

Pt. Ravishankar Shukla University, Raipur
M. SC. MICROBIOLOGY (Program code- M. Sc. 0407)
Scheme and Syllabi of Examination for SESSION 2022-2024

July 2022-December 2022

	Paper code.	Title of Paper	Marks	
			(External)	(Internal)
FIRST Semester	MB-101	Bacteriology & Virology	80	20
	MB102	Phycology & Mycology	80	20
	MB103	Biomolecules & Enzymology	80	20
	MB104	Biology of Immune System	80	20
	MB105	Lab Course I (Based on paper I & II)	100	
	MB106	Lab Course II (Based on paper III & IV)	100	
Total			600	

January 2023-June 2023

	Paper code.	Title of Paper	Marks	
			(External)	(Internal)
SECOND Semester	MB-201	Instrumentation	80	20
	MB 202	Biostatistics	80	20
	MB 203	Microbial Physiology	80	20
	MB 204	Microbial Genetics	80	20
	MB 205	Lab Course I (Based on paper I & II)	100	
	MB 206	Lab Course II (Based on paper III & IV)	100	
Total			600	

July 2023-December 2023

	Paper code.	Title of Paper	Marks	
			(External)	(Internal)
THIRD Semester	MB 301	Molecular Biology	80	20
	MB 302	Bioenergetics & Metabolism	80	20
	MB 303	Environmental Microbiology	80	20
	MB 304	Industrial microbiology & fermentation technology	80	20
	MB 305	Lab Course I (Based on paper I & II)	100	
	MB 306	Lab Course II (Based on paper III & IV)	100	
Total			600	

January 2024-June 2024

	Paper code	Title of Paper	Marks	
			(External)	(Internal)
Fourth Semester	MB 401	Microbial Biotechnology	80	20
	MB 402	Medical Microbiology -	80	20
	MB 403	Food & Dairy Microbiology	80	20
	MB 404	Agricultural Microbiology	80	20
	MB 405	Lab Course I (Based on paper I & II)	100	
	MB406	Lab Course II (Based on paper III & IV)	100	
Total			600	
Or				
		Project Work		
		Dissertation	240	60
		Project report with presentation	160	40
		Viva-voce	80	20
Total			600	
Grand Total			2400	

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- Each student will be evaluated continuously throughout the semester. There will be a class test based on each theory paper. The full marks for internal Assessment will be 20 for each paper.
- There will be a poster/oral presentation based on each theory paper. The full marks will be 20 for each presentation. Each student will be required to submit a brief write-up (not more than 10 pages) on his/her poster/oral presentation.
- A student of IV semester will have the choice to opt for project work in lieu of four theory papers and two lab courses provided he/she secure at least 65% or more marks in aggregates in semester I and II
- The valuation of all the projects will be carried out by an external examiner and HoD or its nominee..

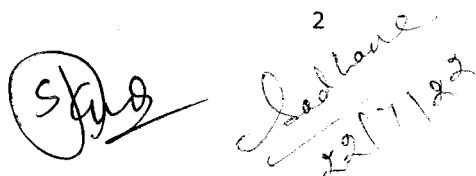
Scheme for lab course

S. no.	Exercise	(For each semester) Maximum marks
1	Major Exercise based on paper 1	20
2	Minor Exercise based on paper 1	10
3	Major Exercise based on paper 2	20
4	Minor Exercise based on paper 2	10
5	Spotting/Interpretation	10
6	Viva-voce	10
	Sub Total	80
	Sessional(Internal)	20
	Total	100

**M. Sc. – MICROBIOLOGY
SEMESTER I
BACTERIOLOGY & VIROLOGY
July 2022-December 2022**

UNIT- 1

- Morphology and ultra structure of bacteria: Morphological types, Archaeobacteria, Gram negative and positive Eubacteria, Actinomycetes and L-forms
- Cell wall: synthesis, antigenic properties
- Capsule: types, composition and function Cell membranes: structure, composition and properties.
- Structure and functions of flagella, pili, gas vesicles, chromosomes, carboxysomes, magnetosomes Phycobolismes, Endospore. Cell division
- Reserve food material, polyhydroxybutyrate, polyphosphate granules, oil droplets, cyanophycin granules and sulphur inclusions.

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UNIT-2

- Classification of microorganisms: Basis of microbial classification
- Haeckel's three kingdoms concept, Whittacker's five kingdom concept, three domain concept of Carl Woese
- Salient feature of bacterial classification according to the Bergey's manual of determinative bacteriology
- Cultivation of bacteria: aerobic, anaerobic, shake & still cultures
- Nutritional types, culture media, Growth curve, Generation time, Growth kinetics, Asynchronous, synchronous, batch, continuous cultures
- Measurement of growth, factors affecting growth, Control of bacteria and preservation methods.

UNIT 3

- Brief outline on discovery of viruses, Classification and nomenclature of viruses
- Distinctive properties of viruses, morphology and ultra structure, capsids and their arrangements, types of envelopes and their composition, Viral genome, their types and structures
- Virus related agents (viroids, prions).
- Bacteriophages: structural organization, life cycle; one step growth curve, eclipse phase, phage production, burst size, lysogenic cycle, bacteriophage typing
- Brief description on M13, Mu, T3, T4, and Lambda P1.

UNIT- 4

- Cultivation of viruses: embryonated eggs, experimental animals, Cellculture: primary and secondary cell cultures, suspension cell cultures and monolayer cell cultures and transgenic system
- Assay of viruses: physical and chemical methods (protein, nucleic acid, radioactive tracers, electron microscopy), infectivity assay (plaque Method, end point method)
- Structural organization, life cycle, pathogenicity, symptoms, control of vector : Plant Viruses (TMV, CMV, and PVX) and Animal Viruses (Pox, Herpes, HIV, Influenza, Polio)

MARKING SCHEME

Objectives/multiple choice Questions.	$1 \times 8 = 8$
Short Answer type questions	$6 \times 4 = 24$
Long Answer type questions	$12 \times 4 = 48$
TOTAL	80

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Recomonded Books

- A Text book of Microbiology – P.Chakraborty , New central book agency(P) Ltd.Kolkata.
- General Microbiology I &II - C.B. Powar and H. F. Daginawala , Himalaya Publishing House Bombay.
- Microbiology – B.D. Davis, R. Dulbecco, H.N. Eisen and H.S. Ginsberg, Harper and Row Publishers Philadelphia.
- A Text book of Microbiology – R.C. Dubey and D.K. Maheshwari, S. Chand and Company Ltd., New Delhi.
- Microbiology: Fundamentals and Applications – S.S. Purohit, Students Edition, Jodhpur.
- Biology of Microorganisms – T.D. Brock and M.T. Madigan, Prentice Hall Int. Inc
- Fundamental Principles of Bacteriology – A.J. Sallé
- General Microbiology – R.Y. Stainer, J.L. Wheelis and P.R. Painter, Macmillan Educational Ltd. London.
- Modern Microbiology – E.A. Brige, W.M.C. Brown, Oxford, England
- Text book on Principles of Bacteriology, Virology and Immunology – Topley and Wilson, Edward Arnold, London
- Viruses – K.M. Smith
- An Introduction to Viruses – S.B. Biswas and Amita Biswas, Vikas Publishing house Pvt. Ltd.
- Virology: Principles and Applications – John Carter and Venetia Saunders, John Wiley and Sons Ltd.

