પરિપત્ર:

ભક્તકવિ નરસિંહ મહેતા યુનિવર્સિટીની સાયન્સ વિદ્યાશાખાનાં અભ્યાસક્રમ ચલાવતી તમામ સંલગ્ન કોલેજોનાં આચાર્યશ્રીઓને સવિનય જણાવવાનું કે સાયન્સ વિદ્યાશાખા હેઠળનો માઈક્રોબાયોલોજી વિષયનો એમ.એસ.સી પ્રોગ્રામનો સેમેસ્ટર-૧ અને સેમેસ્ટર-૨ નો અભ્યાસક્રમ આ સાથે સામેલ છે.

માનનીય કુલપતિશ્રીની મંજુરી અનુસાર સદર અભ્યાસક્રમ શૈક્ષણિક વર્ષ જુન,૨૦૨૩થી અમલવારી કરવાની રહે છે. સાયન્સ વિદ્યાશાખાનાં માઈક્રોબાયોલોજી વિષયનાં પી.જી.નો અભ્યાસક્રમ ચલાવતી તમામ સંલગ્ન કોલેજોનાં પી.જી.સેન્ટર ધ્વારા તેની અમલવારી કરવા જણાવવામાં આવે છે.

28/12/2023

ખાસ ફરજ પરના અધિકારી
(એકેડેમિક)

ક્રમાંક/બીકેએનએમયુ/એકેડેમિક/૨૧૭૬/૨૦૨૩-૨૦૨૪
ભક્તકવિ નરસિંહ મહેતા યુનિવર્સિટી,
સરકારી પોલીટેકનિક કેમ્પસ,
ભક્તકવિ નરસિંહ મહેતા યુનિવર્સિટી રોડ,
ખડીયા, જૂનાગઢ-૩૬૨૨૬૩
તા.૨૮/૧૨/૨૦૨૩

પ્રતિ,

- ભક્તકવિ નરસિંહ મહેતા યુનિવર્સિટી સંલગ્ન સાયન્સ વિદ્યાશાખાનાં પી.જી.(માઈક્રોબાયોલોજી)નાં અભ્યાસક્રમો ચલાવતી તમામ કોલેજોના આચાર્યશ્રીઓ તરફ....

નકલ સાદર રવાનાઃ-

- માન.કુલપતિશ્રી/કુલસચિવશ્રીનાં અંગત સચિવશ્રી.
- પરીક્ષા નિયામકશ્રી, ભક્તકવિ નરસિંહ મહેતા યુનિવર્સિટી, જુનાગઢ

નકલ રવાના જાણ તથા યોગ્ય કાર્યવાહી અર્થેઃ

સીસ્ટમ મેનેજરશ્રી, આઇ.ટી.સેલ વિભાગ (વેબસાઇટ ઉપર પ્રસિદ્ધ થવા અર્થે.)

Bhakta Kavi Narsinh Mehta University
Junagadh

BOARD OF LIFE SCIENCE STUDIES
FACULTY OF SCIENCE
SYLLABUS FOR
MASTER OF SCIENCE (HONOURS) PROGRAMME
(SEMESTER-I, II)

Department of Life Sciences

1. The Course

    - The course is full time course comprising of four semesters. There will be four theory papers (three core papers and one interdisciplinary / multidisciplinary paper) and one combined practicals in first two semesters. The last two semesters offer choice of courses to the students where two core courses and one elective (to be chosen from three available) courses will be taught. Any elective course will be taught only when prerequisite number of the student enrols for that course. Students shall be required to submit at the time of practical examination at the end of each semester.
        - The laboratory Journal and diary of field work (Tour report) duly signed by the teachers concerned from time to time.
        - A set of assignments, submissions, preparations or materials illustrating the subject - matter as per syllabus for each semester.

2. Eligibility

    - The candidate with B.Sc. degree in Microbiology with minimum 45% is eligible for admission to M.Sc. Microbiology course.
    - A total of 20 seats are available in the Microbiology.
    - Students will be admitted as per the reservation policy in effect from time to time, as directed by the University.

3. Educational tour

    - The study/ educational tour is compulsory and part of Curriculum to study different ecosystems, botanical, zoological and microbiological places of interest anywhere in the country. Since the tour or tours are part of the curriculum, these can be conducted during any or all of the four semesters. However, in special cases, alternative of the educational tour will be decided and assigned to the student concerned, by the Staff Council of the Department.

