Kurukshetra University, Kurukshetra

(Established by the State Legislature Act-XII of 1956)
("A++" Grade, NAAC Accredited)

Syllabus of the Programme
for
Post Graduate Programme

M.Sc. MICROBIOLOGY

as per NEP 2020
Curriculum and Credit Framework for Postgraduate Programme

With Multiple Entry-Exit, Internship and CBCS-LOCF
With effect from the session 2024-25 (in phased manner)

DEPARTMENT OF MICROBIOLOGY
FACULTY OF LIFE SCIENCES

KURUKSHETRA UNIVERSITY, KURUKSHETRA -136119
HARYANA, INDIA

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Session: 2024-25			
Part A – Introduction			
Name of Programme	**M.Sc. Microbiology**		
Semester	**1**		
Name of the Course	**Diversity of Prokaryotic & Eukaryotic microbes**		
Course Code	**M24-MIC-101**		
Course Type	**CC-1**		
Level of the course	**400-499**		
Pre-requisite for the course (if any)	**NA**		
Course Learning Outcomes (CLO)	• CLO1. Student will know the history and morphological features of bacteria. • CLO2. Student will be able to general characteristics of bacteria and archaea and specific key features of model archaeal organisms. • CLO3 Students will know how to control the microorganism using different methods and antimicrobial testing. • CLO4. Students will be able to identify the common features of fungi, algae and protozoa.		
Credits	Theory	Practical	Total
	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Time	3 hours		

Part B- Contents of the Course

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	**History, development ,scope of microbiology:** **Microbial diversity:** Review of classical and current important experimental techniques in microbial taxonomy. Species concept and species evolution, 5-Kingdom classification system, 3-Domain classification system, Prokaryotic and eukaryotic cellular organization, Polyphasic Approach,Use of Bergey's manual (Determinative and Systematic) for microbial identification.Molecular clocks, phylogeny and molecular distances. Phenetic Methods/Chemotaxonomy : Cell wall composition, whole-cell protein, lipid, Isoprenoid quinone, cytochrome, amino acids sequences of various proteins, protein, enzyme profiling, fermentation product profiles, secondary metabolites. Use of Automated systems typing method for identification and classification of microbes. Genotypic Methods : Determination of the DNA base ratio (moles percent), nucleic acid hybridization, DNA-based typing methods • Importance of rRNA in molecular taxonomy : rRNA homology studies, 16S rRNA, 18s rRNA / rDNA fingerprinting, Exploration of Uncultured Microbial Diversity ,Concept of 'unculturable' bacterial diversity •,Strategies for culture of 'unculturable' bacteria • Culture independent molecular methods - PCR dependent approaches versus PCR independent approaches (RFLP, RAPD, ARDRA, DGGE, TGGE, Microarray, FISH, RISA) , Metagenomics- Concepts, work flow, Collection and processing of samples, metagenomic DNA isolation.	15

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II	**Morphological features and arrangement of bacterial cells and Archaea :** Gram-positive and Gram negative bacteria; Extracellular appendages: flagella- arrangement, basic structure and locomotive function; pili- different types, their distribution among bacteria & related functions; fimbriae- occurrence, function and features distinguishing pili and fimbriae; glycocalyxcomposition and role in bacteria; and capsule- microcapsule and slime. Reserve food, pure culture, culture characteristics, isolation; media; maintenance and preservation Bacterial cell wall & cell membrane: Detailed structure of gram negative and gram positive bacterial cell wall, outer membrane lipopolysaccharide (LPS), protoplasts, sphaeroplasts, peptidoglycan sysnthesis, L-forms, cell wall synthesis and its inhibitors including different antibiotics; periplasm; molecular and chemical structure of cell membrane; cytoskeleton including tubulin and actin structural filaments and their role in bacteria. archaea cell, actinomycetes, rickettsia & chlamydia, mycoplasma, spirochetes. General characteristics of archaea; how archea are different from eubacteria; key features of model archaeal organisms: *Halobacterium; Pyrococcus; Sulfolobus;* and *Methanococcus.*	15
III	**Fungi-** Characteristics and classification of fungi. Kirk et al. system of classification. Modes of Reproduction in fungi. Fungi as saprotrophs & their role in decomposition in cellulose, hemicellulose, pectin and lignin. **Algae**- Structure, nutrition and Reproduction in algae. Distribution and classification of algae. Economic importance of Algae as food, Source of agar-agar, alginate, diatomite and iodine etc, antibiotics from algae, use in fisheries and malaria control, as pollution indicator. Algae as photobioreactor. **Virus structure:** Viral morphology, life cycle, virus cultivation **Protozoa**- Morphology, reproduction, modes of nutrition, modes of transmission, locomotory organelles, encystment, excystment.	15
IV	**Control of microorganisms:** physical and chemical methods – Dry heat, moist heat, radiations, osmotic pressure, filtration methods; chemical methods - characteristics of an ideal antimicrobial chemical agent, phenols, alcohols, quaternary ammonium compounds, halogens, heavy metals and their compounds, aldehydes, ethylene oxide and their application. **Antibiotic susceptibility testing**. Mode of action of antibiotics - cephalosporin, chloramphenicol, ciprofloxacin, polymyxin B, sulphonamides. Antimicrobial drug resistance - Mechanism and spread	15
	Total Contact Hours	60

Suggested Evaluation Methods

Internal Assessment: 30		**End Term Examination: 70**	
➢ **Theory**	**30**	➢ **Theory:**	**70**
• Class Participation:	5	Written Examination	
• Seminar/presentation/assignment/quiz/class test etc.:	10		
• Mid-Term Exam:	15		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Stainier RY, Ingraham JL, Wheelis ML & Palmer PR. General Microbiology, MacMillan.
2. Tortora GJ, Funke BR & Case CL. Microbiology: An introduction with Mastering Microbiology,. Benjamin Cummings.
3. Madigan MT, Martinko JM, Stahl DA & Clark DP. Brock Biology of Microorganisms. Benjamin Cummings
4. Mackie & McCartney Practical Medical Microbiology . Collee JG, Fraser AG, Marmion BP & Simmons A (eds.), Churchill Livingstone, Edinburgh.
5. Atlas RM, Parks LC & Brown AL. Laboratory Manual of Experimental Microbiology. MosbyYear Book, Inc., Missouri.
6. Willey JM, Sherwood LM & Woolverton CJ DA. Prescott, Harley and Klein's Microbiology. McGraw Hill International Edition, USA.
7. Arora DR & Arora B. Medical Parasitology, CBS Publishers, New Delhi.