**M.Sc.- MICROBIOLOGY
SEMESTER I
PAPER – II PHYCOLOGY AND MYCOLOGY
July 2022-December 2022**

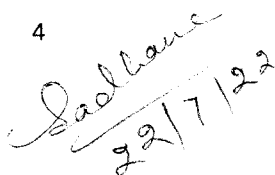
UNIT 1

- Algae – Distribution, classification, thallus range and nutrition,
- Pigmentation of Blue Green Algae, Green Algae, Diatoms, Euglenoids,
- Algal Reproduction ,
- Algal Ecology ,
- Algal Biotechnology.,
- Lichens – General account, classification, structure, reproduction and economic importance.

UNIT 2

- General Features of fungi: Structure and cell differentiation, Classification, Reproduction
- Salient features of Division Myxomycotina, Mastigomycotina and Zygomycotina. Life cycle and economic importance of representative members
- Salient features of Division Ascomycotina– Hemiascomycetes, Plectomycetes, Pyrenomycetes, Discomycetes, labelbeniomyces, Iculoascomycetes.
- Life cycle and economic importance of representative members.




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UNIT 3

- Salient features of Division Basidiomycotina–Teliomycetes, Hymenomycetes. Life cycle and economic importance of representative members
- Salient features of division Deuteromycetes –Hypomycetes, Coelomycetes, Blastomycetes. Life cycle and economic importance of representative members
- Evolutionary tendencies in lower fungi and higher fungi.

UNIT 4

- Fungi and Ecosystem – Saprophytes, substrate groups and nutritional strategies, substrate successions,
- Fungi and bioremediation, Industrial importance of Fungi
- ,Mycorrhiza – Ectomycorrhiza, Endomycorrhiza, Vesicular Arbuscular Mycorrhiza,
- Heterothallism , Sexhormones , Effect of Environment on growth , Prevention of fungal growth

MARKING SCHEME

Objectives/Multiple type questions	1×8= 8
Short answer type questions	6×4=24
Long answer type questions	12×4=48
TOTAL	80

Recommended Books

- An Introduction to Mycology – R.S. Mehrotra, and K.R. Aneja 1990, New Age International publishers.
- Introduction to Mycology (3rd Ed.) – Alexopoulos, C.J. and C.W. Mims 1979. Wiley Eastern Ltd., New Delhi.
- Fundamentals of Mycology – J.H. Burnett Publisher : Edward , Arnold Cranerussak.
- The Fungi – M. Charil & S.C. Watkinson, Publisher: Academic Press.
- Fundamentals of Fungi – E. Moore-Landeekeer, Publisher: Prentice Hall.
- Physiology of Fungi – K.S. Bilgrami and R.N. Verma, Vikas Pub.
- The Algae: Structure and Reproduction, Vol I and II – F.E. Fritsch, Vikas Publishing house Pvt. Ltd.
- A text book of Algae – A.V.S.S. Sambamurthy, I.K. International Pub
- Algae Vol. I – G. Smith

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M. Sc. Microbiology
FIRST SEMESTER
PAPER III: BIOMOLECULES AND ENZYMOLOGY
July 2022-December 2022

UNIT I

- Carbohydrates: structure, classification, properties and function; derivatives of monosaccharides, homo and hetero-polysaccharides, Peptidoglycan, glycoproteins and liposaccharide.
- Lipids: Classification, structure and function.
- Nucleic Acid: Structure of purine and pyrimidine bases, nucleoside and nucleotide; DNA structure and conformation; RNA - Structure, types and functions.

UNIT II

- Amino acids: structure, classification and functions; Synthesis of peptides and protein sequencing.
- Proteins- properties, covalent structure; secondary, tertiary and quaternary structure of proteins, Ramchandran plot.

UNIT III

- Enzyme: classification, coenzymes, active site of enzyme,
- Factors contributing to the catalytic efficiency of enzyme; enzyme kinetics- Michaelis-Menten equation, determination of Km, enzyme inhibition, allosteric enzymes, isoenzymes, ribozyme, multi enzyme complexes

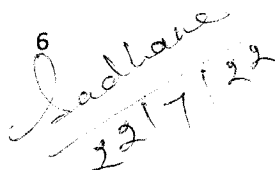
UNIT IV

- Chemistry of porphyrins: Importance of porphyrins in biology; structure of hemoglobin and chlorophyll porphyrins
- Structure and biological role of animal hormones,
- Structure and biological role of water soluble and fat soluble vitamins.

MARKING SCHEME

Obiectives/Multiple type questions	1×8= 8
Short answer type questions	6×4=24
Long answer type questions	12×4=48
TOTAL	80





Books Recommended:

- Principles of Biochemistry by Nelson, Cox and Lehninger
- Biochemistry by G. Zubay
- Biochemistry by Stryer
- Biochemistry by Garrett and Grosham
- Text book of biochemistry by West, Tood, Mason & Bruglen
- Biochemistry by White, Handler & Smith
- Biochemistry by D. Voet and J C Voet

**M. Sc. Microbiology
FIRST SEMESTER
PAPER IV: BIOLOGY OF IMMUNE SYSTEM
July 2022-December 2022**

UNIT I

- Cells of immune system: Hematopoiesis and differentiation, mononuclear cells and granulocytes. Antigen presenting cells.
- Immunoglobulins- structure, types and function.
- Antigen: nature of antigen , factors affecting immunogenicity, Haptens and super antigens. Antigenic determinants. Recognition of antigens by T and B cells. Antigen processing.
- Cells mediated immune response
- Immunity to infections.