4. Seminars / Assignments / Submission

    - Regular seminars will be organised on I and II Semesters and it is compulsory. Presentation on relevant topics, mostly from syllabus (oral and / or poster), is mandatory for the enrolled student. For each seminar, a student will be given marks, which will be added in the III Semester marksheet.

5. Attendance
    - Admitted students have to attend all the Lectures, Practicals and Seminars. A minimum prescribed attendance as per University rules is required to sanction a term grant. Students whose term is not granted will not be allowed to appear in the examination, and will have to join the same semester in the following year.

6. Semester wise distribution of marks
    - SEMESTER-I: 4 Papers (100 Marks each*) : 400
      1 Combined Practical : 200
      Total : 600
    - SEMESTER-II:
      4 Papers (100 Marks each*) : 400
      1 Combined Practical : 200
      Total : 600

    *** 70 external + 30 internal**

7. The M.Sc. courses run by this Department are full time studies and as such, a student admitted to the Department is not allowed to join any other courses or study, or take up any paid service.
8. The candidate should bring all original mark sheets, certificates etc. At the time of the interview.

M. Sc. Microbiology

Semester - I

Course code	Paper title	Hours / week	Credits
MIC 101	Cell Biology (Core)	04	04
MIC 102	Molecular Biology, Genetics & Evolution (Core)	04	04
MIC 103	Biodiversity & Biosystematics (Core)	04	04
MIC 104	Biostatistics, Bioinformatics & Biosafety** (Multidisciplinary / Interdisciplinary)	04	04
MIC 105	Combined Practical Course	14	08
MIC 106	Seminar Course – 1	02	00
	Total		**24**

Semester - II

Course code	Paper title	Hours / week	Credits
MIC 207	Biochemistry (Core)	04	04
MIC 208	Biotechnology & Immunology (Core)	04	04
MIC 209	Environmental Science (Core)	04	04
MIC 210	Analytical Techniques** (Multidisciplinary / Interdisciplinary)	04	04
MIC 211	Combined Practical Course	14	08
MIC 212	Seminar Course - 2	02	00
	Total		**24**

M.Sc. Microbiology

DETAILED SYLLABUS

Semester - I

MIC 101: CELL BIOLOGY

Unit-1 : Cell Structure & Cell Cycle

1.1 Cell Concept, Ultrastructure of Plasma Membrane, microbial and Plant Cell Wall
1.2 Ultrastructure of Nucleus and Nucleolus. Pore Complex of Nuclear envelop
1.3 Ultrastructure of Chromosome, Chromosomal Models, Special types of chromosomes
1.4 Cell Cycle, G_1/S Transition, Cyclines and cyclin dependent kinases. Regulation of CDK- cycline activity

Unit-2 : Cellular Organization

2.1 Mitochondria: Membrane Organization, Biogenesis and role in cellular energetics
2.2 Chloroplasts: Ultrastructure, biogenesis, Photosynthetic units and reaction centres
2.3 Ultrastructure and functions of Lysosome, Peroxisomes & Glyoxisomes
2.4 GERL System and its functions. Vacuoles and their role in cell structure and function

Unit-3 : Cytoskeleton, Cellular Transport & Sorting

3.1 Cytoskeleton: Ultrastructure and functions of Microtubules, microfillaments and associated proteins
3.2 Cytoskeleton: Ultrastructure and functions of Actin, Myosin, IF and associated proteins
3.3 Intracellular Junctions and their functions. Ca^{++} dependent homophillic and non-homophillic cell-cell adhesion
3.4 Transport across cell membrane: diffusion, active transport and pumps, uniports, symports and antiports

Unit-4 : Cellular Communication, Apoptosis and Cancer

4.1 Cell surface receptors and their mode of action. Phenomenon of exocytosis and endocytosis
4.2 Second messenger system, MDP kinase pathways
4.3 Apoptosis: Mechanism and significance
4.4 Cell biological approach of cancer, AIDS

MIC 102: MOLECULAR BIOLOGY, GENETICS & EVOLUTION

Unit-1. Population Genetics

1.1 Principles of Mendalian genetics: Dominance, segregation, independent assortment
1.2 Hardy-Weinberg genetic equilibrium, Natural selection
1.3 Genetics of Speciation
1.4 Origin of life: Coacervates, Miller's experiment, theories of organic evolution

