

GUJARAT UNIVERSITY

**SYLLABUS OF
M.Sc - II
EXAMINATION**

MASTER OF SCIENCE

GUJARAT UNIVERSITY
SYLLABUS M.Sc. PART II (MICROBIOLOGY)
(Effect from June, 2004)

There shall be three theory papers each of three hours duration and three practicals each of seven hours duration. Each theory paper shall carry hundred marks and each practical shall carry fifty marks. Fifteen marks from each practical shall be reserved for dissertation or review of literature on given specific topic. The candidate is required to show article to faculty in/ before interpreting his/her experimental work. Two typed/computerised bound copies of the dissertation shall be submitted to the University during the final M.Sc. at least fifteen days before the commencement of the final examination.

Each theory paper is divided into five units. Each unit will have equal weightage while setting question paper. Question or its sub question including the options will be set from the same unit.

There shall be at least one microbiological study tour during two years of P.G. study. It will pertain to different microbiological/environmental industries/work even outside Gujarat State. The microbiological tour is highly essential for studying microbiological process and technology.

Practical batch will be consisting of maximum 10 students.

Student can select any one paper from the three optional papers as paper VI.

PAPER IV : BIOPROCESS AND FERMENTATION TECHNOLOGY

UNIT I : ELEMENTS OF BIOPROCESS TECHNOLOGY :

- * Industrial strains – Strategies for selection, improvements, maintenance
- * Containment of recombinant organisms
- * Substrate and product modification and Media formulation
- * Mixed culture, consortium and mixed substrate concept
- * Screening for novel products

UNIT II : BIOREACTOR DESIGN AND SCALE UP :

- * Laboratory, pilot and large scale reactor
- * Sterilisation kinetics – sterilisation of Media and Air
- * Mass transfer of oxygen
- * Concepts of Newtonian and Non-Newtonian Fluids

UNIT III : BIOPROCESS KINETICS :

- * Control of process parameters
- * Instruments for monitoring bioreactor and fermentation processes, Micro process based control system, data analysis, dynamic model of fermentation process
- * Downstream processes – cell separation and product purification

UNIT IV : SELECTIVE TECHNIQUES AND ITS APPLICATION :

- * Immobilisation – Cells, Enzymes and Enzyme + Cell
- * Tissue Culture
- * Monoclonal Antibody
- * Bioassay
- * Emerging technology and its application : Bioreporters, Biosensors and Microprobes

UNIT V : QUALITY ASSURANCE AND FERMENTATION ECONOMY :

- * Basic of quality assurance and quality control
- * Sterility testing, LAL test and bioassays

- * Product safety analysis
- * Patenting of processes and products
- * Economics of fermentation processes

PAPER V : ADVANCES IN INDUSTRIAL MICROBIOLOGY

UNIT I : HEALTHCARE PRODUCTS :

- * Antibiotics
- * Anticancer agents
- * Vaccines
- * Steroid transformation
- * Production of rDNA
- * Siderophores

UNIT II : FOOD AND BEVERAGES :

- * Modern brewery technology – Wine, Beer and Whisky
- * Traditional fermented foods Soya sauce
- * Dairy products – Cheese, Yoghurts, Liquid products
- * Starter culture and its importance
- * Amino acids – Lysine, Glutamic acids
- * Vitamins – B2, B12

UNIT III : INDUSTRIAL CHEMICALS AND BIOCHEMICALS :

- * Organic acids – Citric acid, Acetic acid
- * Ethanol, Acetone – Butanol
- * Amylase, Lipase, Protease

UNIT IV : BIOPOLYMERS AND BIOFUELS :

- * Exopolysaccharides
- * Biopolymers
- * Bio plastic
- * Biosurfactants
- * Biogas
- * Gasohol

UNIT V : MICROBIAL BIOMASS :

- * Biofertilizer - Nitrogen, Phosphorus, Sulphur, Iron, Mycorrhizae,
- * Bioinsecticides, Biopesticides
- * SCO
- * SCP
- * Edible Mushrooms.