UNIT II

- Innate immune mechanism and characteristics of adaptive immune response
- Primary and secondary lymphoid organs and tissues
- Antigen and antibody interaction

UNIT III

- Major Histocompatibility Complex- types, structural organization, function and distribution. Role of MHC molecule in antigen presentation and co-stimulatory signals.
- Transplantation and Rejection.
- Complements in immune function.
- Cytokines and interleukins- structure and function



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UNIT IV

- Ontogeny and phylogeny of lymphocytes. Lymphocyte traffic.
- Hypersensitive reactions and their types.
- Immunodeficiency disorders.
- Autoimmunity.
- Tumor Immunology

MARKING SCHEME

Objective/Multiple type questions	1×8= 8
Short answer type questions	6×4=24
Long answer type questions	12×4=48
TOTAL	80

Books Recommended:

- Kuby's Immunology: R.A. Goldsby, Thomas J Kindt and Barbara A. Osborne
- Immunology- A short Course: E. Benjamini, R. Coico and G. Sunshine
- Immunology: Roitt, Brostoff and Male
- Fundamentals of Immunology: William Paul
- Immunology: Tizard
- Immunology: Abbas *et al*

M. Sc. Microbiology

SEMESTER -I

LAB COURSE I

BACTERIOLOGY & VIROLOGY AND MYCOLOGY & PHYCOLOGY

List of Practical Exercises

Bacteriology and Virology

1. Isolation of bacteria from following sources and study their cultural characteristic Air, Water, Soil.
2. Identification of isolated bacteria by Gram staining
3. Identification of isolated bacteria on the basis of biochemical properties IMViC test
4. TSIA test
5. H₂S production test Catalase production test Amylase production test
6. Determination of bacterial growth by Turbidity measurement (Spectrophotometric method).

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7. Isolation of Actinomycetes from soil and study their cultural characteristics.
8. Phage titration.
9. Symptomatological Study of Viral Diseases (plants and animals).

Mycology & Phycology

1. Isolation of Rhizospheric fungi by Warcup's method.
2. Isolation of Keratinophilic fungi from soil by Keratin Bait technique.
3. Isolation of Coprophilous fungi from dung by Moist Chamber method.
4. Isolation of Storage fungi from food grains by Blotter technique.
5. Isolation of Zoosporic fungi from water by Seed Bait technique.
6. Isolation of Aeromycoflora by petri plate exposure.
7. Study of Endomycorrhizal colonization and calculation of percent root infection.
8. Study the special features of selected fungi.
9. Isolation of green Algae and Cyanobacteria from soil and water samples.
10. Study the special features of selected green algae, cyanobacteria and diatoms.
11. Study the special features and types of lichens.
12. Micrometry and camera Lucida studies of some microbial structures.

M.Sc. MICROBIOLOGY
SEMESTER – I
LAB COURSE II
BIOMOLECULES AND ENZYMOLOGY & BIOLOGY
OF IMMUNE SYSTEM
List of Practical Exercises

Biomolecules

1. Preparation of buffer and determination of pH
2. Determine the carbohydrates in the given sample by Molish test
3. Determine starch by Iodine test
4. Determine reducing sugar in the sample by Benedict's reagent
5. Determine total sugars in the sample by Dubois method
6. Distinguish between aldose and ketose sugar by Seliwanoff's test
7. Detection of free amino acid in the sample by Ninhydrin test
8. Detection of presence of lipid by Saponification.
9. Extraction of protein and estimation by Folin-Lowry and Biuret method
10. Isolation of genomic DNA from bacterial cell and estimate by DPA method (Diphenylamin method)
11. Isolation and estimation of RNA from yeast
12. Enzyme production test by microorganisms (Amylase / Lipase / Gelatinase / Pectinase / Protease)

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Immunology

13. Study of agglutination reaction with blood grouping and Blood examination for Rh factor
14. Characterization of Lymphocytes from blood
15. Antigen antibody reaction by Double Diffusion technique
16. Separation of Immunogen by immuno electrophoresis technique
17. Dot ELISA
18. Determination of concentration of given antigen by RID technique

M.Sc. Microbiology

II Semester

PAPER I

INSTRUMENTATION

January 2023-June 2023

UNIT I

- Centrifugation: Principle, techniques. Preparative, analytical and ultracentrifuges, sedimentation coefficient and factors affecting sedimentation coefficient. Application of centrifugation.
- Photometry: Basic principles of colorimetry, UV- visible spectrophotometry & IR-spectrophotometry. Spectrofluometry. Atomic absorption spectroscopy: Principle, Instrumentation and applications.

UNIT II

- Theory, principle and applications of Paper and Thin Layer Chromatography. Gel filtration, Ion exchange and Affinity chromatography. Gas-liquid chromatography and HPLC. Microtomy: types, principle and applications.
- Microscopy: light, phase-contrast, fluorescence and electron microscopy.
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UNIT III

- Electrophoresis, Moving boundary and Zonal. Paper electrophoresis, Starch gel, agarose, PAGE. 2D-electrophoresis Isoelectric focusing and isotachopheresis.
- Lyophilization: Principle, instrumentation and applications.



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UNIT IV

- Optical rotator dispersion and circular dichorism D: Principles, instrumentation and applications. NMR, GC-Mass: Principles, instrumentation and applications.
- Radioactivity: GM counter, liquid Scintillation counter, solid Scintillation counter, gamma counters. RIA and Autoradiography: applications.

Books Recommended:

- Instrumental Methods of Analysis by B.K. Sharma
- Instrumentation by Chatwal & Chatwal
- Instrumentation by Upadhyaya & Upadhyaya

Marking scheme

Objectives/multiple choice Questions.	1×8=8
Short Answer type questions	6×4=24
Long Answer type questions	12×4=48
TOTAL	80

M.Sc. Microbiology
II Semester
PAPER II
BIOSTATISTICS
January 2023-June 2023

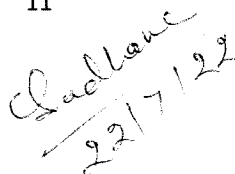
Unit – 1

- Introduction: Definition, Basic concepts
- The sample and population Measurement scales, Statistical inference and parameters
- Classification of Data: Objective of Classification, Types of data
- Presentation of data: Tabulation, Frequency distribution, Graphical presentation of data and interpretation
- Measures of central tendencies (mean, mode, median)
- Measures of dispersion (range, mean deviation, standard deviation and error)

Unit – 2

- Probability : Calculation of Probability,
- Correlation: Types and Methods
- Correlation coefficient and its significance




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Unit – 3

- Regression analysis: linear regression, regression coefficient, uses of regression analysis, difference between correlation and regression.
- Tests of significance: Chi-Square, characteristics, applications
- Student's t Test: Properties and Applications

Unit – 4

- Analysis of Variance (ANOVA): Introduction, procedure, multiple comparisons
- Variance – Ratio test 'F'test
- Experimental designs: Basic concepts and principles, types, significance.
- Statistical quality control: Introduction, types, advantages.