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Session: 2024-25			
Part A – Introduction			
Name of Programme	**M.Sc. Microbiology**		
Semester	**1**		
Name of the Course	**Microbial Genetics**		
Course Code	**M24-MIC-102**		
Course Type	**CC-2**		
Level of the course	**400-499**		
Pre-requisite for the course (if any)	**NA**		
Course Learning Outcomes (CLO)	CLO 1: It will provide the students a basic appreciation of the underlying principles and practical strategy of the analytical and preparative techniques that are fundamental to study and understanding of life processes. CLO 2: It will make the students to understand the general reactions of various metabolic pathways. CLO 3: Students will be able to explain the principle, working, materials used and applications of various biological techniques that are used to study the basic biological processes. CLO 4: Students will be able to describe the structure and classification of biomolecules.		
Credits	Theory	Practical	Total
	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Time	3 hours		

Part B- Contents of the Course

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	Essentials of nucleic acid: A brief overview of microbial genetics. Beginning of experimental proof of DNA as genetic material: Transforming principle, Experiments of Griffith, Macleod, Avery, McCarty, Hershey and Chase. RNA as a genetic material. DNA and RNA structure : Xray crystallography, chargaff's rules, phosphodiester bond, glycosidic bond, Watson and crick model of DNA, unusual structures and different types of DNA. Brief account of organization of eukaryotic genomes, packaging of DNA as nucleosomes. DNA denaturation, DNA melting, Tm value, Renaturation kinetics, Cot value, C-value paradox, repetitive DNA. Relaxed DNA, positive and negative supercoiling, overwinding and underwinding and its significance, Topological properties, linking no, twist and writhe, superhelical density, topoisomers, mechanism of action of topoisomerases and DNA gyrase	15
II	Maintenance of Structure of DNA. DNA damage and repair: photoreactivation, base excision repair, nucleotide excision repair, mismatch repair, SOS and error prone repair, and Recombination repair. Mutation : spontaneous and induced mutation, types of point mutation, consequences of point mutation, molecular basis of spontaneous and induced mutation, Base analogues, chemical mutagens, intercalating agent, radiation as mutagens, mutation rate, reversion and suppression, Ames test, significance and harmful effects of mutations. Transposable genetic elements: structure of transposon, IS sequences, bacterial transposon, composite transposon, Tn3 transposon, phage Mu, replication and maturation of Mu DNA, mechanism and significance of transposition: duplication of a target sequences at an insertion sequences, replicative transposition, non replicative transposition, cointegrate as an intermediate in transposition of Tn3.Genetic phenomenon mediated by transposon in bacteria,	15

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III	Maintenance of genetic information: Overview of DNA replication: initiation, elongation and termination, unidirectional and bidirectional replication, replication fork, origin of replication. primosomes, replisomes. Enzymology of DNA replication: different types of DNA polymerases, exonuclease , Nick translation and proof reading function. Different modes of DNA replication, rolling circle model of replication,Semiconservative replication , Meselson –Stahl experiment, priming reactions, leading and lagging strand synthesis ,okazaki fragments. Replication in retroviruses. Plasmid replication. Regulation of bacterial chromosome replication. Inhibitors of DNA replication. Relationship between cell cycle and replication. Brief idea of eukaryotic replication	15
IV	Genetic recombination in Bacteria: Horizontal and vertical gene transfer. Bacterial Conjugation: Sex Factor, chromosomal transfer by F+ culture, Hfr , isolation of Hfr strains, F +×F- cross, Hfr transfer, interrupted mating and time of entry mapping genes in bacteria, rate of chromosome transfer, Isolation of F' plasmids, Bacterial Transformation: discovery of transformation, competence, DNA uptake, molecular mechanism of transformation, mapping by transformation. Bacterial Transduction- DNA transfer by phages, lytic and lysogenic cycle, Specialized and generalized transduction. co- transduction and linkage , mapping by cotransduction.	15
	Total Contact Hours	60

Suggested Evaluation Methods

Internal Assessment: 30		**End Term Examination: 70**	
➢ **Theory**	**30**	**Theory**	**70**
• Class Participation:	5	Written Examination	
• Seminar/presentation/assignment/quiz/class test etc.:	10		
• Mid-Term Exam:	15		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Maloy SR, Cronan JE Jr. &Freifelder D. Microbial Genetics, 2nd ed., Narosa Publishing House
2.Snyder L &ChampnessW. Molecular Genetics of Bacteria, 3rd ed., ASM Press
3. Gardner JE, Simmons MJ &SnustadDP. Principles of Genetics. John Wiley & Sons
4. Nelson DL & Cox MM.Lehninger's Principles of Biochemistry 5th ed., W.H. Freeman and Company
5. Klug WS and Cummings MR. Essentials of Genetics.Pearson Educational International.
6 Griffiths AJ, Wessler SR,LewontinRC and Carroll SB . Introduction to genetic analysis.W.H.Freeman and Company,New York. 7.Lewin B Gene IX. Jones and Bartlett Publishers.
8. Watson JD Molecular Biology of the Gene 6th edition. Benjamin Cummings.
9. Alberts B *et.al* Molecular Biology of the Cell 5thedition. Garland Science, New York and London.
10. Stryer L Biochemistry 5th edition. W.H. Freeman and Company, USA.

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Session: 2024-25			
Part A – Introduction			
Name of Programme	**M.Sc. Microbiology**		
Semester	**1**		
Name of the Course	**Microbial and analytical techniques**		
Course Code	**M24-MIC-103**		
Course Type	**CC-3**		
Level of the course	**400-499**		
Pre-requisite for the course (if any)	**NA**		
Course Learning Outcomes (CLO)	CLO1. Student will be able to understand the relationship between wavelength, magnification and resolution in various types of microscopy. CLO2. Student will be able to understands the differences between different types of chromatographic and spectroscopic methods CLO3. Students will be familiar with different types of hydrodynamics based separation methods and immobilization methods. CLO4. Students will be able to understand the processes of electrophoresis for separation of macromolecules and applications of radioactivity in biology.		
Credits	Theory	Practical	Total
	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Time	3 hours		

Part B- Contents of the Course

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	Microscopy: Basics of microscopy: image formation, magnification, resolution. Wave theory Electromagnetic theory. Principles and working of bright field microscope, fluorescent microscope, phase contrast microscope, electron microscope (SEM & TEM), dark field microscopy. confocal microscopy.Atomic absorption spectroscopy (AAS)Principles of staining. Flow cytometry- flurochromes, fluorescent probe and working principle and its applications	15
II	Chromatography: Gel filtration, ion exchange & affinity chromatography, paper chromatography, Thin Layer Chromatography. Basic principles and biological applications of HPLC and GC. Principles and used of MALDI-TOF and LC-MS platforms. Spectroscopy: Basic concepts, principles and biological applications of different types of spectroscopy: UV, IR, NMR, Raman. X-ray diffraction, circular dichromism for microbiologists.	15
III	Centrifugation: Basics of centrifugation based methods: viscosity, diffusion, sedimentation equilibrium, dialysis, solvent fractionation, centrifugation, Biological applications and interpretations of Density Gradient methods, Ultracentrifugation methods. Methods of bacterial and enzyme immobilization, their advantages and applications. Basics of Radioactive isotopes and radioactive decay, sample preparation, counting, Safety precautions during handling, biological applications	15

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IV	PAGE: Polyacrylamide gel electrophoresis (PAGE), native PAGE, SDS-PAGE, 2D electrophoresis, iso electric. Types of Agarose gel electrophoresis. Protein engineering and proteome analysis: Proteome analysis by 2D gel electrophoresis coupled to mass spectrometric analysis. PMF verses MS/MS. Protein arrays and their applications. DNA Microarray and its applications. Methods to study gene function: Gene silencing and gene knockout.	15
	Total Contact Hours	60

Suggested Evaluation Methods

Internal Assessment: 30		**End Term Examination: 70**	
➢ **Theory**	**30**	➢ **Theory:**	**70**
• Class Participation:	5	Written Examination	
• Seminar/presentation/assignment/quiz/class test etc.:	10		
• Mid-Term Exam:	15		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Freifelder D. Physical biochemistry, Freeman Company.
2. Wilson K & Walker J. Principles and Techniques of Biochemistry and Molecular Biology, 6th ed., Cambridge University Press.
3. Sheehan D. Physical Biochemistry: Principles and Applicatons, John Wiley & Sons Ltd, Chichester, England.
4. Upadhyay, Upadhyay & Nath. Biophysical chemistry. Himalaya Publishing house.
5. Valeur B. Molecular Fluorescence: principles and Applications. 2nd edition. Wiley.
6. Govil G and Hosur RV. NMR – Conformation of Biological Molecules. 1st edition. SpringerVerlag.

