

# DEPARTMENT OF MICROBIOLOGY

## COURSE CURRICULUM & MARKING SCHEME

### M.Sc. MICROBIOLOGY

### Semester - IV

SESSION : 2024-25



ESTD: 1958

## GOVT. V.Y.T. PG AUTONOMOUS COLLEGE, DURG, 491001 (C.G.)

(Former Name – Govt. Arts & Science College, Durg)

NAAC Accredited Grade A<sup>+</sup>, College with CPE - Phase III (UGC), STAR COLLEGE (DBT)

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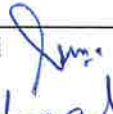









**DEPARTMENT OF MICROBIOLOGY**  
**GOVT. V. Y. T. P.G. AUTONOMOUS COLLEGE DURG**  
**SYALLABUS AND MARKING SCHEME**

**FOURTH SEMESTER**

**Session: 2024-2025**

Paper No.	Title of the Paper	Marks Allotted in Theory		Marks Allotted in Internal Assessment		Credits
		Max	Min	Max.	Min.	
I	MMB401 ENVIRONMENTAL MICROBIOLOGY	80	16	20	04	05
II	INDUSTRIAL MICROBIOLOGY AND FERMENTATION TECHNOLOGY	80	16	20	04	05
IIIA	MICROBIAL BIOTECHNOLOGY  (Elective)	80	16	20	04	05
IIIB	MICROBIAL GENOMICS AND PROTEOMICS  (Elective)	80	16	20	04	05
IV	LAB COURSE Based on Paper I	100	-	-	-	04
V	LAB COURSE Based on Paper II & III	100	-	-	-	04
VI	PROJECT WORK	200	50	-	-	08
	Total	640		60		31

**Name and Signatures**

Chairperson/ HOD- Dr. Pragya Kulkarni 	Student Nominee – Ms. Yogita Lokhande 
Subject Expert - Dr. Anita Mahiswar 	Departmental members
Subject Expert - Dr. Sonal Mishra 	1. Mrs. Rekha Gupta 
VC Nominee – Dr. Prakash Saluja	2. Mrs. Neetu Das 
Industrial Representative- Shri Amitesh Mishra 	3. Ms. Anamika Sharma 
Member of Other Department- Dr. Ranjana Shrivastava	4. Ms. Mrinalini Soni 
	5. Ms. Neetu Bhargava 

M.Sc. – MICROBIOLOGY  
SEMESTER IV  
PAPER – I  
MMB 401 ENVIRONMENTAL MICROBIOLOGY

Max.M.-80; Min. M. -16

Upon successful completion of the course students will be able –

- ❖ To understand the different branches of environmental microbiology
- ❖ To study the interactions of microbes in different environments
- ❖ To get idea about the role of microorganisms in their respective environments
- ❖ To make acquainted with the concept of decomposition by microbes

**Unit – I**

- Aerobiology: Droplet nuclei, aerosol, Assessment of air quality, solid-liquid-impingement methods.
- Brief account of air borne transmission of microbes (viruses, bacteria & Fungi) their diseases and preventive measures.
- Positive and negative roles of microbes in environment: Bioremediation, Biodegradation of recalcitrant compounds, lignin, pesticides, bioaccumulation of metals, biodeterioration of paper, leather, wood, textiles.
- Metal corrosion: mode of deterioration, organisms involved, its disadvantages, mode of prevention.

**Unit – II**

- Aquatic microbiology: Water ecosystem, fresh water (pond, lakes, streams)-marine habitats (estuaries, mangroves, deep sea, hydrothermal vents, salt pans, coral reefs)
- Zonations of water ecosystems: Upwelling, Eutrophication
- Potability of water: microbial Assessment of water quality, Water purification

**Unit – III**

- Soil microbiology: Classification of soils, Physical and chemical characteristics
- Brief account of microbial interactions, symbiosis, mutualism, commensalisms, competition, ammensalism, synergism, parasitism, predation
- Biogeochemical cycles and the organisms: carbon, nitrogen, phosphorus and sulphur
- Biofertilisers: biological nitrogen fixation, nitrogenase enzyme, nif genes
- Symbiotic microbes: Rhizobium and Frankia, Non symbiotic microbes: azotobacter razospirillum
- Mycorrhiza: ecto, endo, ectendomycorrhizae
- Microbiology of rumen

**Unit – IV**

- Waste Treatment: -types of wastes (solid,liquid), characterization
- Treatments: physical, chemical, biological (aerobic, anaerobic, primary, secondary and tertiary).
- Solid waste treatment: Saccharification, Gasification, Composting,
- Utilization of solid wastes in food (SCP, mushroom, yeast), fuel (ethanol, methane) fertilizer (composting)
- Liquid waste treatment: Trickling Activated sludge, Oxidation pond, Oxidation ditch.