Marking Scheme-

Objectives/multiple choice Questions.	1×8=8
Short Answer type questions	6×4=24
Long Answer type questions	12×4=48
TOTAL	80

Recommended books

- Statistics in Biology – C.I.K. Bliss, Vol.1, McGraw Hill, New York
- Statistics for Biologists – R.C. Campbell, Cambridge Uni. Press, Cambridge.
- Microbiological Assay – W. Hewitt, Academic Press, New York.
- Hand Book for experimental immunology – D.M. Weir, (W. Lutz), Blackwell Pub. Ltd. Oxford.
- Practical Statistics for experimental Biologists –A.C. Wardlaw, John wiley and Sons, New York.
- Biostatistics, A foundation for analysis in the health science, Wayne W. Daniel, Wiley India Edition
- A text book of Biostatistics, B. Annadurai
- Research Methodology, Methods and Techniques, C.R. Kothari, New Age International Pub.
- Biostatistical analysis – J.H. Zar
- Introduction to Biostatistics – R.R. Sokal and F.J. Rohlf
- Fundamentals of Biostatistics – Khan and Khanum, Ukaaz Pub. Hyderabad.
- Biostatistics – P. Ramakrishnan, Saras Pbu. Kanyakumari

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M. Sc. Microbiology
SEMESTER II
PAPER III: MICROBIAL PHYSIOLOGY
January 2023-June 2023

UNIT I

- Microbial photosynthesis: Historical account, structure of photosynthetic pigments i.e., chlorophylls and bacterio-chlorophylls, carotenoids, phycobilins, primary photochemistry and electron transport (light harvesting, charge-separation and electron transport in anoxygenic photosynthesis), ATP synthesis.
- Eubacterial photosynthetic microbes, development of photosynthetic apparatus, carbon metabolism.
- Cynobacterial organization of photosynthetic apparatus. Halobacterial photo-phosphorylation.

UNIT -II

- Biosynthesis of peptidoglycan, teichoic acid, lipopolysaccharide, biosynthesis and degradation of essential amino acids, microbial degradation of aromatic, polycyclic and halogenated aromatic compounds. Microbial metabolism of hydrogen.

UNIT -III

- Aerobic metabolism of methane and methanol: Methane and methanol users, Oxidation of methane, Formaldehyde and formic acid, assimilation of C-1 compounds. Anaerobic respiration: Sulphur compounds and nitrate as electron acceptors, electron transport in SO₄ and NO₃ reducers.
- Anaerobic metabolism of glucose, Fermentation process, modes of glucose fermentation (lactic acid, ethanol, acetic acid, butyric acid, acetone and butanol, formate and propionate). Transport of nutrients across membrane

UNIT - IV

- Nitrogen metabolism: Biological nitrogen fixation, Mechanism of nitrogen fixation, ammonia assimilation, properties and regulation of glutamine synthetase, glutamate synthetase, glutamate dehydrogenase.
- Biochemistry of methanogenesis; bio-transformation of steroid and non-steroid compounds.

Marking scheme-

Objectives/multiple choice Questions.	1×8=8
Short Answer type questions	6×4=24
Long Answer type questions	12×4=48
TOTAL	80

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M.SC. MICROBIOLOGY
SEMESTER II
PAPER IV
MICROBIAL GENETICS
January 2023-June 2023

Unit - I

- DNA damages: Biological indications of damage to DNA
- Types of DNA damage (deamination, oxidative damage, alkylation, pyrimidindimers)
- Evidences to repair system
- Repair pathways (methyl directed mismatch repair, very short patch repairs, nucleotide excision repairs, base excision repairs, recombination repairs, and SOS system)

UNIT – II

- Gene as a unit of Mutation
- Types of mutagens and their origin
- Genetic analysis of mutants and Isolation of mutants
- Gene as a unit of recombination
- Molecular nature of recombination

UNIT – III

- Gene transfer mechanism: Transformation, Transduction, Conjugation, Transfection,
- Lysogeny and their applications
- Genetic analysis of Bacteria and Yeast
- Plasmids, types and their uses in genetic analysis, as vector for gene cloning, Replication of selected plasmids, compatibility
- Transposons and their uses in genetic analysis
- Construction of bacterial strains

UNIT – IV

- Genetics of phage: genetic recombination in phages
- Effect of parental ratio, reciprocity
- Genetic mapping of phage T4 and other phages
- RAPD ,RFLP
- Features of T4 life cycle and T4 gene organization
- λ phage DNA and its genetic organization, life cycle of λ



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Recommended Books

- Microbial Genetics – Maloy et al. 1994, Jones and Bartlett publishers.
- Modern microbial genetics – Streips and Yasbin, 1991, Niley Ltd.
- Microbial genetics – S.R. Maloy, J.E. Cronan, and David Freifelder, 2nd edition 2006, Narosa publishing house, New Delhi.
- Microbial Genetics – C.B. Powar, Vol I&II, Himalaya Pub.
- Genetics – P.K. Gupta, Rastogi Pub.
- Biotechnology and Genetics – R. Shetty
- Genetics – W. Monroe
- Genetics – N.W. Strickberger 3rd edition
- Fundamentals of Genetics – B.D. Singh, Kalyani Pub.
- Fundamental Principles of Bacteriology – A.J. Salle, TMH Edition, New Delhi

MARKING SCHEME

Objectives/Multiple type questions	1×8= 8
Short answer type questions	6×4=24
Long answer type questions	12×4=48
TOTAL	80

SEMESTER II
LAB COURSE I
INSTRUMENTATION AND BIOSTATISTICS
List of practical Exercises

INSTRUMENTATION

1. Verification of Beers Law
2. Determination of absorption maxima
3. Quantitative determination, Enzyme kinetics
4. Amino acid and carbohydrate separation by paper and TLC
5. Ion exchange and gel filtration chromatography
6. SDS Polyacrylamide Gel Electrophoresis
7. Isoenzymes
8. Separation of sub-cellular organelles by differential centrifugation

