology.
46. Production of polyclonal antobodies by hybridoma technology. immunoelectrophoresis, crossed antigen-antibody electrophoresis, radioimmunoassay, immunoblotting, immunoflourescence, agglutination, rosette formation, complement-fixation.
47. Antigen-induced T cell proliferation.generation of cytotoxic T lymphocytes.

M.Sc. (Final) Biotechnology Exam - 2017
Paper- V Cell and Tissue Culture

Min. Pass Marks: 36 **Duration: 3 Hours** **Max. Marks: 100**

Note: Attempt any five questions, taking atleast one question from each unit. Each question carries equal marks.

Unit- I

Introduction and history of plants tissue culture. Tissue Culture media (composition and preparation).Types of culture. Initiation and maintenance of callus. suspension culture, single cell culture and somaclonal variation. Organogenenesis : somatic embryogenesis, and clonal propagation transfer and establishment of whole plants in soil.

Unit-II

In vitro pollination, embryo culture and embryo rescue.

Protoplast isolation, culture and fusion; selection of hybrid cell and regeneration of hybrid plants; symmetric and asymmetric hybrids, cybrids. Anther and pollen culture: production of haploid plants and homozygous lines. Crop preservation and germplasm conservation.

Unit-III

Transgenic plants and Gene transfer methods. Selection of clones, marker and reporter genes in screening methods. RFLP, RAPD and other molecular markers. . Natural Products with special reference to alkaloids: production in plant tissue culture. Optimization, extraction of alkaloids and steroids, selection for cells for higher yields. Biotransformation, immobilization, elicitors and hairy root culture for production of useful metabolites. Antisense RNA technology and its application.

Unit-IV

Introduction to the balanced salt solutions and simple growth medium. Brief discussion on the chemical, physical and metabolic functions of different constituents of culture medium. Biology of the cultured cells, Organ and Histotypic culture. Measuring parameters of growth. Basic technique of mammalian cell cultures in vitro. Microcarrier culture, cell syncronization and cell culture. Application of animal cell culture. Hybridoma technology and monoclonal antibodies.

Unit-V

Methods of Micropropagation and their application in forestry, Floriculture, agriculture and conservation of biodiversity and threatened plants.

Applications of plants biotechnology in breeding and crop improvement anther, embryo and endosperm culture, production of haploids, Male sterile plant.

Application of plants tissue culture in plant pathology. Development of virus free plants. Growth of obligate parasites in culture. Development of disease resistance. Screening of germplasm.

Reference books:

1. Freshney, Culture of Animal Cells, 5th Edition, Wiley-Liss, 2005
2. Ed. John R.W. Masters, Animal Cell Culture - Practical Approach, 3rd Edition, Oxford University Press, 2000.
3. Plant Tissue Culture by MK Razdan
4. Plant Tissue Culture by MK Razdan & SS Bhojwani (1996) Elsevier
5. Plant Physiology by L Taiz & E Zeiger 4th Edition (2006) Sinauer Associates Inc, Publishers
6.Plant Biotechnology by H.S. chawla.
7. Plant Biotechnology and Transgenic Plants, Edited by Kirsi Marja Oksman-Caldentey, Wolfgang Barz Marcel Dekker 2002
8.Plant Tissue Culture Concepts and Laboratory Exercises, Second Edition, Robert N Trigiano, Dennis J Gray, CRC Press November 1999

Paper VI Environmental Biotechnology

Min. Pass Marks: 36 **Duration 3 hrs.** **Max. Marks: 100**

Note: Attempt any five questions, taking atleast one question from each unit. Each question carries equal marks.

Unit-I

Environmental biotechnology: Current status of biotechnology in environmental protection. Biotechnology for pollution abatement: Bioscrubbers and biofilters; Biotechnology for air and water pollution abatement. Aerobic and anaerobic biological treatment. Use of immobilized enzymes and microbial cells for effluent treatment.