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Session: 2024-25	
Part A – Introduction	
Name of Programme	**M.Sc. Microbiology**
Semester	**1**
Name of the Course	**Microbial biochemistry and metabolism**
Course Code	**M24-MIC-104**
Course Type	**CC-4**
Level of the course	**400-499**
Pre-requisite for the course (if any)	**NA**
Course Learning Outcomes (CLO)	CLO1. Students will be acquainted with methods of measuring microbial growth, growth kinetic parameters. Students will gain in-depth knowledge of primary, secondary and group translocation transport systems along with intracellular signaling in bacteria in response to various nutritional and physiological stresses. CLO2.Students will have basic ideas of structure and functions of different macromolecules. Students will have learnt basic concepts of enzyme biochemistry, its kinetics and regulation. CLO3. Students will gather understanding of inorganic and organic nitrogen assimilation and its regulation. Students will understand details of lipid and nucleotide metabolism in E. coli and yeasts. CLO4. Student will learnt central metabolic pathways for carbon metabolism in bacteria. Students will also have brief ideas about bacterial photosynthesis, sulphur metabolism, methanogenesis.

Credits	Theory	Practical	Total
	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Time	3 hours		

Part B- Contents of the Course

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	Structure and classification of macromolecules:, carbohydrates, Proteins ,lipids and nucleic acids . **Carbohydrate Chemistry and Metabolism:** Carbohydrates chemistry, Metabolites-primary, secondary and precursor. Glycolysis and gluconeogenesis and its Regulation; Pentose phosphate pathway; Glycogen synthesis and breakdown and its regulation; TCA cycle and its regulation, and its role in energy generation; Glyoxylate cycle; Entner-Doudoroff Pathway Co-metabolism of pentoses and hexoses **Metabolism of lipids and nucleotides:** Biosynthesis and degradation of lipids and its regulation in *E. coli*, lipid accumulation in yeast. Nucleic acid chemistry :Purine and pyrimidine biosynthesis, deoxyribonucleotide synthesis, regulation of purine and pyrimidine biosynthesis, inhibitors of nucleotide biosynthesis	15
II	**Amino Acids, Peptides, and Proteins**- Chemistry, structure and Metabolism: Structure and function of amino acids, General reaction of amino acid and Stickland reaction, Amino acid synthesis and breakdown, urea cycle and biological amines,biological N2 fixation ,Inorganic nitrogen assimilation- nitrate and ammonia assimilation, regulation of glutamate synthetase,.Glutathione: distribution in bacteria, biosynthesis and role in redox regulation. **Enzymes:** Introduction, classification, activation energy, enzyme kinetics, kinetic parameters, catalytic efficiency, activity units, turnover number. Methods of plotting enzyme kinetics data: Lineweaver –Burk plot, Michaelis Menten equation, saturation kinetics. Isozymes, ribozymes and abzyme, Enzyme inhibition, models and type of inhibition, allosterism and allosteric regulation. Kinetics of single substrate enzyme catalysed Reaction; Kinetics of reversible inhibitions enzyme catalyzed reactions, King and Altman approach to derive two substrate enzyme catalyzed reactions, types of two substrate enzyme catalyzed reactions, : Enzyme purification	15

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III	**Bacterial photosynthesis:** Photosynthetic microorganisms, Photosynthetic pigments and generation of reducing power by cyclic and non-cyclic photophosphorylation, Electron transport chain (ETC) in photosynthetic bacteria, Carbon dioxide fixation pathways. **Respiration:** Aerobic and anaerobic Mitochondrial electron transport chain, structure and function of ATPase (bacterial and mitochondrial), generation and maintenance of proton motive force, oxidative phosphorylation, inhibitors and un-couplers of electrontransport chain and oxidative phosphorylation, Atkinson's energy charge, phosphorylation n potential and its significance, Anaerobic Respiration: Concept ofanaerobic respiration, Brief account of chemolithotrophy oxidized sulfure compounds, and nitrate as electron acceptor with respect to electron transport chain and energy generation, Biochemistry of Methanogens	15
IV	**Growth and cell division:** Bacterial growth and its measurement, growth curve,growth physiology, Factors affecting growth, Batch, continuous, synchronous and diauxic growth., growth yields, growth kinetics, cell division Modes of reproduction. Cultivation of microorganisms. Cell differentiation and sporulation in *Bacillus*. Reserve food material, polyβ hydroxyl butyrate, poly phosphate granules, sulphur inclusions, cyanophycin granules, cell cycles and its control. **Solute Transport:** Introduction, passive, facilitated, active transport, kinetics. Membrane transport proteins: porins and aquaporins, mechanosensitive channels, ABC transporter, group translocation PEP-PTS system, inducer exclusion and expulsion. **Physiological Adaptation and Intracellular signaling:** Introduction to two component system. Response to physiological stress: aerobic-anaerobic shifts- Arc and Fnr system, osmotic homeostasis. Response to nutritional stress: phosphate supply- Pho regulon, and stringent response. Bioluminescence in bacteria.	15
	Total Contact Hours	60

Suggested Evaluation Methods			
Internal Assessment: 30		**End Term Examination: 70**	
➢ **Theory**	**30**	➢ **Theory:**	**70**
• Class Participation:	5	Written Examination	
• Seminar/presentation/assignment/quiz/class test etc.:	10		
• Mid-Term Exam:	15		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Gottschalk G. Bacterial Metabolism, Springer
2. Caldwell DR. Microbial Physiology and Metabolism, 2nd ed., Star
3. Moat AG, Foster JW & Spector MP. Microbial Physiology,4th ed., John Wiley and Sons
4. Nelson DL & Cox MM. Lehninger's Principles of Biochemistry, 5th ed., WH Freeman & Company
5. Berg JR, Tymoczko CZ & Stryer L. Biochemistry, 6th ed., W.H. Freeman and Company
6. Madigan MT, Martinko JM, Stahl DA & Clark DP. Brock Biology of Microorganisms, 13th ed., Benjamin Cummings.
7. Prescott LM, harley JP & Klein DA.Microbiology, McGraw Hill International Edition, USA.
8. Atlas RM, Parks LC & Brown AL. Laboratory Manual of Experimental Microbiology. Mosby-Year Book,Inc., Missouri.
9. Brown AE. Benson's microbiological applications. TataMacGrawHill
10. White D, Drummond J, Fuqua C The Physiology and Biochemistry of Prokaryotes .4th Edition. Oxford University Press
11. Cohen G N Microbial Biochemistry. 2nd Edition. Springer.