Unit-2. DNA as a hereditary material

2.1 Structure of Nucleic acids, Structural differences in prokaryotic and eukaryotic DNA
2.2 DNA constancy and C-value paradox,
2.3 DNA replication and DNA methylation
2.4 Linkage and genetic mapping

Unit-3. Gene structure and expression

3.1 The Concept of Gene
3.2 Genetic code, Transcription and RNA processing
3.3 Translation and post translational modifications
3.4 Regulation of gene expression and Operon model

Unit-4. Structural Changes in DNA material and Extra Chromosomal inheritance

4.1 Molecular basis of spontaneous and induced mutations
4.2 Chromosomal aberrations
4.3 DNA damages and repair
4.4 Extra-chromosomal inheritance: Inheritance of Mitochondrial and chloroplast genes, maternal inheritance.

MIC 103: BIODIVERSITY & BIOSYSTEMATICS

Unit – 1: Biodiversity

1.1 Basic Concepts of Biodiversity: Genetic, species and ecological diversity.
1.2 Terrestrial, Marine Biodiversity, Eco-tourism and Biodiversity. Conservation and Sustainable use of Biodiversity. Ecosystem monitoring and Rehabilitation.
1.3 Threats to Biological Diversity: Habitat Destruction, Invasive species, Disease, Over-exploitation, Pollution, Climate change and Biodiversity.

1.4 Structure and functions of the Convention on Biological Diversity (CBD), CBD mechanisms and working bodies.

Unit – 2: Microbial Taxonomy

2.1 Principles of systematics and classification of microbes.
2.2 Introduction to akaryotes, virus, archea & bacteria, cyanobacteria and prokaryotes
2.3 Fungus like protists: Cellular slime moulds, plasmodial slime moulds. General features of Fungus
2.4 Organisms of health importance: Common parasites and pathogens of humans and domestic animals

Unit – 3: Plant Taxonomy

3.1 Principles of systematics and classification of Plants
3.2 General features and Classification of green protists like diatom, dinoflagellates, lichens and algae
3.3 Non-tracheophytes (Mosses) and Non-Seed Tracheophytes (Ferns and Fern allies).
3.4 Seed plants: Gymnosperm and Angiosperms

Unit – 4: Animal Taxonomy

4.1 Principles of systematics and classification of Animals. Organisms of conservation concern: Rare, endangered species. Conservation strategies.
4.2 Classification of Protista (Flagellates, Amoebas, Ciliates and Apicomplexans).
4.3 Major invertebrate phyla, Lower chordates
4.4 Vertebrates: Fish, Amphibia, Reptiles, Birds and Mammal

MIC 104: BIOSTATISTICS, BIOINFORMATICS & BIOSAFETY

Unit – 1: Basics and concepts of Biostatistics

1.1 Data classification, Frequency distribution and Graphs
1.2 Measure of Central Tendency: Meaning, Objectives, Merits, Demerits & Uses
1.3 Measure of Dispersion – Range, Variance, Standard deviation, Coefficient of Variation; Confidence limit and confidence interval
1.4 Probability distributions (Binomial, Poisson and normal), Sampling distribution; Difference between parametric and non-parametric statistics; Confidence Interval; Errors; Levels of significance;

Unit – 2: Statistical tests in Biology

2.1 Regression and Correlation analysis
2.2 Student's t-test: Paired and Unpaired
2.3 Level of Significance & Degree of Freedom: Chi-square test (X^2); Analysis of Variance (ANOVA)
2.4. Basics of Multivariate statistics

Unit - 3: Bioinformatics

3.1 Introduction of Bioinformatics, Basic terminology, Application of bioinformatics in various fields: Medicine, Agriculture, Industries etc.
3.2 Types and structures of biological databases
3.3 Sequence alignment: Nucleotide and Protein sequences, Pairwise and multiple sequence alignment, BLAST and Phylogenic analysis
3.4 Gene prediction: Gene structure in prokaryotic and eukaryotic systems, Prediction tools for the gene

Unit - 4: Biosafety & Bioethics

4.1 Biosafety fundamentals: Introduction; Historical Background; Introduction to Biological Safety Cabinets; Primary Containment for Biohazards; Biosafety Levels.
4.2 Biosafety regulation: Biosafety Guidelines-Government of India; Roles of Institutional Biosafety Committee, RCGM, GEAC etc.
4.3 Environmental release and application of GMO
4.4 Risk Analysis; Risk Assessment; Risk management and communication.