Unit- II

Bioremediation: In situ technique- bioventing, bioaugmentation, air sparging, natural attenuation. Ex-situ techniques- land farming, solid phase, slurry phase treatment. Factors influencing bioremediation. Phytoremediation: Phytoextraction, phytostabilization, Phytostimulation, Phytotransformation, Rhizofiltration. Mechanism of phytoremediation. Future of Phytoremediation. Transgenic plants for phytoremediation.

Unit-III

Biomineralization: Modes of biomineralization; Organisms for mineralization ; Metal- microbe interaction; Bacterial, fungal, algal remediation. Mechanisms of bioleaching-direct and indirect. Bichemical reactions involved in bioleaching. Biomineralization of metals-iron, zinc, copper, gold and uranium.

Biaccumulation: Bioaccumulation process-uptake, storage, elimination, state of dynamic equilibirium.Factors affecting bioaccumulation.

Unit-IV

Biomagnification of pesticides and heavy metals. Consequences of biomagnification.

Bioinsecticides for productivity improvement and crop protection.Microbial pesticides, Bt insectices, Neem insecticides. Biofertilizers:Applications of bacteria, algae, fungi and azolla. Production technology for biofertilizers. Green manure and aquatic plants as biofertilizers. Composting and Vermicomposting technologies. Integrated nutrient management (INM).

Unit-V

Biomonitoring: Scope of the concept. Objectives of biomonitoring.Parameters for biomonitoring. Micro-organisms, lower plants, and higher plants as bioindicators. Algae, fungi, leaf, stem, root, flower, pollen germination, cell and chromosome, human system as indicator of pollution. Significance of bioindicators. Applications of bioindicators.

Spiderwort strategy for detection of low level atomic radiation.Excellent test systems.Increase of somatic mutation. Importance of concentration of radiation.

Role of Dianococcus radiodurans in disposal of radioactive waste material and its future in environmental biotechnology.

Reference Books:

1. Environmental Biotechnology: Concepts and Applications Hans-Joachim Jördening, Josef Winter John Wiley & Sons,
2. Advanced Environmental Biotechnology By S.K.Agarwal APH Publishing,
3. Environmental Biotechnology By S.N Jogdand Himalaya Publishing
4. Textbook of Environmental Biotechnology By Mohapatra I. K. International Pvt Ltd
5. Environmental Biotechnology: Basic Concepts and Applications By Indu Shekhar Thakur
6. Environmental Biotechnology: Theory and Application By Gareth G. Evans , Judy Furlong

Paper- VII Biostatistics, Bioinformatics & Computer Applications

Min. Pass Marks: 36 **Duration 3 hrs.** **Max. Marks: 100**

Note: Attempt any five questions, taking atleast one question from each unit. Each question carries equal marks.

Unit-I

Collection, organization and representation of data: Collection of data, Primary and Secondary data. Sampling & sampling design- Census method, sample method, random and non-random sampling. Size of sample . Tabulation and graphics representation. Measure of central tendency: Mean, Median and Mode. Measure of dispersion: Range, Standard deviation, Lorenz curve. Skewness and kurtosis: Objectives and measures of skewness. Karl Pearson's coefficient of skewness. Bowley's coefficient of skewness. Kelly's measure of skewness. Kurtosis. Correlation analysis: Types of correlation- Partial and Negative correlation, Linear and non-linear correlation, Methods of studying correlation- scatter diagram, graphic method, Karl Pearson's coefficient of correlation. Correlation of grouped data, Rank correlation, Concurrent deviation method, Partial and multiple correlation.

Unit-II

Regression analysis: Regression Line, regression equations- of X on Y and Y on X. regression in a bivariate grouped frequency distribution. Multiple regression. Probability theory: Types of probability- Mathematical, posterior and axiomatic probability. Theorems of probability- Addition and multiple theorem. Theorems of probability- Addition and multiple theorem. Theoritical distributions: Binomial, Poission and Normal distribution.

Unit-III

Sampling and test of significance: Steps in tests of hypothesis. Sampling distribution. Standard error. Test of significance for attributes. Test for number of success and proportion of success. Test of significance for variables (Large samples)- tests of differences between means of two samples and between two standard deviations. Tests of significance for variables (Small samples)- Students t-distribution to test the difference between means of two samples, and test the significance of an observed correlation coefficient. Variance ratio test (F-Test). Chi-square test and goodness of fit: Characteristics of X^2 test, use of X-test, Analysis of variance: One way and two way classification. Multivariate analysis.