PAPER VI : ENVIRONMENTAL MICROBIOLOGY AND BIOTECHNOLOGY (Optional)

UNIT I : CONCEPT AND DYNAMICS OF ENVIRONMENT :

- * Basic concepts – Community structure and organisation
- * Productivity and biogeochemical cycles
- * Microbial production of pollutants
- * Global problems
- * Environmental impact assessments
- * Conservation strategies

UNIT II : PRINCIPLES AND METHODS OF WASTE MANAGERMENTS :

- * Characterisation of waste
- * Biological problems of waste treatment
- * Waste treatment – Physical, Chemical, Biological, Aerobic, Anaerobic, Primary, Secondary, Tertiary
- * Solid waste treatment – Saccharification, gasification, composting
- * Utilisation of solid waste for food, fuel and fertilisers
- * Treatment methods – Tickling, Activated sludge, Oxidation ponds and ditch, Fixed film, Rotatory biological contractor, Fluidised bed and Packed bed reactors

UNIT III : PRINCIPLES AND METHODS OF BIOREMEDIATION :

- * Principles – Biosorption, Bioaccumulation, Bioconversion, Biodegradation, Biotransformation, Co-metabolism,
- * Mechanisms – Activation, Acclimatisation, Detoxification, Bioremediation technique kinetics, GMOs and their impacts
- * Bioremediation of Oil spills, Metals and Hazardous wastes.

UNIT IV : BIODEGRADATION AND BIODETERIORATION :

- * Biodegradation of Lignin, Pesticides, Dyes and Hydrocarbons
- * Biodeterioration, Prevention and Control of Paper, Leather, Wood, Textiles, Paints, Stone, Metal, Rubber, Plastic, Petroleum

UNIT V : BIOGEO TECHNOLOGY :

- * Bioleaching of metals
- * Biobeneficiation
- * Desulphurisation of fuel
- * Oil field microbiology

REFERENCES :

- | | |
|---|--------------------------------|
| Manual of Environmental Microbiology, 2nd ed. | C. J. Hurst <i>et al</i> (eds) |
| Manual of Industrial Microbiology and Biotechnology, 2nd ed. | Demain & Davies |
| Microbial Mineral Recovery | Ehrlich & Bierley |
| Genetic Engineering | S. Mitra |
| Recombinant DNA Methodology II | Ray Wu |
| Enzymes and Immobilized Cells in Biotechnology | A. L. Laskin |
| Environmental Microbiology – A Laboratory Manual | Pepper <i>et. al</i> |
| Biodegradation and Bioremediation | M. Alexander |
| Sources of experiments for the teaching of microbiology | Primrose & Wardlaw |
| Microbial Transformation and Degradation of toxic Organic Chemicals | Young & Cernigilla |
| Biotechnology of Filamentous Fungi | Finkelstein & Ball |
| Assessing Ecological Risks of Biotechnology | Lev R. Ginzburg |
| Microbiological Quality Assurance | Brown & Gilbert |
| Comprehensive Biotechnology Volume: II | Conney & Humphrey |
| Biotechnology Volumes | H.J. Rehm & Reed |
| Waste Water Treatment | Arceivala |
| Molecular Industrial Mycology | Leong & Berka |
| Topics in Enzyme & Fermentation Biotechnology | Volumes by Wisemen |
| Bioprocess Engineering | P.K. Ghosh |

Principles of Fermentation Technology	Stanbury, Whittaker & hall
Superbugs	Horikoshi & Grants
N ₂ Fixation	Muller & Newton
Biodeterioration	volumes
Handbook of water and waste water treatment technology	Paul
Recent advances in biological N ₂ - fixation	Subbarao
New approaches in microbial ecology	Tiwari & Saxena
Genetic control of environmental pollutants	Gilbert & Alexander
Microbial cell-cell interaction	Martin
Bacteria in their natural environment	Fletcher
How computer works	Rem white
Introduction to environmental Microbiology	Michael R.
Biology of Industrial Microorganisms	A.L. Duncun

For each topic the current references will be given as and when needed.