MIC 105: COMBINED PRACTICAL COURSE

SUGGESTED PRACTICALS BASED ON PAPERS 101, 102, 103 AND 104

101. Cell Biology: Suggested practical work

1. Preparation of paraffin blocks of animal tissue – Understanding the cytological and histological techniques
2. Section cutting, spreading and staining methods, Microscopy
3. Supra – vital Cytological staining of cellular organelles
4. Cellular metabolites: Permanent Cytological Staining
5. Nucleic Acids: Permanent Cytological Staining
6. Cytogenetics: Onion root tip squash preparation for mitosis
7. Dipteran salivary gland squash preparation for giant chromosome
8. Cytological Staining of Barr body
9. Cytogenetics: Stages of meiosis
10. Histological and Cytological Staining of Drumstick
11. Enzyme histochemistry & Cytochemistry
12. Observations on permanent cytological slides

102. Molecular Biology, Genetics & Evolution: Suggested practical work

1. To confirm thalassemia by NESTROFT (Necked Eye Single Tube RBCs Osmotic Fragility Test)
2. To induce polyploidy in root of Allium cepa and observe cytological changes in cell
3. To study karyotype of human chromosome
4. Identification of normal male and female karyotype
5. Identification of Turner syndrome using Karyotype
6. Identification of Klinefelter syndrome using the karyotype
7. Identification of Down syndrome using the karyotype
8. Identification of Edwards syndrome using the karyotype
9. To perform linkage analysis and Map construction with example
10. To perform Pedigree analysis and Probabilities with example
11. Staining of Microbial Cells: Monochrome, Negative & Gram Staining
12. Bacterial Motility (Hanging Drop Method)
13. Bacteriological Media Composition & Preparation and Bacterial Cultivation Methods

103. Biodiversity & Biosystematics: Suggested practical work

1. General features & classification of Invertebrates up to class or order
2. General features & classification of vertebrates up to class or order
3. General features and classification of diatoms, dinoflagellates, lichens and algae
4. General features and classification of non-tracheophytes and non-seed tracheophytes
5. General features and classification of Gymnosperms
6. General features and classification of angiosperms
7. Negative staining, Differential staining (Gram's staining)
8. Specialized staining: Capsule staining, Spirocheck staining, Metachromatic granule staining, Cell wall staining
9. Hanging drop techniques for motility

104. Biostatistics, Bioinformatics & Biosafety: Suggested practical work

1. Frequency Distribution
2. Standard Deviation and Coefficient of Variation

3. Confidence limits for the population mean
4. Students 't' test
5. Analysis of Variance
6. Regression and Correlation
7. Chi Square Test
8. Multivariate analysis
9. Basic Terminologies in Bioinformatics
10. Biological databases
11. NCBI Search for Gene Sequences
12. UniProt Knowledgebase (UniProt KB) Search for Protein Sequences
13. RCSB PDB search for Protein 3D Structures
14. Pair wise Sequence Alignment using NCBI BLAST
15. Pair wise Sequence Alignment using Bio edit
16. Multiple Sequence alignment using CLC Protein Workbench
17. Multiple Sequence alignment using Clustal X
18. Analysis of 3 D structure of protein by Rasmol

SUGGESTED BOOKS FOR PAPER: MIC 101- CELL BIOLOGY

1. *Biology by Peter Raven, George Johnson, Kenneth Mason, Jonathan Losos, Susan Singer, McGraw Hill Education*
2. *Cell and Molecular Biology by S.C. Rastogi, New Age international*
3. *Cell Biology, Genetics, Molecular Biology, Evolution &Ecology by Verma P.S. & Agarwal V.K.*
4. *Cell Biology by Gerald Karp, Wiley*
5. *The Cell – A molecular Approach, Cooper and Hausman*
6. *Molecular cell biology, Lodish, WH freeman*
7. *Cells, Benjamin Lewin, Jones and Bartlett Publishers, Inc*
8. *Cell Biology, Devasena, Oxford*
9. *Cell and Molecular Biology by Eduardo D.P.De Robertis and E.M.P.De Robertis*