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Session: 2024-25			
Part A – Introduction			
Name of the Programme	**M.Sc. Microbiology**		
Semester	**1**		
Name of the Course	**Practical based on Papers M24-MIC-101 & M24-MIC-102**		
Course Code	**M24-MIC-105**		
Course Type	**PC-1**		
Level of the course	**400-499**		
Pre-requisite for the course (if any)	**NA**		
Course Learning Outcomes (CLO)	CLO1. The student will be versed with different sterilization processes and different staining techniques of given microbial isolate. CLO2. The student will learn different techniques for isolation and purification of bacteria, fungi, algae from different sources. CLO3. The student will learn the antimicrobial susceptibility testing and minimal inhibitory concentration (MIC) of an antibiotic. CLO4. The student will be able to perform genetic recombination in bacteria by conjugation, transformation and transduction		
Credits	Theory	Practical	Total
	0	4	4
Teaching Hours per week	0	8	8
Internal Assessment Marks	0	30	30
End Term Exam Marks	0	70	70
Max. Marks	0	100	100
Examination Time	0	4 hours	

Part B- Contents of the Course

Practicals	**Contact Hours**
Course Contents 1. Handling of general microbiological instrumentations (Hot air oven, Laminar air flow, micropipetting, autoclave, weighing balance, pH meter, BOD incubator ,distillation apparatus, centrifuge. 2. Principles of sterilization techniques and their application in microbiology lab 3. Staining techniques: -(a) Simple staining (b) Gram staining (c) Negative staining (d) Endospore staining. (e) Capsule staining 4. Study of different isolation techniques:(a) Pour plate. (b) Spread plate. (c) Streak plate. 5. Standard plate count. 6. Isolation of bacteria, fungi, actinomycetes, algae. 7. Measurement and counting of conidia/spores of a mold. 8. To study antimicrobial susceptibility testing using antibiotic disc: agar well and disc diffusion. 9. Replica plating method: Preparation of master and replica plates. 10.Isolation of antibiotic resistant bacterial population by gradient plate and replica plate method 11. Determination of minimum inhibitory concentration (MIC) of antibiotics 12. Isolation of thermotolerant mutants of a bacterial /yeast culture 13. UV mutagenesis and isolation of mutants by replica plate method 14. Demonstration of genetic recombination in bacteria by conjugation, transformation and transduction	120

Suggested Evaluation Methods

Internal Assessment: 30		**End Term Examination: 70**	
➢ **Practicum**	**30**	➢ **Practicum**	**70**
• Class Participation:	5	Lab record, Viva-Voce, write-up and execution of the practical	
• Seminar/Demonstration/Viva-voce/Lab records etc.:	10		
• Mid-Term Exam:	15		

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Part C-Learning Resources
Recommended Books/e-resources/LMS: 1. Cappucino JG and Welsh CT. Microbiology: A laboratory manual. 11th edition. Pearson. 2. Thompson DA. Biochemistry Lab Manual. 3rd edition. 3. Segel IH. Biochemical calculations: how to solve mathematical problems in general biochemistry, Wiley, 2nd Edition. 4. Sambrook J & Russell D. Molecular Cloning: A laboratory manual. 4th edition. Cold Spring Harbor laboratory Press. 5. Collee JG, Fraser AG, Marmion BP & Simmons A (eds.). Mackie & McCartney Practical Medical Microbiology. Churchill Livingstone, Edinburgh. 6. Atlas RM, Parks LC & Brown AL. Laboratory Manual of Experimental Microbiology. MosbyYear Book, Inc., Missouri.

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Session: 2024-25			
Part A – Introduction			
Name of the Programme	**M.Sc. Microbiology**		
Semester	**1**		
Name of the Course	**Practical based on Papers M24-MIC-103 & M24-MIC-104**		
Course Code	**M24-MIC-106**		
Course Type	**PC-2**		
Level of the course	**400-499**		
Pre-requisite for the course (if any)	**NA**		
Course Learning Outcomes (CLO)	CLO1. The student will be able to determine concentration of sugar and protein in a given sample after drawing a standard curve. CLO2. The student will be able to study the growth rate of bacteria and effect of various parameters like temperature, pH, oxygen, osmotic pressure, heavy metals on bacterial growth. CLO3. The student will be able to extract and analyse different proteins from bacteria through PAGE and SDS PAGE. CLO4. The student will learn different chromatographic techniques for the separation of compounds.		
Credits	Theory	Practical	Total
	0	4	4
Teaching Hours per week	0	8	8
Internal Assessment Marks	0	30	30
End Term Exam Marks	0	70	70
Max. Marks	0	100	100
Examination Time	0	4 hours	

Part B- Contents of the Course

Practicals	**Contact Hours**
Course Contents 1. Preparation of various buffers 2. To perform general test for carbohydrates (DNS, Molisch's, Anthrone Barfoeds, Bials, Mucic, Seliwanoffs) Proteins (Lowry, Biuret). 3. Preparation of growth curve of bacteria. 4. Determination of specific growth rate and generation time of a bacterial culture 5. Effect of temperature, pH, oxygen, osmotic pressure, heavy metals on bacterial growth 6. Determination of thermal death point (TDP) & thermal death time (TDT) of an organism 7. To perform different biochemical test to characterize the bacterial culture 8. Determination of size and motility (hanging drop technique) of given bacterial culture. 8. Isolation of proteins from bacterial culture by ammonium sulphate ppt. and NaCl extraction. 9. Demonstration of PAGE and SDS-PAGE. 10. To study principle and working of spectrophotometer. 11. Demonstration of thin layer chromatography. 12. Demonstration of paper chromatography. 13. Working of compound microscope. 14. Various types of Electroimmunodiffusion.	120

Suggested Evaluation Methods

Internal Assessment: 30		**End Term Examination: 70**	
➢ **Practicum**	**30**	➢ **Practicum**	**70**
• Class Participation:	5	Lab record, Viva-Voce, write-up and execution of the practical	
• Seminar/Demonstration/Viva-voce/Lab records etc.:	10		
• Mid-Term Exam:	15		

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Part C-Learning Resources
Recommended Books/e-resources/LMS: 1. Cappucino JG and Welsh CT. Microbiology: A laboratory manual. 11th edition. Pearson. 2. Thompson DA. Biochemistry Lab Manual. 3rd edition. 3. Segel IH. Biochemical calculations: how to solve mathematical problems in general biochemistry, Wiley, 2nd Edition. 4. Sambrook J & Russell D. Molecular Cloning: A laboratory manual. 4th edition. Cold Spring Harbor laboratory Press. 5. Collee JG, Fraser AG, Marmion BP & Simmons A (eds.). Mackie & McCartney Practical Medical Microbiology. Churchill Livingstone, Edinburgh. 6. Atlas RM, Parks LC & Brown AL. Laboratory Manual of Experimental Microbiology. MosbyYear Book, Inc., Missouri.

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Session: 2024-25	
Name of the Programme	**M.Sc. Microbiology**
Semester	**1**
Name of the Course	Seminar
Course Code	**M24-MIC-107**
Course Type: (CC/DEC/PC/Seminar/CHM/OEC/EEC)	Seminar
Level of the course	400-499
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO1: To enhance the communication skill of students to express the subject effectively during academic and professional discourse and to improve their ability to comprehend, and integrate academic text.
Credits	Seminar
	2
Teaching Hours per week	2
Max. Marks	50
Internal Assessment Marks	0
End Term Exam Marks	50
Examination Time	1 hour
Instructions for Examiner: Evaluation of the seminar will be done by the internal examiner(s) on the parameters decided by staff council of the department. There will be no external examination/viva-voce examination.	