Unit-IV

Bioinformatics: Introduction, historical resume, definitions. Bioinformatics and pharmaceutical industry, Concept of discovery of drug, post- genomic era, role of bioinformatics in pharmaceutical industry, Challenges. Bioinformatics business- Commercialization of bioinformatics, Biotechnology and bioinformatics, Current market study, Future prospects of bioinformatics business. Role of intranet and internet in bioinformatics. Bioinformatics career, Future prospects, Current prospects, career outlook, Geographical considerations. Ethical issues.

Unit-V

Introduction to Macro and Micro-computers, Attachments and peripherals. Hardware and Software.
Application of computer in statistical data processing. Software packages for statistical analysis: SAS, MINITAB, BMDP, SPSS, S-plus, MATLAB. Academic and research software- XGobi, Xlisp-Start, ExplorN, MANET. Pitfalls of data analysis by employing statistics: problem with statistics, Source of bias, Problem with interpretation.

Reference books:

1. Bioinformatics(2002) Bishop Martin
2. Molecular databases for protein and sequence and structure studies: Sillince A. and Sillince M.
3. Sequence Analysis primers : Gribskov, M. and Devereux, J.
4. Bioinformatics: Sequence and Genome Analysis By David W. Mount, University of Arizona, Tucson
5. Discovering Genomics, Proteomics, & Bioinformatics, Second Edition By A. Malcolm Campbell, Davidson College; Laurie J. Heyer, Davidson College; With a Foreword by Francis S. Collins
6. Biostatistics:P.N.Arora, P.K.Malha
7. Introductory statistics for Biology: Mahajan , S. K.
8. Statistical Methods : Mishra and Mishra
9. Fundamental of computeres by P.K.Sinha

Paper VIII Industrial Biotechnology

Min. Pass Marks: 36 **Duration 3 hrs.** **Max. Marks: 100**

Note: Attempt any five questions, taking atleast one question from each unit. Each question carries equal marks.

Unit-I

Isolation, preservation and maintenance of industrial microorganisms, strain improvement Microbial growth and death kinetics, media for industrial fermentation air and media sterilization,

Types of Fermentations: batch, continuous, fed-batch, solid state, sub-merged, aerobic and anaerobic, dual and multiple fermentations, their advantages and disadvantages. Fermentor: Basic design and Types, environmental control ,analysis of mixed microbial populations.

Unit-II

Down stream processing: Biomass separation by centrifugation, filtration, flocculation and other recent developments.

Cell disintegration: Physical, chemical and enzymatic methods.

Extraction: Solvent, two phase, liquid extraction, whole broth, aqueous multiphase extraction. Purification by different methods. Concentration by precipitation, ultra-filtration, reverse osmosis. Drying and crystallization.

Unit-III

Industrial production of alcohol (ethanol), acids (citric acid and gluconic) solvents (glycerol, acetone butanol), antibiotics (Penicillin, Streptomycin, Tetracycline), amino acids (Lysine, Glutamic acid), steroids transformation, hormones vaccines : types and production. Whole cell immobilization and industrial applications

Unit-IV

Introduction to food technology -elementary idea of Canning and packing, Sterilization and pasteurization of food products, Production of mushroom. cheese, single cell protein, single cell oil .

Synthetic seeds-Progress and potentials. Scaling-up production and automation in plant propagation. Use of robotics in plant production. Mass scale plant production facilities: design and planning clean area transfer and examination and control. Sericulture. Silkworm- Improvement through biotechnology

Unit-V

Production planning and scheduling. Air conditioning, air handling and demineralization, distillation, reverse osmosis. Hardening and acclimatization - success and bottlenecks. 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.