SUGGESTED BOOKS FOR PAPER: MIC 102 - MOLECULAR BIOLOGY, GENETICS & EVOLUTION

1. *Biology, Raven and Johnson,2013, McGraw Hill India publication*
2. *Campbell Biology, Jane B. Reece, Pearson Benjamin Cummings*
3. *Cell and Molecular Biology by S.C. Rastogi, New Age international*
4. *Cell Biology, Genetics, Molecular Biology, Evolution and Ecology, Verma and Agarwa,*
5. *Evolution third edition, Mark Ridley, Blackwell Publishing*
6. *Evolution, Strickberger, Monroe W, Jones & Bartlett Publishers, Inc.*
7. *Life: The Science of Biology, William, W. H. Freeman*
8. *Genetic Engineering – SmitaRastogi and Neelam Pathak*
9. *Genetic Engineering, Verma P.S., S Chand & Company*

SUGGESTED BOOKS FOR PAPER: MIC 103 - BIODIVERSITY & BIOSYSTEMATICS

1. *Biodiversity: Perception, Peril and Preservation Prabodh K. Maiti, PHI Learning Private Limited*
2. *The Bio-Diversity of India, ErachBharucha, Grantha Corporation*
3. *Biogeography and Biodiversity, R. B. Singh, Rawat Pubns*
4. *An Introduction to Biodiversity, Prithipalsingh, Ane books*
5. *An Advanced Textbook on Biodiversity, K. V. Krishnamurthy*
6. *Biodiversity Measurement and estimation, Hawksworth, Chapman*
7. *Fundamentals of Ecology, Eugene Odum, Cengage*
8. *Concepts of Ecology, Kormondy Edward, Pearson Education*
9. *Elements of Ecology, Smith, Pearson Education*
10. *Fundamentals of Ecology and Environmental Biology, S. C. Santra*
11. *Ecology and Environment, PD Sharma, Rastogi Publications*
12. *Modern Textbook of Zoology by R.L. Kotpal*

SUGGESTED BOOKS FOR PAPER: MIC 104 - Biostatistics, Bioinformatics & Biosafety

1. *Introduction to Bio-Statistics, Banerjee Pranab Kumar, S Chand & Company*
2. *Biostatistics, Veer Bala Rastogi, Medtech*
3. *Biostatistics Analysis, Zar, Pearson*
4. *Biostatistics for health and life sciences, Rao K Surya, Himalaya Publishing house*
5. *Research methodology, C R Kothari, New Age Publishers*
6. *Principles of Biostatistics by Marcello Pagano, Duxbury Thomson Learning*
7. *A Text Book of Biotechnology, R. C. Dubey, S. Chand Publication*
8. *Bioinformatics-A beginners Guide-Claverie J & Notredame C*
9. *Developing Bioinformatics Computer Skills-Gibas C & Jambeck P*
10. *The single Genetic Algorithm-Vose M D*
11. *Bioinformatics-Sequence,structure and Databases –Higgins D & Taylor W*
12. *Bioinformatics: Methods And Applications - Genomics, Proteomics And Drug Discovery by Rastogi SC, Rastogi P & Mendiratta N, PHI*
13. *IPR, Biosafety and Bioethics, Goel And Parashar, Person*
14. *Bioethics and Biosafety M.K. Sateesh, I K International Publishing House*
15. *Biosafety and Regulation for Genetically Modified Organisms, Xue, lpha Science International Ltd*

M.Sc. Microbiology

DETAILED SYLLABUS

Semester - II

MIC 207: BIOCHEMISTRY

Unit – 1 : Carbohydrates, Lipids and Fatty Acid metabolism

1.1 Monosaccharides and disaccharides: Types and properties
1.2 Polysaccharides: Homopolysaccharides and hetropolysaccharides
1.3 Classification and properties of simple and compound lipids
1.4 Function of lipids, Metabolism of fatty acids: Beta oxidation

Unit – 2 : Protein Structure and Function

2.1 Physical and chemical properties of amino acid, Classification of amino acids
2.2 Primary and Secondary structure of protein
2.3 Tertiary and Quaternary structure of protein, Ramchandran Plots
2.4 Titration curves and function of proteins