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Session: 2024-25				
Part A – Introduction				
Name of Programme	**M.Sc. Microbiology**			
Semester	**2**			
Name of the Course	**Recombinant DNA Technology**			
Course Code	**M24-MIC-201**			
Course Type	**CC-5**			
Level of the course	**400-499**			
Pre-requisite for the course (if any)	**NA**			
Course Learning Outcomes (CLO)	CLO1: Will be familiar with the use of various cloning vectors, and methods of DNA, RNA and protein analysis and various applications of PCR. CLO2. Will be able to understand the methods by which DNA is sequenced and will gain insights into how entire genomes of organisms are sequenced. CLO3. Will have learnt about promoter analyses, the many uses of the reporter genes, and methods to study the transcriptome along with overexpression of proteins. CLO4. Will have learnt about different methods to analyze protein-DNA and protein-protein interactions, protein engineering, and methods for proteome analyses. Will know about the creation of plant and animal transgenics.			
Credits		Theory	Practical	Total
		4	0	4
Teaching Hours per week		4	0	4
Internal Assessment Marks		30	0	30
End Term Exam Marks		70	0	70
Max. Marks		100	0	100
Examination Time		3 hours		

Part B- Contents of the Course

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	**Basics of DNA cloning, and methods of DNA and protein analysis:** Simple cloning and cloning using linkers and adaptors. Cloning into various kinds of vectors – plasmids, phages lambda and M13, phagemids, cosmids, P1 phage, PACs, BACs and YACs. Selection and screening of clones. Southern and Northern Blotting. Radiolabelling probes. Isolation and purification of DNA. RFLP analysis. DNA fingerprinting and its application in forensics, in disease diagnosis and in identification of strains. Western Blotting analysis. **Polymerase chain reaction and construction of cDNA and genomic DNA libraries:** Concept of PCR and various thermophilic enzymes used in PCR. Gradient PCR versusTouchdown PCR. Designing primers. Cloning PCR products. Long PCR, Inverse PCR,Vectorette PCR, RT-PCR, 5' and 3' RACE, Real Time PCR using SYBR Green, Scorpion primers and TaqMan probes, MOPAC, Multiplex PCR, Differential Display PCR, RAPD fingerprinting of micro-organisms, Ligation Chain Reaction, Overlap PCR, Rolling Circle Amplification Technology. Vectors used in the construction of cDNA versus genomic DNA libraries. Steps in the construction of cDNA versus genomic DNA libraries. Screening libraries by colony hybridization and colony PCR. Screening expression libraries. Enriching for clones in cDNA libraries by positive selection and subtractive hybridization. Identifying genes in complex genomes by direct selection of cDNA and exon trapping	15

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II	**Genome sequencing:** DNA sequencing by Sanger's method – traditional and cycle sequencing. Physical mapping by restriction fragment fingerprinting of BAC clones and STS mapping. EPCR. Whole genome shotgun sequencing. Clone-by-clone shotgun sequencing of genome – preparation of BAC/YAC library, selection of BACs, subclone library construction, random shotgun phase and finishing phase followed by sequence authentication.	15
III	Transcriptional analysis of gene expression and transcriptomics: Gene expression analysis by Northern Blotting, RT-PCR, EST analysis and the use of reporter genes. Enzymatic and bioluminescent reporters. Reporters used in protein localization and trafficking studies. Promoter analysis – deletion analysis and linker scanning analysis coupled to reporter assays, mapping transcriptional start sites by S1 nuclease mapping, primer extension studies or 5' RACE. Transcriptome analysis by DD-PCR and EST analysis, DNA microarrays (cDNA arrays and oligo arrays), Serial Analysis of Gene Expresion (SAGE), RNA-seq. Overexpression of recombinant proteins: Overexpression and tagging of recombinant proteins in *E.coli*, driven by lac, T7 and Tet-regulatable promoters, Expression in *B. subtilis*. Overexpression systems in *S.cerevisiae*, *P.pastoris*, *S.pombe* and *K.lactis*. Baculovirus overexpression system. Mammalian cell overexpression system.	15
IV	Gel retardation assay, DNA footprinting by DNase I and chemical methods, yeast one-hybrid assay, ChIP- chip, ChIP-seq. Yeast two hybrid, three-hybrid, split hybrids and reverse hybrid. Co-immunoprecipitation, pull-down, far-western. Use of GFP and its variants in FRET analysis, use of BiFC. Phage display. Insertional and deletion mutagenesis. Site directed mutagenesis by conventional and PCR-based methods. **Applications of recombinant DNA technology:** Human protein replacements – insulin, hGH and Factor VIII. Human therapies – TPA, interferon, antisense molecules. Vaccines – Hepatitis B, AIDS, and DNA vaccines. Creating transgenic animals and plants.	15
	Total Contact Hours	60

Suggested Evaluation Methods			
Internal Assessment: 30		**End Term Examination: 70**	
➢ **Theory**	**30**	➢ **Theory:**	**70**
• Class Participation:	5	Written Examination	
• Seminar/presentation/assignment/quiz/class test etc.:	10		
• Mid-Term Exam:	15		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Molecular Biology by D.P. Clarke, N. Pazdernik. 2nd edition. Academic Press.
2. Molecular Cloning: A laboratory manual by J. Sambrook, D. Russell. 4th edition. Cold Spring Harbor laboratory Press.
3. DNA Technology: The Awesome Skill by I. Edward Alcamo. Harcourt Academic Press.
4. Molecular Biology of the Gene by J. Watson, T. Baker, S. Bell, A. Gann, M. Levine, R. Losick. 7th edition. Pearson.
5. Gene Cloning and DNA Analysis: An Introduction by T.A. Brown. 7th edition. WileyBlackwell Publishers.
6. Old & Primrose. Principles of gene manipulation. Blackwell Scientific Publications.
7. Sambrook&Russel. Molecular Cloning, 3rd volume. CSH Press.
8. Genome Analysis. 4th volume. CSH Press.
9. Lewin B. Genes VIII, International Edition, Pearson Education
10. Alberts B, Johnson A, Lewis J, Raff M, Roberts K, & Walter P. Molecular Biology of the Cell, 5th ed., Garland Science Publishing
11. Fritsch J &Maniatis EF. Molecular cloning a laboratory Manual, Cold Spring Harbor Laboratory

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Session: 2024-25			
Part A – Introduction			
Name of Programme	**M.Sc. Microbiology**		
Semester	**2**		
Name of the Course	**Molecular Biology**		
Course Code	**M24-MIC-202**		
Course Type	**CC-6**		
Level of the course	**400-499**		
Pre-requisite for the course (if any)	**NA**		
Course Learning Outcomes (CLO)	CLO1. Student will be able to understand the process of transcription, the first level of gene expression and its regulation. CLO2. Student will be able to understand different events associated with the processing of newly synthesized RNA including the process of RNA interference and RNA editing CLO3. Students will be able to describe translation mechanism in prokaryotes, regulation of translation, and post-translational processing including the significance of genetic code. CLO4. Student will be able to explain positive and negative regulation of gene expression taking examples of lactose, tryptophan and arabinose operon		
Credits	Theory	Practical	Total
	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Time	3 hours		

Part B- Contents of the Course

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	**Transcription:** History : linking genes and proteins , evidence for mRNA, transcription v/s replication : similiarities and differences. General principle and steps of transcription: basic apparatus , initiation , elongation and termination. Classes of RNA : rRNA, mRNA and tRNA, structure and function . Types of RNA polymerases: prokaryotic and eukaryotic , structure of prokaryotic RNA polymerase, Monocistronic and polycistronic RNA, transcription bubble, structure of promoter, DNA binding assay for promoter finding , Abortive transcription, Regulation of transcription, Alternate sigma factor , rho dependent and independent termination , hairpin structure for termination . Brief idea of transcription in eukaryotes	15
II	**Maturation and processing of RNA:** Primary transcript, coding and non coding RNA, rRNA processing: Methylation and nucleolytic cleavage and ribonucleoproteins (RNPs), tRNA processing : cutting and degradation of tRNA, ribozymes , mRNA processing : poly A tail, capping, introns and its types and exons and their structure, splicing mechanism , transesterification reaction, self splicing and spliceosomes. Alternative poly A site and alternative splicing. RNA editing and RNA interference (RNAi), miRNA. CRISPR-Cas systems for editing, regulating and targeting genomes.	15