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BIOSTATISTICS

1. Construction of frequency tables by given sample data
2. Construction of histograms by given sample data
3. Compare the measures of central tendency from common data table
4. Prove that the frequency distributions with equal means have different amount of dispersion
5. Calculate the standard deviation of the given data mean.
6. Compare the sample mean with the population mean by t Test
7. Determination whether the observed frequencies are similar to expected frequencies by χ^2 test
8. Estimate and test the given hypothesis about population mean by ANOVA
9. Computation of correlation coefficient

M. Sc. Microbiology

SEMESTER II

Lab Course II

Microbial Physiology & Microbial Genetics

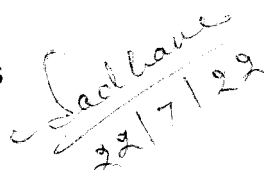
Microbial Physiology

1. Qualitative assay of different extra-cellular enzymes
2. Quantitative assay of alkaline and acid phosphatases from microorganisms.
3. Determination of K_m value of beta- fructofuranosidase from yeast
4. Antibiotic sensitivity test
5. Measurement of CM-cellulase by viscometric and reducing sugar method.
6. Experiment on production of enzymes and optimizing parameters for enzyme production in shake flask culture using *Aspergillus niger*, *Saccharomyces cerevisiae* for production of amylase, invertase respectively.
7. Experiment on production of citric acid and optimizing parameters for citric acid production in shake flask culture using *Aspergillus niger*.

Microbial Genetics

1. Determination of antibiotic sensitivity by Well Diffusion method
2. Determination of MIC for different antibiotics
3. Isolation of antibiotic resistant bacterial population by Gradient plate method
4. Isolation of UV induced Auxotrophic mutants by Replica Plating technique.
5. Study of bacterial Transformation




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M.SC. MICROBIOLOGY
III SEMESTER
PAPER I: MOLECULAR BIOLOGY
July 2023-December 2023

UNIT-I

- Nucleic acid as genetics information carriers: experimental evidence, melting of DNA
- DNA replication: general principles, various modes of replication, Types and properties of DNA polymerases, Proof reading, Continuous and discontinuous synthesis, Exonuclease activity in eukaryotic and prokaryotic DNA polymerases
- Super helicity in DNA, Linking number, Topological properties, Mechanism of action of topoisomerases
- Initiation of replication of single stranded DNA, Construction of replication fork in test tube
- Retroviruses and their unique modes of DNA synthesis, Relationship between replication and cell cycle Inhibitors of DNA replication: Blocking precursor synthesis, nucleotides polymerization, altering DNA structures

UNIT – II

- Transcription: general principles, basic apparatus, steps (initiation, elongation and termination) in prokaryotic and eukaryotic
- Types of RNA polymerases, Inhibitors of RNA synthesis
- Polycistronic and monocistronic RNAs, Maturation and processing of RNA: Methylation, Cutting and trimming of rRNA,
- Capping, Polyadenylation and splicing of mRNA, Cutting and modification of tRNA degradation system
- Catalytic RNA, group I and group II intron splicing RNaseP

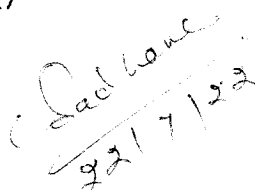
UNIT – III

- Basic features of genetic code
- Protein synthesis: steps, details of initiation, elongation, termination, roles of various factors in above steps, Inhibitors of proteins synthesis
- Synthesis of exported proteins on membrane bound ribosomes

UNIT – IV

- Regulation of genes expression: Operon concept, catabolite repression instability of bacterial RNA, Positive and negative regulation: Inducers and co repressors, Negative regulation (E.coli lac operon), Positive regulation (E-coli ara operon, regulation by attenuation – his and trp operons; anti termination – N protein and nut sites in I).
- DNA binding proteins, enhancer sequences and controls of transcription by interaction between RNA polymerases and promoter regions,
- Use of alternate sigma factors, controlling termination attenuation and anti termination.
- Identification of protein binding sites on DNA. Regulation of rRNA and tRNA synthesis.




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Marking scheme-

Objectives/multiple choice Questions.	1×8=8
Short Answer type questions	6×4=24
Long Answer type questions	12×4=48
TOTAL	80

Recommended Books

- Molecular biology of gene, Watson, Baker, Bell, Gann, Levine, Personal Education LPE
- Principles and Techniques of Biochemistry and Molecular Biology, K. Wilson and J. Walker, Cambridge low price Edition.
- Mol Bio- Fundamentals of Molecular Biology, A. Upadhyay, Himalaya Pub.
- Molecular Biology, A.V.S.S. Sambamurthy, NarosaPub.
- Essentials of Molecular Biology, Malacinski, M.George and David Freid felder, Narosa Pub.
- Biochemistry, C.B. Powar and Chatwal, Himalaya Pub.
- Principles of Biochemistry, Nelson and Cox

M.Sc. MICROBIOLOGY
SEMESTER III, PAPER II
BIOENERGETICS AND METABOLISM
July 2023-December 2023

UNIT I

- First and second laws of thermodynamics. Concept of free energy, High – energy compounds, ATP cycle, structural basis of free energy change during hydrolysis of ATP. Other high – energy biological compounds.

UNIT II

- Basic concepts of intermediary metabolism. Carbohydrate metabolism: Glycolysis, Kreb's cycle, glycogenolysis, glycogenesis, pentose phosphate pathway, gluconeogenesis, and glyoxylate pathway, inborn errors of carbohydrate metabolism.
- Regulation of carbohydrate metabolism

UNIT III

- Electron transport and oxidation phosphorylation: electron carriers, Complexes I to IV, substrate level phosphorylation, mechanism of oxidative phosphorylation, Shuttle system for entry of electron, Biosynthesis and degradation of Lipids, Regulation of lipid metabolism.



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UNIT IV

- Nitrogen Assimilation. Biosynthesis of amino acids and proteins. Degradation of amino acids protein.
- Regulation of amino acid metabolism. Biosynthesis and degradation of purine and pyrimidine nucleotides.