Unit – 3 : Enzymes: Basic Concepts and Kinetics

3.1 An introduction to enzymes: Nomenclature and classification
3.2 Principles and mechanism of enzymes catalysis: single and multisubstrate, Coenzymes and cofactors
3.3 Kinetic properties of enzymes, Michaelis-Menten Model, Double reciprocal plot
3.4 Enzyme Inhibition: Competitive, Non- competitive, Uncompetitive and Mixed type

Unit – 4 : Metabolism: Basic Concepts and Regulation

4.1 Concept of Bioenergetics: laws of thermodynamic, Entropy and Enthalpy, Energy rich compounds andelectron carriers
4.2 Glycolysis and Citric Acid Cycle
4.3 Other pathways of carbohydrate metabolism ED, Pentose Phosphate, Glyoxylate,
4.4 Gluconeogenesis Allosteric proteins, Feedback inhibition

MIC 208: BIOTECHNOLOGY & IMMUNOLOGY

Unit – 1 : Biotechnology

1.1 Biotechnology : Definition, History and Career scopes, Techniques of immobilization of enzymes & cells, Applications of Immobilized Enzymes & Cells

1.2 Bioremediation, Basics of genetic engineering, DNA isolation techniques

1.3 Restriction enzymes, Gene targeting

1.4 Vectors : plasmids, cosmids and phages, Host vector system

Unit – 2 : Animal and Plant Tissue culture

2.1 Principles and Techniques of Plant Tissue Culture

2.2 Basic Steps of Plant Tissue Culture

2.3 Types of Plant Tissue Culture

2.4 Principles and techniques of animal tissue culture

Unit – 3 : Immunology

3.1 Antigen Antibody: Factors Influencing Immunogenicity, Structure of Ig, Ig Classes & Biological Activities, Monoclonal Antibodies

3.2 Innate and Adaptive Immune System

3.3 Antigen-Antibody Interactions: ELISA Test, Agglutination, Precipitation, Immunofluorescence

3.4 Hypersensitivity and Autoimmunity

Unit 4- Intellectual Property Right

4. 1 IP: Fundamentals of patents, Trademarks, Copyright & Related Rights, Industrial Design, Traditional Knowledge, Geographical Indications, Protection of New GMOs; International framework for the protection of IP.

4. 2 IP as a factor in R&D; IPs of relevance to Biotechnology and few Case Studies; Introduction to History of GATT, WTO, WIPO and TRIPS.

4.3 Patent Application: Types of patents, Patent application- forms and guidelines, fee structure, time frames;

4.4 Types of patent applications: provisional and complete specifications; PCT and convention patent applications; International patenting-requirement, procedures and costs

MIC 209: ENVIRONMENTAL SCIENCES

Unit-1 Ecological Principles

1.1 Habitat and Niche: Concept of habitat and niche; niche width and overlap; fundamental and realized niche; resource partitioning; character displacement.
1.2 Population Ecology: Characteristics of a population; population growth curves; population regulation; life history strategies (r and K selection)
1.3 Concept of metapopulation – demes and dispersal, interdemic extinctions, age structured populations.
1.4 Species Interactions: Types of interactions, interspecific competition, herbivory, carnivory, pollination, symbiosis.

Unit-2 Community Ecology

2.1 Community Ecology: Nature of communities; community structure and attributes; levels of species diversity and its measurement; edges and ecotones.
2.2 Ecological Succession: Types; mechanisms; changes involved in succession; concept of climax.
2.3 Ecosystem Ecology: Ecosystem structure; ecosystem function; energy flow and mineral cycling (C,N,P); primary production and decomposition;
2.4 Structure and function of some Indian ecosystems: terrestrial (forest, grassland) and aquatic (fresh water, marine, estuarine).

Unit-3Environment Science

3.1 Definition and Scope of Environmental science.The Environment: Physical environment; biotic environment; biotic and abiotic interactions.
3.2 Structure and composition of atmosphere, hydrosphere, lithosphere and biosphere.
3.3Biomes of the world,Parasitism, prey-predator relationships
3.4 Overview of Sanctuaries, National park and Botanical garden

Unit-4 Pollution and Environmental Impact Assessment

4.1 Air: Natural and anthropogenic sources of pollution, primary and secondary pollutants, Methods of monitoring and control of air pollution, Effects of pollutants on human beings, plants, animals, materials and on climate, Acid rain, Air Quality Standards
4.2 Water: Types and Sources of water pollution, Standards, sewage and waste water treatment. Water quality standard, Soil pollution and Soil pollution control
4.3 Global Environmental problems: Ozone depletion, global warming and climatic change, clean development mechanism.
4.4 Introduction to environment impact analysis, EnvironmentalImpact Assessment methodologies, Procedure for reviewing environmental impact analysis, Principles of Remote sensing and its applications of environmental sciences, Application of GIS in Environmental management.