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III	**Translation:** Basic features of genetic code: Triplet code, deciphering of genetic code, degeneracy, characteristics of genetic code, variation in different organisms, universality ,wobble hypothesis, significance of genetic code. Central dogma. Basic steps of translation: basic apparatus, initiation, elongation, termination, coupled transcription and translation, aminoacylsite(A site), peptidyl site (P site) and E site , initiation, elongation and termination factors, aminoacyl tRNA synthetases, leader sequences, in vitro translation system. Post translational modifications. Brief idea of translation in eukaryotes.	15
IV	**Regulation of gene expression:** Constitutive and inducible genes, Operon concept, structural genes, promoter, operator ,regulator genes , concept of inducer and repressor ,catabolite repression, Positive and negative regulation, lac, different mutations study of lac operon, trp operon and concept of attenuation and ara operon, stringent response, ppGpp, cAMP as regulatory molecules.	15
	Total Contact Hours	60

Suggested Evaluation Methods

Internal Assessment: 30		**End Term Examination: 70**	
➢ **Theory**	**30**	➢ **Theory:**	**70**
• Class Participation:	5	Written Examination	
• Seminar/presentation/assignment/quiz/class test etc.:	10		
• Mid-Term Exam:	15		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Maloy SR, Cronan JE & Freifelder D. Microbial Genetics, Jones & Bartlett publishers.
2. Dale JW. Microbial Genetics of bacteria, Jones & Bartlett publishers.
3. Lewin B . Gene XI , Oxford University press.
4. Freifelder D . Molecular Biology Jones and Bartlett Publishers USA
5. Lodish *et al* . Molecular Cell Biology W.H freeman.
6. Maloy SR, Cronan JE Jr. & Freifelder D. Microbial Genetics, 2nd ed., Narosa Publishing House
7. Gardner JE, Simmons MJ &Snustad DP. Principles of Genetics. John Wiley & Sons
8. Nelson DL & Cox MM.Lehninger's Principles of Biochemistry 5th ed., W.H. Freeman and Company
9. Klug WS and Cummings MR. Essentials of Genetics. Pearson Educational International.
10 Griffiths AJ, Wessler SR, Lewontin RC and Carroll SB . Introduction to genetic analysis. W.H. Freeman and Company,New York.
11. Watson JD Molecular Biology of the Gene 6th edition. Benjamin Cummings.
12. Alberts B *et.al* Molecular Biology of the Cell 5thedition. Garland Science, New York and London.
13. Stryer L Biochemistry 5th edition. W.H. Freeman and Company, USA.

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Session: 2024-25	
Part A – Introduction	
Name of Programme	**M.Sc. Microbiology**
Semester	**2**
Name of the Course	**Medical Microbiology**
Course Code	**M24-MIC-203**
Course Type	**CC-7**
Level of the course	**400-499**
Pre-requisite for the course (if any)	**NA**
Course Learning Outcomes (CLO)	CLO1. Student will be able to understand the basics of classical and molecular microbial pathogenicity. CLO2. Student will be able to understand the spread of microbes through body, their strategies and mechanism to cause the damage. CLO3 Students will understand the emergence of new infections as well as various methods of molecular microbial epidemiology. CLO4. Students will be able to understand the various mechanisms of antimicrobial resistance and new rapid diagnostic principles.

Credits	Theory	Practical	Total
	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Time	3 hours		

Part B- Contents of the Course

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	Significance of Microbiology in Medicine, Classification of medically important microbes, Normal microbial flora of the human body: normal flora of skin, eye, throat, gastrointestinal tract and urogenital tract - Infections- Sources, types – opportunistic, nosocomial and community acquired infections - Mode of transmission, carriers and their types – investigation of epidemic diseases. Host pathogen interaction: Definitions - Infection, Invasion, Pathogen, Pathogenicity, Virulence, Toxigenicity, Carriers and their types, Transmission of infection, Pathophysiologic effects of LPS. Events occurring immediately after the entry of the microorganisms in host in relation to establishment of infections.	15
II	**Medical bacteriology:** Morphological, cultural and biochemical characteristics of and epidemiology, mechanism of bacterial pathogenesis, lab diagnosis, prophylaxis and control of medically important diseases caused by: *Staphylococcus aureus, Group A Streptococci, Corynebacterium diphtheriae, Clostridium tetani, Bacillus anthracis, Leptospira interrogans, Treponema pallidum, Mycobacterium tuberculosis, Escherichia coli, Vibrio cholerae, Niesserriae, Haemophilus influenza, Helicobacter pylori, Pseudomonas and Salmonella.* Brief note on Chlamydia, Rickettsia Mycoplasama, anaerobic bacterial infections, Atypical Mycobacterium, Zoonotic bacterial pathogens, Antibacterial agents: five modes of action with one example each: Inhibitior of nucleic acid synthesis, inhibition of cell wall synthesis, inhibitor of cell membrane function, inhibitors of protein synthesis, inhibitors of metabolism	15

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III	**Medical mycology:** Morphological and cultural characteristics of and epidemiology, mechanism of fungal pathogenesis, lab diagnosis and treatment of medically important diseases caused by: Superficial mycosis – *Tinea versicolor*. Cutaneous mycoses: *Microsporum, Trichophyton*, Epidermophyton. Subcutaneous mycoses: Sporotrichosis, Chromoblastomycosis, Zygomycosis. Systemic Mycoses – *Histoplasma capsulatum, Blastomyces dermatitidis, Cryptococcus neoformans, Coccidioides immitis, Paracoccidioides brasiliensis*. Opportunistic mycoses: *Candidiasis, Cryptococcosis and Aspergillosis*. Antifungal agents: Mechanism of action of Amphotericin B, Griseofulvin	15
IV	**Morphology of, and pathogenesis, laboratory diagnosis and treatment of medically important protozoan diseases caused by**: *Entomoeba histolytica, Giardia lamblia, Trichmonas vaginalis, Plasmodium vivax, Leishmania donovani, Taenia solium, Ascaris lumbricoides, Ancyclostoma duodenale and Wuchereria bancrofti.* **General properties of and epidemiology, pathogenesis, lab diagnosis and treatment of medically important viral diseases caused by:** Influenza viruses, Measles, Mumps, Rubella, Chicken Pox, Hepatitis A,B,C, D and E, Poliomyelitis, HIV, Human Papilloma Virus, Rabies, Yellow fever, Dengue and Japanese Encephalitis viruses. Brief note on oncogenic viruses. Antiviral agents: Mechanism of action of Amantadine, Acyclovir, Azidothymidine	15
	Total Contact Hours	60

Suggested Evaluation Methods

Internal Assessment: 30		**End Term Examination: 70**	
➢ **Theory**	**30**	➢ **Theory:**	**70**
• Class Participation:	5	Written Examination	
• Seminar/presentation/assignment/quiz/class test etc.:	10		
• Mid-Term Exam:	15		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

- Ananthanarayanan R and Jeyaram Paniker CK. Textbook of Medical Parasitology. 5th Ed. and 8th edition. Jay Pee brother's Medical publisher, Pvt. Ltd., New Delhi. 2004.
- Rajan S. Medical Microbiology. MJP Publishers, Chennai. 2007.
- Negar Barazandeh. Microbiology Titles Basic Bacteriology, Parasitology, Mycology. 2008.
- Subhash Chandra Parija.Textbook of Microbiology and Immunology. A division of Reed Elsevier India Private Limited. 1st edition.2009.
- Jawetz, Melnick, & Adelberg's. Medical Microbiology. Twenty-Sixth Edition. The McGraw-Hill Companies, Inc. 2010.