Marking scheme-

Objectives/multiple choice Questions.	1×8=8
Short Answer type questions	6×4=24
Long Answer type questions	12×4=48

Recommended Books

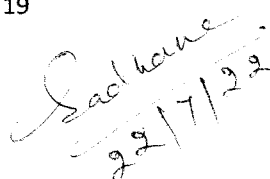
- General Biochemistry by A.C. Deb.
- Biochemistry by Lehninger (Kalyani publication)
- Biochemistry by U.Satyanarayan.
- Microbiology by Anantanarayan and Panikar.
- Fundamentals of Biochemistry; J L Jain, Sunjay Jain, Nitin Jain; S. Chand & Company Ltd
- Practical Biochemistry: Principles and Techniques; 5th Edition; Keith Wilson and John Walker
- Biophysical Biochemistry: Principles and Techniques; Avinash Upadhyay, Kakoli Upadhyay and Nirmalendu Nath; Himalaya Publishing House.
- Biochemistry by U. Satyanarayan.

**M.Sc. MICROBIOLOGY
THIRD SEMESTER
PAPER III
ENVIRONMENTAL MICROBIOLOGY
July 2023-December 2023**

UNIT – I

- Distribution and ecology of microorganism: air spora- concepts and components, indoor and outdoor aerospora, aeroallergens, Ecosystem- concept, components, food chains, food webs, and trophic levels.
- Energy transfer efficiencies between trophic levels. Environmental factors influencing the growth and survival of microorganism. Physical factors- temperature, light, osmotic pressure and hydrostatic pressure. Chemical factors- pH, O₂ and CO₂.
- Microorganisms of extreme environments: psychrophiles, mesophiles, thermophiles, acidophiles, alkalophiles, halophiles and specific habitats.




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UNIT – II

- Microbiology of water: aquatic ecosystems-types- fresh water (ponds, lakes, streams) - marine (estuaries, mangroves, deep sea, hydrothermal vent, salt pans, coral reefs). Zonation of water ecosystems– upwelling eutrophication. Food chain.
- Drinking and potable water, ecology of polluted water, microbiological treatment processes. Waste water disposal and reclamation. Brief account of *major* water borne diseases and their control measures.

UNIT – III

- Soil microbiology: Micro flora of various soil types (bacteria and nematodes): rhizosphere- phyllosphere – brief account of microbial interactions symbiosis, mutualism, commensalism, competition, amensalism, synergism, parasitism, predation, biological N₂ fixing organisms, symbiotic fungi, Phosphate solubilizing organisms,
- Ecology of litter decomposition; extracellular enzymes (hydrolases), heterotrophic potential decomposers and utilizers relationship.

UNIT –IV

- Biodegradation of cellulose lignins and hydrocarbons (superbug). Composting, treatment of solid wastes. Bioaccumulation of metals and detoxification-biopesticides;
- Biodeterioration: classification of biodeterioration of materials (monuments, paints, rubbers, plastics, fuels, lubricants, metals, stone, cosmetics, toiletries).
- Gmo and their impact

MARKING SCHEME

Objectives/Multiple type questions	1×8= 8
Short answer type questions	6×4=24
Long answer type questions	12×4=48
TOTAL	80

Recommended Books

Microbial Ecology By Atlas And Bartha

Environmental Microbiology And Microbial Ecology By Larry L.Barton and R.J.C. McLean

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M.Sc. – MICROBIOLOGY
SEMESTER III
PAPER IV
INDUSTRIAL MICROBIOLOGY AND FERMENTATION TECHNOLOGY
July 2023-December 2023

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
- Design and Types of fermenter: Batch, fed batch and continuous fermenters
- Agitation, aeration, antifoam, pH and temperature control
- 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

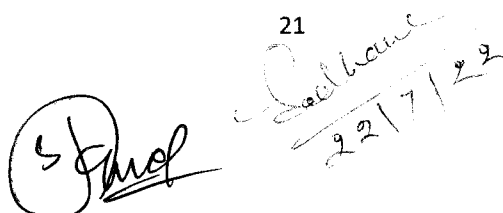
- Production and application of microbial enzymes: Amylases and proteases, uses, microorganisms, inoculum preparation, production medium, fermentation and recovery
- Fermentative production of vitamin B2 and vitamin B12
- Industrial production of organic acid-citric acid, glutamic acid and lactic acid

UNIT – IV

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

Recommended Books

- Fermentation technology – M.L. Srivastava, Nrosa Pub.
- Principles of Fermentation technology – P.R. Stanbury Solid State Fermentation in Biotechnology – A.Pandey, S. Rodriguez and Nigam, Asia Tech Pub.
- Advances in Fermentation Technology – A.Pandey, S. Rodriguez and Nigam, Asia Tech Pub.
- Biotechnological innovations in chemical synthesis – BOITOLpub., Butterworth,
- Industrial Microbiology – G.Reed (Editor), CBS publishers, New Delhi.
- Biology of Industrial Microorganisms – A. L. Demain.
- Pharmaceutical Biotechnology – S.P. Vyas and V.K. Dixit, Cbs pub. New Delhi.


A handwritten signature in a circle is on the left. To its right, the name 'Sachin' is written in cursive, with the date '22/7/22' written below it.

- Industrial Biotechnology – S.N. Jogdand, Himalaya Pub. House ,Delhi
- Industrial Microbiology – A.H. Patel, Macmillan India Ltd.

**M.Sc. MICROBIOLOGY
THIRD SEMESTER
LAB COURSE 1
MOLECULAR BIOLOGY AND BIOENERGETICS AND METABOLISM
List of practical exercises**

MOLECULAR BIOLOGY

1. Isolation of DNA from plant (Cauliflower/Onion/Leaf)
2. Isolation of Genomic DNA from Bacteria (Gram positive/ Gram negative).
3. Estimation of total DNA from given sample by DAP method
4. Estimation of RNA from yeast
5. Isolation and purification of Plasmid DNA from bacteria.
6. Isolation of total protein and protein profile study of microbial culture.