MIC 210: ANALYTICAL TECHNIQUES

Unit – 1 : Microscopy and Autoradiography

1.1 Theories of Tissue fixation and staining techniques
1.2 Principles of Transmission and Scanning Electron microscopy
1.3 Principles of Phase Contrast and Fluorescence Microscopy
1.4 Principle and applications of Autoradiography

Unit – 2 : Spectroscopy

2.1 Basic principles of Spectroscopy, UV, IR, Raman, ESR, ORD
2.2 CD and structure of proteins using NMR and ESR
2.3 Neutron and X-Ray diffraction for elucidation of 3D structure
2.4 Molecular modelling, Mass Spectrometry

Unit – 3 : Chromatographic techniques

3.1 Basic Principle and types of Chromatography
3.2 Gas Chromatography & GC-MS
3.3 Ion Exchange Chromatography, gel permeation, Affinity chromatography
3.4 High Performance Liquid Chromatography and FPLC

Unit – 4 : Centrifugation and Electrophoretic Techniques

4.1 Principle and applications of Centrifugation techniques
4.2 Basic principles of Electrophoresis, Agarose gel, native and SDS-PAGE
4.3 Isoelectric focusing, 2D-PAGE and their uses in protein research
4.4 Fractionation and Blotting Technique

MIC: COMBINED PRACTICAL COURSE

SUGGESTED LABORATORY WORK

1. To prepare a titration curve of a weak acid with a strong base
2. To prepare a titration curve and determine the pK and pI value of an amino acid
3. To prepare a calibration curve of reducing sugars by DNSA
4. To prepare a calibration curve of protein by Folin-Lowry method
5. Extraction and estimation of protein by Folin-Lowry method
6. To prepare a calibration curve of amino acid using Ninhydrin reaction method
7. Extraction and estimation of free amino acid content in germinating seeds by ninhydrin reaction method
8. To determine saponification value of fats and oils
9. Isolation & Identification of Bacteria, Yeasts & Fungi
10. Biochemical Tests: Metabolic Activities of Enteric Bacteria: Sugar Fermentation, IMViC, H2S production, Phenylalanine DeaminaseUrea Hydrolysis, Nitrate Reduction, Amylase, Protease
11. Direct ELISA Technique
12. Indirect ELISA Technique
13. Preparation of plant tissue culture media
14. To perform the ouchterlony double diffusion.
15. To learn the technique of radial immunodiffusion.
16. To learn the technique of agglutination.
17. To determine colour of soil by physical observation and to determine water holding capacity
18. To determine field capacity of soil
19. To determine temperature soil by thermometer.
20. To determine soil-moisture by oven drying
21. To determine soil texture
22. To estimate the amount of organic carbon by Walkley and Black titration method
23. To estimate the amount of Ca from given soil sample
24. To estimate the amount of Mg from given soil sample
25. To determine the amount of carbonate in the soil by rapid test
26. To determine Calcium Carbonate in the Soil.
27. To determine phosphate content in the soil
28. To determine the alkalinity of given water sample.
29. To determine acidity of given water sample.
30. Dissolved oxygen (DO)
31. Biological oxygen demand (BOD)
32. Bacteriological analysis by MPN
33. Colour, turbidity, odour and pH, TS, TDS and TSS
34. Chloride estimation
35. Sulfate estimation