Reference Books

1. Sullia S. B& Shantharam S: (1998) General Microbiology, Oxford & IBH Publishing Co. Pvt.Ltd.
2. Glaser A.N & Nilaido.H (1995) Microbial Biotechnology,W.H Freeman & Co.
3. Prescott & Dunn (1987) Industrial Microbiology 4th Edition, CBS Publishers & Distributors.
4. Prescott & Dunn (2002) Industrial Microbiology, Agrobios (India) Publishers.
5. Crueger W. & Crueger A. (2000) A text of Industrial Microbiology, 2nd Edition, PanimaPublishing Corp.
6. Stanbury P.F, Ehitaker H, Hall S.J (1997) Priciples of Fermentation Technology., Aditya Books (P) Ltd.
7. S.N.Jogdan (2006) Industrial Biotechnology, Himalaya Publishing House

PRACTICALS

Min. Marks: 72 **Duration: 10 Hrs. (2 days)** **Max Marks: 200**

1. Descriptive statistics: systematic tabular summarization of data (before analysis), measures of central tendency, measures of dispersion. measures of skewness (using calculators).
2. Correlations (product-moment coefficient, Spearman's rank coefficient) and regression (linear regression, curve fitting).
3. Statistical distributions: fitting discrete uniform, bionomial, Poisson and normal probability distribution of given data.
4. Testing of hypotheses -Tests of significance (Mean, Standard Deviation, and Correlation coefficient), Chi-square test for good-ness-of-lit, test for independence of attributes, non-parametric tests (run test) using calculators and printed tables, and using Minitab.
5. Sampling (drawing random samples using random number, tables, computer programs for random number generation), Design of experiments, ANOVA (one-way and two-way).
6. Molecular modelling and construction to long chain proteins: i) conversion of internal coordinates of a molecule of Cartesian coordinates ii) from cartesian coordinates to internal coordinates iii) fourth atom fixation.
7. Acquaintance with tissue culture laboratory..
8. Preparatory techniques: Washing of glassware, dry and steam sterilization. Maintenances of aseptic conditions. Sterilization techniques.
9. Preparation of culture Media. Media preparation: Filter sterilization. Sterility tests, media storage. Serum inactivation.
10. Short term cultures: a) Primary culture of cells b) Organ culture.
11. Growth studies, Cell count, protein estimation.
12. Staining of cultures and observations under microscope.
13. Development and maintenance of a cell line.
14. Staining and screening of cells/sera for mycoplasma, viruses.
15. Freeze-storing and revival of cultured cells.
16. Karyotyping. Virus propagation in cells/ embryogenated eggs. Plaque/Focus formation assay.
17. Cytopathogenic response of cells to viruses.
18. Clonogenic assay cell - cell interaction -Coculture of normal and mutant cells.
19. Cell cloning by single cell dilution method.
20. Cell synchronization (determination of mitotic index and cell cycle time).
21. LDH isozyme analysis of the given cell lines.
22. Introduction to plant tissue culture technique role of nutrients in plant growth and development and hormonal regulation in plants, incubation conditions, types of cultures and tabulations of results.
23. Embryo development: permanent mounts and experimental: a) chick developmental stages and Gastrulation b) plant embryo: developmental stages (permanent slides and fresh preparation)
24. Cell motility and flagella staining.
25. Cytology and Histology of various organs (permanent slides and fresh preparation)
26. Cell types of plants -maceration of various tissue explant and identification or xylem vessels, trachieds, stomata, root hair etc.
27. Chromatography: Paper, TLC. SDS – PAGE.
28. Isolation of antibiotics producing microbes from soil by crowded plates technique and demonstration of antibiotic sensitivity by giant colony inhibition spectrum
29. Fermentation of grape juice and estimation of alcohol by distillation.
30. Enzyme immobilization using sodium alginate.
31. Production microbial enzyme (amylase) and conversion of starch to glucose.
32. Separation of cells by flocculation. Use of alum as a flocculating agent to separate yeast from fermentation broth.
33. Comparative study of surface culture (Mat culture of *aspergillus niger/Pencillin*), solid state fermentation (Mushrooms) and submerged cultures.
34. Purification of a product secreted by a functional cell line.
35. Estimation of hormones secreted by a hormone -secreting cell line.
36. Cell/hybridization. .
37. Immunohistochemical staining (oncogene expression),
38. Transplantations -tumors, organs, cells.