BIOENERGETICS AND METABOLISM

1. Protein estimation by Lowry, Bradford and Spectrophotometric method
2. Estimation blood cholesterol
3. Estimation of sugar by Nelson- Somagy and Benedict's reagent, Dubois method
4. Isolation and estimation of lipid from seeds and egg.
5. Estimation of inorganic and total phosphorus by Fiske-Subba Rao method
6. Assay of phosphatases in blood and seeds
7. Urease estimation in bacte

**M. Sc. Microbiology
THIRD SEMESTER
Lab Course II**

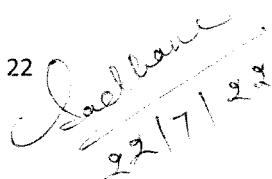
Environmental microbiology & Industrial microbiology and fermentation technology

Environmental microbiology

1. BOD & COD estimation in water sample
2. Study of microbial contaminants from water and wastewater.
3. Study of air borne microorganisms using various methods.
4. Assay of anti-fungal and antibacterial properties of agro-chemicals and fungicides.
5. Assessment of quality of oils using saponification value, iodine number, and free fatty acid composition.
6. Study of thermophilic microorganisms.
7. Bacteriological examination of water by multiple-tube fermentation test.
8. Determination of coliforms to determine water purity using membrane filter method.
9. Lipase production test.
10. Isolation of Rhizobium from root nodule.



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11. Measurement of spore size using micrometry

12. Isolation of microorganisms from rhizosphere and phylloplane. metals, stone, cosmetics, toiletries).

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. Demonstration of Zymography

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M. Sc. MICROBIOLOGY
SEMESTER IV
PAPER-I: MICROBIAL BIOTECHNOLOGY
(January 2024-June 2024)

Max. Mark 80

UNIT-I

- Techniques of Microbial technology: Scope of genetic engineering, restriction and modification enzymes, ligation and transformation, agarose and polyacrylamide gel electrophoresis,
- Southern, northern, western blotting, polymerase chain reaction,
- DNA sequencing,
- cloning vectors- plasmids, bacteriophages, phagemids, cosmids. YAC, BAC.

UNIT – II

- Basics of Genomics, RNA interference, Cloning strategies, cDNA synthesis and cloning, mRNA enrichment, DNA primers, linkers, adaptors and their synthesis, library construction and screening; Cloning interacting genes, two and three hybrid systems, cloning differentially expressed genes, nucleic acid microarrays;
- Site directed mutagenesis and protein engineering.
- immobilization techniques.

UNIT – III

- Microbial screening, selection and strain improvement, bacterial enterotoxins, peptide hormone, interferons.
- Biofertilizers, biopesticides, enzyme electrodes, enzyme in pulp and paper industry.
- Bioremediation

UNIT – IV

- Role of national and international organization in biotechnology, cooperative efforts, government programs for biotechnology development and applications, patenting biotechnological process and products in different fields.
- Regulation for bio-hazardous products

Books Recommended:

- Bruce A White (1997) PCR Cloning Protocols. Hanuman Press Totowa, New Jersey.

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- Bruce Birren, Eric D Green, Sue Klapholz, Trichard M Myers, Horald Riethman, & Jane Roskenus
- (1999) Genome Analysis: A Lab Manual vol.1,vol.2,vol.3, Cold Spring Harbor Lab. Press.
- Daniel L Hartl, Elizabeth & Jones W (1998) Genetics: Principles and Analysis. Jones & Bartlett
- Publishers.
- Davies JA & Rez WS (1992) Milestones in Biotechnology Classic papers on Genetic Engineering. Butterworth-Heinemann, Boston.

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M. Sc. MICROBIOLOGY
SEMESTER IV
PAPER-II: MEDICAL MICROBIOLOGY
(January 2024-June 2024)

Max. Mark 80

UNIT – I

- Normal microbial flora of human body, role of resident flora, host microbe interactions.
- Classification of medically important microorganisms.
- Infection and infectious process - routes of transmission of microbes in the body. Source of infection for man; vehicles or reservoirs of infection.
- Mode of spread of infection. Pathogenesis: Infectivity and virulence.

UNIT –II

- Classification of pathogenic bacteria. *Staphylococcus, Streptococcus, Pneumococcus, Neisseria, Corynebacterium, Bacillus, Clostridium*, Non sporing Anaerobes, Organism belonging to Enterobacteriaceae, vibrios, Non fermenting gram negative bacilli *Yersinia; haemophilus; Bordetella; Brucella; Mycobacteria, Spirochaetes, Actinomyces; Rickettsiae, Chlamydiae.*

UNIT- III

- General properties of Viruses; Viruses Host Interactions, Pox viruses, Herpes viruses, Adeno viruses; Picarino viruses; Orthomyxo viruses; Paramyxo viruses; Arboviruses, Rhabdo viruses, Hepatitis viruses; Oncogenic viruses; Human Immuno deficiency viruses.

UNIT- IV

- Mycology - Human mycotic infections caused by Dermatophytes, Histoplasma, Cryptococcus, Candida, opportunistic mycoses.
- Mycotoxins. Description and classification of pathogenic fungi and their laboratory diagnosis.
- Parasitology - Medical importance of Entamoeba, Giardia, Plasmodium, Taenia, Ascaris, Wucherhiria. Laboratory techniques in parasitology.

Books Recommended:

- Prescott & Dunn's. Microbiology. CBS Publishers & Distributors.

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- Anantnarayan R and Panikar CKJ: Text book of Microbiology, Orient Blackswan Pvt. Ltd.
- Broude AI: Medical Microbiology and Infectious Diseases, WB Saunders Co.
- Chapel and Haeney: Essentials of Clinical Immunology, Blackwell Scientific Publications

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M. Sc. MICROBIOLOGY
SEMESTER IV
PAPER-III: FOOD & DAIRY MICROBIOLOGY
(January 2024-June 2024)

Max. Mark 80

UNIT- I

- Microbial flora of fresh food, grains, fruits, vegetables, milk, meat, eggs and fish. Microbiological examination of foods for their infestation by bacteria, fungi & viruses.
- Chemical preservatives and food additives.
- Factors influencing microbial growth in food- Extrinsic and intrinsic factors. Food as a substrate for micro-organism.

UNIT – II

- Canning, processing for heat treatment - D, Z and F values and working out treatment parameters; microbial spoilage of canned foods, detection of spoilage and characterization.
- Mold and mycotoxin contamination of food, aflatoxins, ochratoxins, trichothenes, zearalenone, ergot mycotoxins.
- Role of microorganisms in beverages– beer, wine and vinegar fermentation.

UNIT – III

- The roles of microorganisms in the food industry, positive and negative perspectives. Food-borne infections and intoxications: Bacteria and nonbacterial-with examples of infective and toxic types- *Brucella*, *Bacillus*, *Clostridium*, *Escherichia*, *Salmonella*, *Shigella*, *Staphylococcus*, *Vibrio*, *Yersinia*; nematodes, protozoa, algae, fungi and viruses.
- Food borne outbreak- laboratory testing procedures; Sources and transmission of bacteria in foods: human, animal, and environmental reservoirs; cross-contamination.

