

College of Computer, Science & Information Technology - Junagadh

AFFILIATED TO BHAKTA KAVI NARSINH MEHTA UNIVERSITY



◆ Syllabus ◆

Master of Science

in

[MICROBIOLOGY]

[Semester – I & II]

Academic Year : 2020 – 21

(Effective from June – 2018)



◀ **ADDRESS : C.C.S.I.T. - JUNAGADH** ▶

Green City, Bypass Road, Nr. Chobari Railway Crossing, Junagadh.

Website : <http://ccsit.co.in>, Email : ccsit_junagadh@yahoo.co.in

Phone : 79906 61530, 92280 06940

(SEMESTER-I)

Subject code	Subject Name	Credit	Int. Marks	Ext. Marks	Total Marks
Mic-101	Cell Biology(Core)	4	30	70	100
Mic-102	Molecular Biology, Genetics & Evolution(Core)	4	30	70	100
Mic-103	Biodiversity & Biosystematics(Core)	4	30	70	100
Mic-104	Biostatistics & Bioinformatics	4	30	70	100
Mic-105	Combined Practical Course	8	-	-	200
Mic-106	Seminar Course - 1	-	-	-	-
Total Credits		24	Total Marks		450

(SEMESTER-II)

Subject code	Subject Name	Credit	Int. Marks	Ext. Marks	Total Marks
Mic-207	Biochemistry (Core)	4	30	70	100
Mic-208	Biotechnology & Immunology (Core)	4	30	70	100
Mic-209	Environmental Science (Core)	4	30	70	100
Mic-210	Analytical Techniques (Multidisciplinary / Interdisciplinary)	4	30	70	100
Mic-211	Combined Practical Course	8	-	-	200
Mic-212	Seminar Course - 2	-	-	-	-
Total Credits		24	Total Marks		450

Structure of Theory Examination Paper – External

Question Paper contains 5 Questions (each of 14 marks). Every Question is divided in four parts like (a), (b), (c) and (d). Every Question will be asked from corresponding unit as specified in the syllabus of each course. (i.e. Question-1 is from Unit No. 1 and remaining questions from their corresponding Units).

TOTAL MARKS : 70, TOTAL TIME : 2½ HOURS

General Instructions:

1. Time duration of each theory paper will be of Two and Half hours.
2. Total marks of each theory paper will be 70 marks.
3. There will be five questions.
4. All questions are compulsory.

Instructions to the candidates for Practical Examination:-

1. Practical Exam. would be conducted for 1 ½ days, All the students have to remain present at the examination center 15 minutes before the scheduled time for examination.
2. Students have to carry with them certified Journal, I – card, Examination Receipt, and other necessary requirements for examination.
3. Student should not leave the laboratory without the permission of examiner.
4. Use of calculator is allowed but the use of mobile phones is strictly prohibited.
5. The candidate has to leave the laboratory only after the submission of all the answer sheets of the exercises performed.

M.Sc.(Microbiology) SEMESTER – I

Micro -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, G₁/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 centers
- 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

Micro -102: MOLECULAR BIOLOGY, GENETICS & EVOLUTION

Unit-1 : Population Genetics

- 1.1 Principles of Mendalian genetics
- 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 (chromosome) 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 aberration
- 4.3 DNA damage and repair
- 4.4 Extra-chromosomal inheritance

Micro -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. National Action plan.

Unit – 2: Microbial Taxonomy

- 2.1 Principles of systematics and classification of microbes
- 2.2 Introduction to akaryotes, Virus, Archea & bacteria, cyanobacteria 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

Micro -104 : BIOSTATISTICS AND BIOINFORMATICS

Unit – 1 : Basics and Concepts of Biostatistics

- 1.1 Data, Tabulation, Classification, Frequency distribution and Graphics
- 1.2 Measure of Central Tendency – Mean, Mode & Median: Definition, Objectives, Merits, Demerits & Uses
- 1.3 Measure of Dispersion – Range, Variance, Standard deviation, Coefficient of Variation
- 1.4 Confidence limit and Confidence interval

Unit – 2 : Statistical Tests in Biology

- 2.1 Student's 't' test : Paired and unpaired
- 2.2 Analysis of Variance
- 2.3 Regression and Correlation analysis
- 2.4 Chi-square Test

Unit – 3 : Basics of Bioinformatics and Biological Databases

- 3.1 Introduction of Bioinformatics, Basic terminology
- 3.2 Application of bioinformatics in various fields: Medicine, Agriculture, Industries etc.
- 3.3 File formats and Structure of database
- 3.4 Types of biological databases

Unit – 4 : Sequence Alignment, Gene Prediction and Basic concepts of Omics

- 4.1 Sequence alignment: Nucleotide and Protein sequences, Pairwise and multiple sequence alignment, BLAST
- 4.2 Gene prediction: Gene structure in prokaryotic and eukaryotic systems, Prediction tools for the gene
- 4.3 Phylogenic analysis
- 4.4 Drug discovery

Micro. 105 : COMBINED PRACTICAL COURSE

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

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

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

Biostatistics:

- | | |
|--|-------------------------------|
| 1. Frequency Distribution | 4. Students 't' test |
| 2. Standard Deviation and Coefficient of Variation | 5. Analysis of Variance |
| 3. Confidence limits for the population mean | 6. Regression and Correlation |
| | 7. Chi Square Test |

105. Bioinformatics :

1. Basic Terminologies in Bioinformatics
2. Biological databases
3. NCBI Search for Gene Sequences
4. UniProt Knowledgebase (UniProt KB) Search for Protein Sequences
5. RCSB PDB search for Protein 3D Structures
6. Pair wise Sequence Alignment using NCBI BLAST
7. Pair wise Sequence Alignment using Bio edit
8. Multiple Sequence alignment using CLC Protein Workbench
9. Multiple Sequence alignment using Clustal X
10. Analysis of 3 D structure of protein by Rasmol

M.Sc.(Microbiology) SEMESTER – II

MICRO-207: BIOCHEMISTRY

Unit – 1 : Carbohydrates, Lipids and Fatty Acid metabolism

- 1.1 Monosaccharides and disaccharides: Types and properties
- 1.2 Polysaccharides: Homopolysaccharides and heteropolysaccharides
- 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 and electron 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

MICRO-208 : BIOTECHNOLOGY & IMMUNOLOGY

Unit – 1 : Biotechnology -1.

- 1.1 Biotechnology : Definition, History and Career scopes
- 1.2 Techniques of immobilization of enzymes & cells
- 1.3 Applications of Immobilized Enzymes & Cells
- 1.4 Bioremediation

Unit – 2 : Biotechnology -2

- 2.1 Basics of genetic engineering
- 2.2 DNA isolation techniques
- 2.3 Restriction enzymes, Gene targeting
- 2.4 Vectors : plasmids, cosmids and phages, Host vector system, Screening of the recombinant clones

Unit – 3 : Animal and Plant Tissue culture

- 3.1 Principles and Techniques of Plant Tissue Culture
- 3.2 Basic Steps of Plant Tissue Culture
- 3.3 Types of Plant Tissue Culture
- 3.4 Principles and techniques of animal tissue culture

Unit – 4 : Immunology

- 5.1 Antigen Antibody: Factors Influencing Immunogenicity, Structure of Ig, Ig Classes & Biological Activities, Monoclonal Antibodies
- 5.2 Innate and Adaptive Immune System
- 5.3 Antigen-Antibody Interactions: ELISA Test, Agglutination, Precipitation, Immunofluorescence
- 5.4 Hypersensitivity and Autoimmunity

MICRO-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, interdemec 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 – 3 : Environment 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.
- 3.3 Biomes 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, Environmental Impact Assessment methodologies, Procedure for reviewing environmental impact analysis, Principles of Remote sensing and its applications of environmental sciences, Application of GIS in Environmental management.

MICRO-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

- 1.1 Principle and applications of Centrifugation techniques
- 1.2 Basic principles of Electrophoresis, Agarose gel, native and SDS-PAGE
- 1.3 Isoelectric focusing, 2D-PAGE and their uses in protein research
- 1.4 Fractionation and Blotting Techniqu

MICRO-211 : 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 Deaminase Urea 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