Name and Signatures:

Chairperson/ HOD

Subject Expert

Subject Expert

VC Nominee

Industrial Representative

Member of Other Department

Student Nominee

Departmental members:

**Recommended Books:**

1. Environmental Microbiology – Banwarila, Cybertech. Pub.
2. Introduction to Soil Microbiology – Alexander Martin, Wiley Eastern Press.
3. Agricultural Microbiology – G. Rangaswami and D.J. Bagyaraj, Prentice Hall India Ltd.
4. Environmental Biotechnology –InduShekher Thakur, International Pub. House
5. Microbial Ecology fundamental &applications -R.M.Atlas&R.Bartha, Pearson pub.

**Session: 2024 - 25**  
**M.Sc. – MICROBIOLOGY**  
**SEMESTER IV**  
**PAPER – II**  
**MMB 402 INDUSTRIAL MICROBIOLOGY AND FERMENTATION TECHNOLOGY**

**Max.M. – 80; Min. M. -16**

Upon successful completion of the course students will be able –

- ❖ To understand the history and scope of industrially important microorganisms
- ❖ To be acquainted with the mechanism of strain improvement strategies
- ❖ To gain skill to deal with new ideas through modern techniques
- ❖ To get overview of different products of microbial origin for commercial production

**Unit – I**

- Introduction to industrial microbiology. Definition, scope, history, Screening for microbes of industrial importance
- Primary screening and Secondary screening, Fermentation equipment and its use
- Mode of fermentation: Batch, fed batch and continuous fermenters
- Design and Types of fermenters: Agitation, aeration, antifoam; pH and temperature control during fermentation
- Methods of fermentation: Direct, dual or multiple fermentations, Scale-up of fermentations

**Unit – II**

- Strain development strategies: Environmental factors and genetic factors for improvement
- Raw materials: Saccharides, starchy and cellulosic materials
- Fermentation media and sterilization
- Types of fermentations processes – Solid state, surface and submerged fermentations.
- Role of computer in fermenter operation
- Downstream Processing

**Unit – III**

- Production and application of microbial enzymes: Amylases and proteases, uses, microorganisms, inoculum preparation, production medium, fermentation and recovery
- Fermentative production of vitamin B2 and vitamin B12
- Industrial production of organic acid-citric acid, glutamic acid and lactic acid

**Unit – IV**

- Industrial production of alcohol and alcoholic beverage (beer and wine)
- Commercial production of antibiotics – Penicillin, Tetracycline, Streptomycin
- Fermentative production of amino acids and uses

**Name and Signatures:**

  
**Chairperson/ HOD**

  
**Subject Expert**

  
**Subject Expert**

**VC Nominee**

**Industrial Representative**

  
**Member of Other Department**


  
**Student Nominee**

**Departmental members:**











**Recommended Books:**

1. Fermentation technology – M.L. Srivastava, Nrosa Pub.
2. Principles of Fermentation technology – P.R. Stanbury
3. Solid State Fermentation in Biotechnology – A.Pandey, S. Rodriguez and Nigam, Asia Tech Pub.
4. Advances in Fermentation Technology – A.Pandey, S. Rodriguez and Nigam, Asia Tech Pub.
5. Biotechnological innovations in chemical synthesis – BOITOLpub., Butterworth,
6. Industrial Microbiology – G.Reed (Editor), CBS publishers, New Delhi.
7. Biology of Industrial Microorganisms – A. L. Demain.
8. Pharmaceutical Biotechnology – S.P. Vyas and V.K. Dixit, Cbs pub. New Delhi.
9. Industrial Biotechnology – S.N. Jogdand, Himalaya Pub. House ,Delhi
10. Industrial Microbiology – A.H. Patel, Macmillan India Ltd.