UNIT - IV

- Contamination and Spoilage: Cereals, sugar products, vegetables, fruits, meat and meat products, Milk and Milk products, Fish & sea foods, poultry-spoilage of canned foods. Detection of spoilage and characterization
- Food fermentations: bread, cheese, vinegar, fermented vegetables, fermented dairy products; Experimental and industrial production methods
- Spoilage and defects of fermented dairy products

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Books Recommended:

- M.R. Adams and M.O. Moss: Food Microbiology, Royal Society, Cambridge
- William, C. Frazier and Dennis C. Westhoff: Food Microbiology, Tata McGraw Hill
- Banwait GJ: Food Microbiology CBS Publishers & Distributors, New Delhi.
- Hobbs BC and Roberts D: Food Poisoning and Food Hygiene, Edward Arnold, London

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M. Sc. MICROBIOLOGY
SEMESTER IV
PAPER-IV: AGRICULTURAL MICROBIOLOGY
(January 2024-June 2024)

Max. Mark 80

UNIT-I

- Structure and characteristic features of the following biofertilizer organisms: Bacteria: Azospirillum, Azotobacter, Bacillus, Pseudomonas, Rhizobium and Frankia. Cyanobacteria: Anabaena, Nostoc, Fungi: Glomus, Gigaspora, Sclerocystis, Amanita, Laccaria.
- Biofertilization processes - Decomposition of organic matter and soil fertility and vermicomposting.
- Mechanism of phosphate solubilization and phosphate mobilization.

UNIT – II

- Biofertilizers – biological nitrogen fixation – nitrogenase enzyme – symbiotic nitrogen fixation-(Rhizobium, Frankia) – non symbiotic nitrogen fixation (Azotobacter - Azospirillum),
- VAM- ecto- endoectendo mycorrhizae and their importance in agriculture.

UNIT – III

- Major biogeochemical cycles and the organisms: carbon – nitrogen - phosphorous and sulphur.
- Biopesticides: toxin from *Bacillus thuringiensis*, *Psuedomonassyringae*.
- Biological control - use of Baculovirus, protozoa and fungi.

UNIT – IV

- Microbial diseases of crop plants: symptoms, causal organisms and control. Fungal diseases (Late blight of potato, Tikka disease of groundnut, red rot of sugarcane).
- Bacterial diseases (bacterial blight of rice, citrus canker, Tundu disease of wheat)
- Viral diseases (Tobacco mosaic, leaf curl of papaya, yellow vein mosaic of bhindi).

Books Recommended:

- **Bagyraj and Rangasamy: Agricultural Microbiology**
- **K R Aneja ; Agricultural Microbiology**
- **N. S. Subba Rao**

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M. SC. MICROBIOLOGY

SEMESTER -VI, LAB COURSE I

MICROBIAL BIOTECHNOLOGY & MEDICAL MICROBIOLOGY

(January 2024-June 2024)

Microbial biotechnology

1. Bacterial culture and antibiotic selection media. Preparation of competent cells.
2. Isolation of plasmid DNA.
3. Isolation of Lambda phage DNA.
4. Estimation of nucleic acids.
5. Agarose gel electrophoresis and restriction mapping of DNA.
6. Construction of restriction map of plasmid DNA.
7. Cloning in plasmid/phagemid vectors.
8. Preparation of single stranded DNA template.
9. Gene expression in E. coli and analysis of gene product
10. PCR

Medical Microbiology

1. Identification of micro flora of mouth, skin and wounds.
2. Identification of enteric pathogens by TSIA medium
3. IMVIC test.

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M. SC. MICROBIOLOGY
SEMESTER-IV, LAB COURSE II
FOOD AND DAIRY MICROBIOLOGY & AGRICULTURAL MICROBIOLOGY
(January 2024-June 2024)

Food & dairy microbiology

1. Isolation and identification of microorganisms from fermented food, fruits, cereal grains and oil seeds.
2. Determination of quality of milk sample by methylene blue reductase test.

Agricultural microbiology

1. Isolation and enumeration of bacteria from different soil type.
2. Isolation and enumeration of fungi from different soil type
3. Preparation of Winogradsky Column to study the various soil microflora.
4. Isolation of Rhizobium from root nodules.
5. Isolation of Azatobacter from soil.
6. Isolation of Cyanobacteria from peddy field.
7. Measurement of pH of soil sample

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M.Sc. MICROBIOLOGY

Objectives of the programme:

The aim of the postgraduate degree in Microbiology is to make students familiar about the various basic concepts and skills of Microbiology. The understanding, knowledge and skills of students will be developed through teaching learning processes in the class, practical skills through the laboratory work, their presentation and articulation skills by seminars and group discussions, exposure to industry/ laboratories and interaction with experts in industry, scientists, pathologists, training for writing short reports, review papers and project reports where they will be guided and mentored by the academic and other experts of the subject.

The important qualification descriptors for a PG degree in Microbiology are following:

1. Knowledge of application of microbiology in diverse fields.
2. Understanding of different types of microbes, their habitats and various Microbiological processes.
3. Developing basic skills of isolating microbes, culturing microbes, maintaining microbes, identifying microbes, determination of microbial contamination in water, food etc., control of microbes, antibiotic susceptibility, safety issues related to handling of microbes, Good Microbiological practices etc.
4. Generation of new knowledge through small research projects
5. Ability to participate in team work through small microbiology projects, field trips, surveys and laboratory visits.
6. Analysis of data collected through study and small projects.
7. Ability to present and articulate their knowledge of Microbiology through seminars, poster presentations, group discussion and review writing.
8. Knowledge of recent developments in the area of Microbiology.
9. Awareness how some microbiology leads may be developed into enterprise.

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Programme Learning Outcomes:

A candidate who has acquired a PG degree in Microbiology needs to have acquired/developed following competencies during the programme of the study:

1. Student has acquired knowledge and understanding of the microbiology concepts and their application in diverse areas such as medical, industrial, environment, genetics, agriculture, food and others.
2. Student has acquired basic practical skills/competencies in working with microbes, their isolation, identification and use in the laboratory as well as outside, including the use of good microbiological practices.
3. Student has become competent enough to use microbiology knowledge and skills to analyse problems involving microbes, articulate these with peers/ team members/ other stake holders, and undertake higher studies etc.
4. Student has developed a broader perspective of the discipline of Microbiology to enable him to identify challenging societal problems and plan his professional career

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