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Session: 2024-25	
Part A – Introduction	
Name of Programme	**M.Sc. Microbiology**
Semester	**2**
Name of the Course	**Biostatistics and computer for biologists**
Course Code	**M24-MIC-204**
Course Type	**CC-8**
Level of the course	**400-499**
Pre-requisite for the course (if any)	**NA**
Course Learning Outcomes (CLO)	CO1. The students will know the basics of computer, its functioning and various devices attached to computer. CO2. The student will be familiar with MS office basics as well as basics of operating system and networking CO3. The student will be well versed with different statistical methods: Principles of statistical analysis of biological data. Measures of central tendency, dispersion, skewness and kurtosis. CO4. Student will understand Large Sample Test based on Normal Distribution, Confidence Interval; Application of Chisquare test; Small sample test based on t-test and F test.

Credits	Theory	Practical	Total
	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Time	3 hours		

Part B- Contents of the Course

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	**Introduction to computer:** Classification of computers –computer generation-low, medium and high level languages. Block Diagram of a computer; Description of each block in detail; concept of input-output devices; compilers and interpreters, mini, main frame and super computer, their characteristics and applications. BIT, BYTE. **Concept of Memory:** Types of Memory; Concept of Central processing Unit (CPU), Control Unit (CU), and Arithmetic Logic Unit (ALU). **Data representation and storage** –binary codes, binary systems and its relationship to Boolean Operations. Different numbers systems and conversions. Secondary storage media.	15
II	**Word Basics :** – Formatting Text and Documents : Auto format, Line spacing, Margins, Borders and Shading, etc. **Microsoft excel:** Data entry, graphs, aggregate functions- formulations and functions (students are expected to be familiar with all operations). **Operating system basics :** Overview, The purpose of operating systems, Types of operating systems, Providing a user interface, Running programs, Managing hardware, Enhancing an OS utility software. **Networking Basics :** Overview, Sharing data anywhere, anytime, The uses of a network, Common types of networks, Hybrid networks, How networks are structured, Network topologies and protocols, Network media, Network hardware. Internet: How internet works? Significance.	15

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III	**Biostatistics:** Statistics, its meaning and objectives .Population samples, frequency tables and their graphs, measures of central tendency (mean, mode, median) and their dispersion. Concepts of moments, Skewness and kurtosis. Intuitive definition of random variables, probability mass function and probability density function, expectation and variance. **Standard distribution**; binomial, Poisson and normal distribution with their important properties and significance.	15
IV	**Fitting of main distributions and testing of goodness** –of – the –fit with special reference to $\chi 2$- test, t –test, Z-test. Fitting of trends; linear and quadratic with least square method. Lines of regression, coefficient of correlation, coefficient of variation and their significance. **Analysis of variance**; one way and two way classification. Brief exposure of three basic principles of design of experiments, treatment, plot and block.	15
	Total Contact Hours	60

Suggested Evaluation Methods

Internal Assessment: 30		**End Term Examination: 70**	
➢ **Theory**	**30**	➢ **Theory:**	**70**
• Class Participation:	5	Written Examination	
• Seminar/presentation/assignment/quiz/class test etc.:	10		
• Mid-Term Exam:	15		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Rosne B. Fundamentals of Biostatistics, Cengage Learning.
2. Zar JH. Biostatistical Analysis, Pearson Education 5th ed.
3. Campbell RC .Statistics for Biologists, Cambridge university press.
4. Daniel WW. Biostatistics: A Foundation for Analysis in Health Science, 6th ed., John Wiley
5. Snedecar GW & Cochram WG. Statistical Methods, Oxford Press.
6. White Ron .How Computers Work? Techmedia.

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Session: 2024-25				
Part A – Introduction				
Name of the Programme	**M.Sc. Microbiology**			
Semester	**2**			
Name of the Course	**Practical based on Papers M24-MIC-201 & M24-MIC-202**			
Course Code	**M24-MIC-205**			
Course Type	**PC-3**			
Level of the course	**400-499**			
Pre-requisite for the course (if any)	**NA**			
Course Learning Outcomes (CLO)	CLO1. The student will be able to isolate the genomic and plasmid DNA from bacterial culture. CLO2. The student will be able to check purity of DNA, through agarose gel electrophoresis and PCR. CLO3. The student will be able to perform transformation study of bacterial cultures CLO4. will learn protocol about isolation of chromosomal and plasmid DNA			
Credits		Theory	Practical	Total
Teaching Hours per week		0	4	4
Internal Assessment Marks		0	8	8
End Term Exam Marks		0	30	30
Max. Marks		0	70	70
Examination Time		0	100	100
			4 hours	
Part B- Contents of the Course				
	Practicals			**Contact Hours**
Course Contents	1. Isolation of plasmid DNA by using alkaline lysis 2. Transformation of plasmid DNA by using CaCl2. 3. Preparation of genomic DNA from bacteria. 4. Demonstration of agarose gel electrophoresis. 5. Demonstration of polymerase chain reaction. 6. Calorimetric estimation of DNA & RNA. 7. To isolate plasmid DNA from a given culture. 8. To prepare agrose gel and to run the plasmid DNA samples 9. Isolation of chromosomal DNA 10. To test the given sample for purity of DNA content. 11. Preparation of competent cell by CaCl2 treatment for transformation			120
Suggested Evaluation Methods				
Internal Assessment: 30			**End Term Examination: 70**	
➢ **Practicum**	**30**		➢ **Practicum**	**70**
• Class Participation:	5		Lab record, Viva-Voce, write-up and execution of the practical	
• Seminar/Demonstration/Viva-voce/Lab records etc.:	10			
• Mid-Term Exam:	15			
Part C-Learning Resources				

Recommended Books/e-resources/LMS:

1. Cappucino JG and Welsh CT. Microbiology: A laboratory manual. 11th edition. Pearson.
2. Thompson DA. Biochemistry Lab Manual. 3rd edition.
3. Segel IH. Biochemical calculations: how to solve mathematical problems in general biochemistry, Wiley, 2nd Edition.
4. Sambrook J & Russell D. Molecular Cloning: A laboratory manual. 4th edition. Cold Spring Harbor laboratory Press.
5. Collee JG, Fraser AG, Marmion BP & Simmons A (eds.). Mackie & McCartney Practical Medical Microbiology. Churchill Livingstone, Edinburgh.
6. Atlas RM, Parks LC & Brown AL. Laboratory Manual of Experimental Microbiology. MosbyYear Book, Inc., Missouri.

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Session: 2024-25			
Part A – Introduction			
Name of the Programme	**M.Sc. Microbiology**		
Semester	**2**		
Name of the Course	**Practical based on Papers M24-MIC-203 & M24-MIC-204**		
Course Code	**M24-MIC-206**		
Course Type	**PC-4**		
Level of the course	**400-499**		
Pre-requisite for the course (if any)	**NA**		
Course Learning Outcomes (CLO)	CLO1. The student will be able to perform sterility testing of a sample and is acquainted with the resident microflora of skin and oral cavity. CLO2. The student will be able to identify human pathogenic microorganisms on selective/ differential media following biosafety norms. CLO3. The student will be able to learn measures of central tendency, dispersion, skewness and kurtosis. CLO4. Student will learn about discrete and continuous random variable, correlation and regression. Emphasis with examples on how descriptive statistics helps in analysing biological sciences data.		
Credits	Theory	Practical	Total
	0	4	4
Teaching Hours per week	0	8	8
Internal Assessment Marks	0	30	30
End Term Exam Marks	0	70	70
Max. Marks	0	100	100
Examination Time	0	4 hours	
Part B- Contents of the Course			
	Practicals		**Contact Hours**
Course Contents	1. To study cultural characteristics of pathogenic bacteria on following selective/differential media: TCBS agar; Hektoen Enteric agar; XLD agar; Endo agar; Salmonella-Shigella agar; Deoxycholate citrate agar 2. To study pathogenicity of *Staphylococcus aureus* by coagulase test 3. To demonstrate the liberation of ammonia from nitrogenous organic compound (ammonification). 4. To perform sterility testing of a sample. 5. To study resident microflora of skin. 6. To study resident microflora of oral cavity 7. Handling of data using measures of central tendency. 8. Handling of data using measures of dispersion. 9. Problems based on skewness and kurtosis. 10. Finding Karl Pearson's correlation coefficient and interpretation of result. 11 Application of Chi-Square Distribution and interpretation of result on given data set a. Chi-square test of proportions. b. Chi-square tests of association. c. Chi-square test of goodness-of-fit		120