36. Ca-Mg Hardness/ Estimation of total hardness of water by EDTA method.
37. Demonstration of a state-of-the-art compound microscope with Brightfield,Phase-Contrast, Fluorescence and Darkfield operational details.
38. Demonstration of computer controlled brightfield microscopy
39. Demonstration of Image capturing and Image analysis by Image Analysis software
40. Determination of molecular mass of Protein by size exclusion chromatography(Theoretical)
41. PCR amplification of gene
42. DNA sequencing of the amplified gene
43. To perform sandwich DOT ELISA test for antigen.
44. To perform Western Blot Technique
45. To isolate genomic DNA from bacterial isolate
46. To separate amino acids by ascending paper chromatography
47. To separation of amino acids by TLC method
48. Demonstrate the colorimetric method using Beer's & Lamberts law
49. To perform the separation technique by using centrifugation method

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SUGGESTED BOOKS

1. *Biology by Peter Raven, George Johnson, Kenneth Mason, Jonathan Losos, Susan Singer, McGraw Hill Education*
2. *Cell and Molecular Biology by S.C. Rastogi, New Age international*
3. *Cell Biology, Genetics, Molecular Biology, Evolution &Ecology by Verma P.S. & Agarwal V.K.*
4. *Cell Biology by Gerald Karp, Wiley*
5. *The Cell – A molecular Approach, Cooper and Hausman*
6. *Molecular cell biology, Lodish, WH freeman*
7. *Cells, Benjamin Lewin, Jones and Bartlett Publishers, Inc*
8. *Cell Biology, Devasena, Oxford*
9. *Cell and Molecular Biology by Eduardo D.P.De Robertis and E.M.P.De Robertis*
10. *Biology, Raven and Johnson,2013, McGraw Hill India publication*
11. *Campbell Biology, Jane B. Reece, Pearson Benjamin Cummings*
12. *Cell and Molecular Biology by S.C. Rastogi, New Age international*
13. *Cell Biology, Genetics, Molecular Biology, Evolution and Ecology, Verma and Agarwa,*
14. *Evolution third edition, Mark Ridley, Blackwell Publishing*
15. *Evolution, Strickberger, Monroe W, Jones & Bartlett Publishers, Inc.*
16. *Life: The Science of Biology, William, W. H. Freeman*
17. *Genetic Engineering – SmitaRastogi and Neelam Pathak*

18. *Genetic Engineering, Verma P.S., S Chand & Company*
19. *Biodiversity: Perception, Peril and Preservation Prabodh K. Maiti, PHI Learning Private Limited*
20. *The Bio-Diversity of India, ErachBharucha, Grantha Corporation*
21. *Biogeography and Biodiversity, R. B. Singh, Rawat Pubns*
22. *An Introduction to Biodiversity, Prithipalsingh, Ane books*
23. *An Advanced Textbook on Biodiversity, K. V. Krishnamurthy*
24. *Biodiversity Measurement and estimation, Hawksworth, Chapman*
25. *Fundamentals of Ecology, Eugene Odum, Cengage*
26. *Concepts of Ecology, Kormondy Edward, Pearson Education*
27. *Elements of Ecology, Smith, Pearson Education*
28. *Fundamentals of Ecology and Environmental Biology, S. C. Santra*
29. *Ecology and Environment, PD Sharma, Rastogi Publications*
30. *Modern Textbook of Zoology by R.L. Kotpal*
31. *Introduction to Bio-Statistics, Banerjee Pranab Kumar, S Chand & Company*
32. *Biostatistics, Veer Bala Rastogi, Medtech*
33. *Biostatistics Analysis, Zar, Pearson*
34. *Biostatistics for health and life sciences, Rao K Surya, Himalaya Publishing house*
35. *Research methodology, C R Kothari, New Age Publishers*
36. *Principles of Biostatistics by Marcello Pagano, Duxbury Thomson Learning*
37. *A Text Book of Biotechnology, R. C. Dubey, S. Chand Publication*
38. *Bioinformatics-A beginners Guide-Claverie J & Notredame C*
39. *Developing Bioinformatics Computer Skills-Gibas C & Jambeck P*
40. *The single Genetic Algorithm-Vose M D*
41. *Bioinformatics-Sequence,structure and Databases –Higgins D & Taylor W*
42. *Bioinformatics: Methods And Applications - Genomics, Proteomics And Drug Discovery by Rastogi SC, Rastogi P & Mendiratta N, PHI*
43. *IPR, Biosafety and Bioethics, Goel And Parashar, Person*
44. *Bioethics and Biosafety M.K. Sateesh, I K International Publishing House*
45. *Biosafety and Regulation for Genetically Modified Organisms, Xue, lpha Science International Ltd*