**Session: 2024 - 25**  
**M.Sc. – MICROBIOLOGY**  
**SEMESTER IV**  
**PAPER – III A (Elective)**  
**MMB 403A MICROBIAL BIOTECHNOLOGY**

**Max.M.- 80; Min. M. -16**

Upon successful completion of the course students will be able –

- ❖ To learn about core techniques, different strategies and cloning vectors of rDNA Technology
- ❖ To learn the sequential steps for creation of important products
- ❖ To know about genetically modified organisms and their impact on environment
- ❖ To understand PCR technique and its applications and gain the knowledge of rights, ethical issues and safety aspects about microbial biotechnology

**Unit – I**

- Genetic Engineering: Scope, Core techniques & essential enzymes used in rDNA technology
- Restriction digestion, ligation & transformation
- Cloning vectors: Plasmids, types & structures , Phages, cosmids vectors, Expression vectors, Promoter probe vectors
- Artificial chromosomes: YAC, and BAC

**Unit – II**

- Specialized Cloning strategies: cDNA synthesis and cloning, mRNA enrichment, DNA Primers, Linkers, Adaptors and their synthesis
- Genomic libraries, Nucleic acid microArrays
- Site directed mutagenesis and Agrobacterium-mediated transformation
- Particle bombardment, Calcium chloride transformation of bacteria

**Unit – III**

- Steroid transformations – Substrates, typical structures, microorganisms, inoculums preparation, 11-hydroxylation, process and recovery
- Therapies for genetic diseases (gene therapy)
- Monoclonal antibodies and hybridoma technology, Vaccine development, Immobilized enzyme
- Genetically modified microorganism and their impact

**Unit – IV**

- PCR: Methods and Applications
- Introduction to Intellectual Property Rights, Patentable subject matter and patent types, Patent requirements: technical specifications, novelty, and non-obviousness
- Rights of patent holder, Patent protection for biological materials
- Regulations for clinical trials, Rules for import and export of biological materials
- Bio-safety and Bioethics

**Name and Signatures:**

**Chairperson/HOD**

**Subject Expert**

**Subject Expert**

**VC Nominee**

**Industrial Representative**

**Member of Other Department**

**Student Nominee**

**Departmental members:**

*[Signature]*

*[Signature]*

*[Signature]*

*[Signature]*

*[Signature]*

**Recommended Books:**

1. Principles of gene manipulation – Old and Primrose, Blackwell Publications
2. Molecular Cloning – Sambrose and Russell, CHS press
3. Biotechnology – B. D. Singh, Kalyani Pub.
4. A text book of Biotechnology – R.C. Dubey, S. Chand & Company Ltd.
5. Biotechnology – S.N. Jogdand, Himalaya Pub.
6. Gene Cloning – Sambrook, MacGraw hill Pub.
7. Genomics and Cloning Technology and Application – H.D. Kumar, East-West Press Pvt.Ltd.



**Session: 2024 - 25**  
**M.Sc. – MICROBIOLOGY**  
**SEMESTER IV**  
**PAPER – III B (Elective)**  
**MMB 403B MICROBIAL GENOMICS AND PROTEOMICS**

**Max. M.- 80 Min. M.-16**

**Upon successful completion of the course students will be able –**

- ❖ **To understand the broader biology of microorganisms for their genetic composition**
- ❖ **To contribute substantial characteristics required for genomic studies**
- ❖ **To be familiar with techniques of identification of genetic material**
- ❖ **To generate a basic knowledge about current applied techniques for proteomic studies**

**Unit - 1**

- Whole genome analysis: preparation of ordered cosmid libraries
- Bacterial artificial chromosome libraries, shotgun libraries
- Conventional sequencing (Sanger, Maxam and Gilbert methods), automated sequencing

**Unit- 2**

- Sequence analysis: computational methods, homology algorithms (BLAST) for proteins and nucleic acids
- Open reading frames, annotations of genes, conserved protein motifs related structure/function (PROSITE, PFAM, Profile Scan)
- DNA analysis for repeats (direct and inverted), palindromes, folding programs

**Unit - 3**

- DNA microarray: printing of oligonucleotides and PCR products on glass slides, nitrocellulose paper
- Whole genome analysis for global patterns of gene expression using fluorescent labelled cDNA or end labelled RNA probes
- Analysis of single nucleotide polymorphisms using DNA chips