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Suggested Evaluation Methods			
Internal Assessment: 30		**End Term Examination: 70**	
➢ **Practicum**	**30**	➢ **Practicum**	**70**
• Class Participation:	5	Lab record, Viva-Voce, write-up and execution of the practical	
• Seminar/Demonstration/Viva-voce/Lab records etc.:	10		
• Mid-Term Exam:	15		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Collee JG, Fraser AG, Marmion BP & Simmons A (eds.). Mackie & McCartney Practical Medical Microbiology. Churchill Livingstone, Edinburgh.
2. Atlas RM, Parks LC & Brown AL. Laboratory Manual of Experimental Microbiology. MosbyYear Book, Inc., Missouri.
3. Danniel WW. Biostatistics: A Foundation for Analysis in the Health Sciences by. John Wiley,
4. Goon AM, Gupta MK and Dasgupta B. Fundamentals of Statistics Vol. I & II. 8th edition. The World Press, India.

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Session: 2024-25			
Part A – Introduction			
Name of the Programme	**M.Sc. Microbiology**		
Semester	**2**		
Name of the Course	**Constitutional, Human and Moral values, and IPR**		
Course Code	**M24-CHM-201**		
Course Type	**CHM**		
Level of the course (As per Annexure-I	**400-499**		
Pre-requisite for the course (if any)	NA		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO-1: Learn the different Constitutional Values, Fundamental rights and duties enshrined in the India Constitution. CLO-2: Understand humanism, human virtues and values, and idea of International peace. CLO-3: Grasp the basic concepts of Moral Values and Professional Conduct which are required to become a part of the civil society and for developing professionalism. CLO-4: Understand *concepts of* Intellectual Property Rights, *Copyright, Patent, Trademark etc., and about threats of* Plagiarism.		
Credits	Theory	Practical	Total
	2	0	2
Teaching Hours per week	2	0	2
Internal Assessment Marks	15	0	15
End Term Exam Marks	35	0	35
Max. Marks	50	0	50
Examination Time	3 hours		

Part B- Contents of the Course (Will be available from common pool)

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	**Constitutional Values:** Historical Perspective of Indian Constitution; Basic Values enshrined in the Preamble of the Indian Constitution; Concept of Constitutional Morality; Patriotic Values and Ingredients Nation Building; Fundamental Rights and Duties ; Directive Principles of the State Policy.	8
II	**Humanistic Values:** Humanism, Human Virtues and Civic Sense; Social Responsibilities of Human Beings; Ethical ways to deal with human aspirations; Harmony with society and nature; Idea of International Peace and Brotherhood (Vasudhaiv Kutumbkam).	7
III	**Moral Values and Professional Conduct** Understanding Morality and Moral Values; Moral Education and Character Building; Ethics of Relations: Personal, Social and Professional; Introduction to Gender Sensitization; Affirmative approach towards Weaker Sections (SCs, STs, OBCs, EWS & DAs); Ethical Conduct in Higher Education Institutions; Professional Ethics.	8
IV	**Intellectual Property Rights:** Meaning, Origins and Nature of Intellectual Property Rights (IPRs);Different Kinds of IPRs – Copyright, Patent, Trademark, Trade Secret/Dress, Design, Traditional Knowledge; Infringement and Offences of IPRs – Remedies and Penalties; Basics of Plagiarism policy of UGC.	7
	Total Contact Hours	30

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Suggested Evaluation Methods			
Internal Assessment: 15		**End Term Examination: 35**	
➢ **Theory**	**15**	➢ **Theory**	**35**
• Class Participation:	4	Written Examination	
• Seminar/presentation/assignment/quiz/class test etc.:	4		
• Mid-Term Exam:	7		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

- Ahuja, V K. (2017). *Law relating to Intellectual Property Rights*, India, IN: Lexis Nexis.
- Bajpai, B. L., *Indian Ethos and Modern Management*, New Royal Book Co., Lucknow, 2004.
- Basu, D.D., *Introduction to the Constitution of India* (Students Edition) Prentice Hall of India Pvt. Ltd., New Delhi, 20th ed., 2008.
- Dhar, P.L. & R.R. Gaur, *Science and Humanism*, Commonwealth Publishers, New Delhi, 1990.
- George, Sussan, *How the Other Half Dies*, Penguin Press, 1976.
- Govindarajan, M., S. Natarajan, V.S. Sendilkumar (eds.), *Engineering Ethics (Including Human Values)*, Prentice Hall of India Private Ltd, New Delhi, 2004.
- Harries, Charles E., Michael S. Pritchard & Michael J. Robins, *Engineering Ethics*, Thompson Asia, New Delhi, 2003.
- Illich, Ivan, *Energy & Equity*, Trinity Press, Worcester, 1974.
- Meadows, Donella H., Dennis L. Meadows, Jorgen Randers & William W. Behrens, *Limits to Growth: Club of Rome's Report*, Universe Books, 1972.
- Myneni, S.R, Law of Intellectual Property, Asian Law House.
- Narayanan, P, *IPRs*.
- Neeraj, P., &Khusdeep, D. (2014). *Intellectual Property Rights*, India, IN: PHI learning Private Limited.
- Nithyananda, K V. (2019). *Intellectual Property Rights: Protectionand Management*. India, IN: Cengage Learning India PrivateLimited.
- Palekar, Subhas, *How to practice Natural Farming*, Pracheen (Vaidik) KrishiTantraShodh, Amravati, 2000.
- Phaneesh, K.R., *Constitution of India and Professional Ethics*, New Delhi.
- Pylee, M.V., *An Introduction to Constitution of India*, Vikas Publishing, New Delhi, 2002.
- Raman, B.S., *Constitution of India,* New Delhi, 2002.
- Reddy, B., Intellectual Property Rights and the Law, Gogia Law Agency.
- Reddy, N.H., SantoshAjmera, *Ethics, Integrity and Aptitude*, McGraw Hill, New Delhi.
- Sharma, Brij Kishore, *Introduction to the Constitution of India,* New Delhi,
- Schumacher, E.F., *Small is Beautiful: A Study of Economics as if People Mattered*, Blond & Briggs, Britain, 1973.
- Singles, Shubham et. al., *Constitution of India and Professional Ethics,* Cengage Learning India Pvt. Ltd., Latest Edition, New Delhi, 2018.
- Tripathy, A.N., *Human Values*, New Age International Publishers, New Delhi, 2003.
- Wadehra, B.L., Law relating to Intellectual Property, Universal Law Publishing Co.

Relevant Websites, Movies and Documentaries:

- *Value Education Websites*, http://uhv.ac.in, http://www.uptu.ac.in.
- *Story of Stuff*, http://www.storyofstuff.com
- Cell for IPR Promotion and Management: http://cipam.gov.in/.
- World Intellectual Property Organization: https://www.wipo.int/about-ip/en/
- Office of the Controller General of Patents, Designs & Trademarks: http://www.ipindia.nic.in/

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