PRACTICALS :

Paper IV :

1. Oxygen Transfer Rate (OTR)
2. Study of rheological changes of broth due to fungal growth
3. Recovery & Purification of fermentation products-enzymes, antibiotics, organic acids, alcohol, exopolysaccharide Influence of medium composition
4. Strain improvement study
5. Immobilisation of cells and enzymes
6. Scale up from flask to lab fermentor
7. Bioassay
8. Validation and Quality assurance

Paper V :

1. Production of antibiotics
2. Production of Amylase
3. Production of Lipase
4. Production of Alcohol
5. Production of Vinegar
6. Study on Indian fermented food
7. Production of Organic Acids
8. Microbial production of Polysaccharide
9. Microbial production of Biosurfactants
10. Microbial production of Biogas
11. Development of SCP, SCO and Biofertilizer

Paper VI :

1. Study of microbial ecology
2. Biotreatment of domestic water
3. Biodegradation of hydrocarbon
4. Biotransformation of metals
5. Bioremediation of organic and inorganic pollutants
6. Biodeterioration of stone, leather, paper
7. Characterisation of waste – physical and chemical
8. Analysis of drinking water by MTT and MFT
9. Biooxidation of Iron

10. Bioleaching study
11. Biooxidation of sulphur in soil

Besides these practicals, other practicals of relevance shall be introduced as per the need.

PAPER VI : RECOMBINANT DNA TECHNOLOGY (Optional)

UNIT I :

- * Core techniques and essential enzymes used in rDNA. Restriction digestion, ligation and transformation.

UNIT II :

- * Cloning vectors-plasmids, phages and cosmids. Cloning strategies. Cloning and selection individual genes, gene libraries: cDNA and genomic libraries.

UNIT III :

- * Specialised cloning strategies. Expression vectors, Promoter probe vector's, vectors for library construction-artificial chromosomes.

UNIT IV :

- * PCR methods and application.

UNIT V :

- * DNA sequencing methods; dideoxy and chemical method.
- * Sequence assembly. Automated sequencing. Genome sequencing and physical mapping of genes.

References :

1. Principles of gene manipulation. 1994. Old & Primose. Blackwell Scientific Publications.
2. Molecular cloning. 3 volumes. Sambroose and Russell. 2000. CSH press.
3. Genome analysis. Four volumes. 2000 CSH Press

PAPER VI : IMMUNOLOGY (Optional)

UNIT I : Immune System and Immunity : History of Immunology; structures, composition and function of cells and organs involved in immune system; host parasite relationships; microbial infections; Virulence and host resistance; Immune responses-innate immunity, acquired immunity; immune haematology-blood Groups, Blood transfusion and Rh incompatibilities.

UNIT II : Antigens and Antibodies : Antigens – structure and properties- types - iso and allo - haptens, adjuvants-antigen specificity. Vaccines and toxoids. Immunoglobulins – structure – heterogeneity - types and subtypes-properties (physico, Chemical & Biological); Theory of antibodies production. Complement - structure- components - properties and functions of complement components; Complement pathway and biological consequences of complement activation.

UNIT III : Antigen-antibody reactions : *In vitro* methods - Agglutination, precipitation, complement fixation, Immuno fluorescence, ELISA, Radio Immuno Assays; *In vivo* methods: skin test and Immune complex Tissue demonstration applications of these methods in diagnosis of microbial diseases.

UNIT IV : Major Histocompatibility Complex and Tumour Immunology : Structure and function of MHC & HL-A system. Gene regulation and IR genes; HLA and Tissue transplantation-tissue typing methods for organ and tissue transplantation in Humans; Graft rejection, Host reactions and rejection; Auto-immunity- theory, mechanism and diseases with their diagnosis; tumour immunology- tumour specific antigens, immune response for tumours, Immunodiagnosis of tumours-detection for tumour markers-alpha foetal proteins, carcinoembryonic antigens etc.

UNIT V : Hyper sensitivity Reactions : Antibody mediated type-1. Anaphylaxis type-2. Antibody dependent cell cytotoxicity type-3. Immune complex mediated reaction type-4. Cell mediated hypersensitivity reaction. The respective diseases, Immunological method of diagnosis. Lymphokines and Cytokines-their Assay methods.

Text Books :

1. Roitt, I. M. (1998), Essentials of Immunology, ELBS
2. Kuby, J. (1994), Immunology II
3. Klaus D. Elger (1996) Immunology – understanding of immune system, Wiley-Liss
4. Topley and Wilson's (1995), Text book on principles of bacteriology, virology and immunology, IX edition (5 volumes), Edward, London