**Unit - 4**

- Proteome analysis: Two-dimensional separation of total cellular proteins, isolation and sequence analysis of individual protein spots by mass spectroscopy.
- Protein microarray
- Advantages and disadvantages of DNA and protein microarrays
- Use of internal, public domain databases for nucleic acid and protein sequences (EMBL, GenBank), database for protein structures (PDB)

**Name and Signatures:**

**Chairperson/ HOD**



**Subject Expert**



**Subject Expert**



**VC Nominee**

**Industrial Representative**

**Member of Other Department**

**Student Nominee**



**Departmental members:**



### **Recommended Books:**

1. Introduction to Bioinformatics. Lesk M.A. (2008) Oxford Publication, 3rd International Student Edition
2. Bioinformatics: methods and applications, genomics, proteomics and drug discovery, Rastogi S.C., Mendiratta N. and Rastogi P. (2007) 2nd ed. Prentice Hall India Publication
3. Principles of Protein structure- Schultz, G. E., and Schirmer, R. H. Dr. ShaktiSahi Proteomics, Daniel C. Leibler
4. Microbial Proteomic- MarjoPoutanen
5. Proteins: Structures and Molecular Principles (2d ed.), TE Creighton Organic spectroscopy, William Kemp
6. Proteome Research: Two-Dimensional Gel Electrophoresis and DetectionMethods (Principles andPractice), T. Rabilloud (Editor), 2000, Springer Verlag
7. Introduction to Protein Architecture: The Structural Biology of Proteins, M.Lesk, 2001, Oxford University Pres

**Session: 2024 - 25**  
**M.Sc. MICROBIOLOGY**  
**SEMESTER -IV**  
**MMBL 07 LAB COURSE I: ENVIRONMENTAL MICROBIOLOGY**  
**List of Practical Exercises**

**M.M. - 100**

**I -Environmental Microbiology**

1. Isolation of pesticide & herbicide degrading microorganisms
2. Study of mycorrhizal root colonization and spore load in soil of different plants
3. Isolation of symbiotic & non-symbiotic biofertilizers from soil
4. Identification of symbiotic bacteroid of Rhizobia
5. Isolation of phosphate solubilizing microorganism from soil
6. Isolation of antibiotic producer from soil and determine the antimicrobial spectrum of isolates.
7. Isolation of nitrate producing microorganism from soil
8. Water analysis for total bacterial population by standard plate count (SPC) method
9. Detection of coliform bacteria in water sample
10. Determination of Biological Oxygen Demand (BOD) of water.
11. Detection of Cyanotoxin in water samples

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**Student Nominee**

**Departmental members:**







**M.Sc. MICROBIOLOGY  
SEMESTER -IV**

**MMBL 08 LAB COURSE II: INDUSTRIAL MICROBIOLOGY, FERMENTATION  
TECHNOLOGY AND MICROBIAL BIOTECHNOLOGY/ MICROBIAL GENOMICS AND  
PROTEOMICS**

**List of Practical Exercises**

M.M. - 100

**I-INDUSTRIAL MICROBIOLOGY AND FERMENTATION TECHNOLOGY**

1. Lipase production and confirmation.
2. Cellulase production and confirmation.
3. Amylase production and confirmation.
4. Xylanase production and confirmation.
5. Production of antibiotics from Actinomycetes and confirmation of anti microbial activity.
6. Liposome production for immobilization of protein.
7. Demonstration of Alcohol production
8. Enzyme assay and study of enzyme kinetics

**II A- MICROBIAL BIOTECHNOLOGY**

1. Isolation of DNA from bacteria and determination of molecular size Isolation and purification of Plasmid DNA from bacteria.
2. Gene Expression study in microorganism.
3. Restriction Mapping of DNA and interpretation.
4. Bio templet based nanomaterial synthesis and study of antimicrobial activity
5. Awareness of Patenting

**II B - MICROBIAL GENOMICS AND PROTEOMICS**

1. Sequence analysis of DNA
2. Protein isolation from E coli, Bacillus and Yeast.
3. Sequence analysis of proteins (by BLAST, ClustalW and Phylip).
4. Protein structure prediction by Homology modeling.
5. Overexpression of heterologous protein in *E. coli*.
6. Purification of cloned protein in *E. coli*.
7. Protein identification by immunoblotting

Name and Signatures:

Chairperson/ HOD

Subject Expert

Subject Expert

VC Nominee

Industrial Representative

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Student Nominee

Departmental members:









