DEPARTMENT OF MICROBIOLOGY

M.Sc. II Year (Semester III) Microbiology
Paper 1: RDT & MICROBIAL GENETICS (MB10301T)

Programme/Class: Degree/M.Sc.	Year: 2nd year	M.Sc. 3rd Semester
Subject: Microbiology		
Course Code: **MB10301T**	**Course Title: RDT & MICROBIAL GENETICS**	

Course outcomes:	Bloom's taxonomy
CO1: Explain and apply restriction–modification systems, DNA modifying enzymes, ligation strategies, and construction of cDNA and genomic DNA libraries.	K2, K4
CO2: Analyze types of plasmids, their functions, replication, transfer, and suitability as vectors in genetic analysis and gene cloning.	K2, K3
CO3: Compare and select appropriate cloning and expression vectors and apply recombinant protein expression and screening techniques.	K2, K4
CO4: Evaluate gene labeling, hybridization, gene transfer, recombination mechanisms, and mobile genetic elements for molecular applications.	K2, K5

Credits:4	Core Compulsory
Max. Marks:25+75	Min. Passing Marks: 40

Total No. of Lectures-Tutorials-Practical (in hours per week): L- 4/w

Unit	Topics	No. of Lectures= 60
I	**Enzymes and Techniques in Recombinant DNA Technology** Host controlled restriction and modification, Restriction enzymes & its nomenclature, DNA modifying enzymes, Cohesive & Blunt end ligation, Linkers, Adaptors, Homopolymer tailing, cDNA library & Genomic DNA library construction	15

II	**Plasmids and Their Role in Gene Cloning** Different types of plasmids, F Factor description and their uses in genetic analyses, col and R plasmids. Function encoded by plasmids, Replication of plasmids, incompatibility, host range, copy number, curing of plasmid, Transfer of plasmid Artificial plasmid, Plasmid as vector for gene cloning	15
III	**Cloning and Expression Vectors** Cloning Vectors – plasmid (pBR322, pUC), Cosmid, Phasmid, Bacteriophage λ, Single stranded DNA Vectors (M13, f1, fd), Cloning vectors for Yeast, Artificial Chromosomal Vectors (BACs, YACs), Prokaryotic & Eukaryotic Expression Vectors with GST, His, MBP tags, Affinity Purification of Recombinant Protein, Yeast two-hybrid system, Phage display technique	15
IV	**Gene Detection, Transfer, and Genome Dynamics** End labeling, Random Priming, Nonradioactive probes, FISH, Hybridization techniques – Southern Blotting, Northern Blotting, Western Blotting, Transformation, conjugation and Transduction – Generalized and Specialized, mechanism and application, Molecular basis of recombination, Insertion Sequences & Transposons, types of transposons, site specific recombination	15

Suggested Readings:

1. **T.A. Brown.** *Gene Cloning and DNA Analysis.* Blackwell Publishing.
2. **S.B. Primrose and R.M. Twyman.** *Principles of Gene Manipulation and Genomics.* Blackwell Scientific Publications.
3. **Old, R.W. and S.B. Primrose.** *Principles of Gene Manipulation: An Introduction to Genetic Engineering.* Blackwell Scientific Publications.
4. **J. Sambrook and D.W. Russell.** *Molecular Cloning: A Laboratory Manual.* Cold Spring Harbor Laboratory Press.
5. **Green, M.R. and J. Sambrook.** *Molecular Cloning: A Laboratory Manual (4th Edition).* Cold Spring Harbor Laboratory Press.
6. **Desmond S.T. Nicholl.** *An Introduction to Genetic Engineering.* Cambridge University Press.
7. **Dale, J.W. and M. von Schantz.** *From Genes to Genomes: Concepts and Applications of DNA Technology.* John Wiley & Sons.
8. **Watson, J.D., Baker, T.A., Bell, S.P., Gann, A., Levine, M. and R. Losick.** *Molecular Biology of the Gene.* Pearson Education.
9. **Lewin, B.** *Genes XII.* Jones & Bartlett Learning.
10. **Alberts, B., Johnson, A., Lewis, J., Morgan, D., Raff, M., Roberts, K. and P. Walter.** *Molecular Biology of the Cell.* Garland Science.

DEPARTMENT OF MICROBIOLOGY

M.Sc. II Year (Semester III) Microbiology

Paper 2: FUNDAMENTALS OF MOLECULAR BIOLOGY (MB10302T)

Programme/Class: Degree/M.Sc.	Year: 2nd year	M.Sc. 3rd Semester
Subject: Microbiology		
Course Code: **MB10302T**	Course Title: FUNDAMENTALS OF MOLECULAR BIOLOGY	

Course outcomes	Bloom's taxonomy
CO1: Explain DNA structure, replication mechanisms, and DNA damage–repair processes as the molecular basis of genetic continuity.	K2, K4
CO2: Explain transcription mechanisms, RNA processing, regulation, and functional diversity of RNA in prokaryotic and eukaryotic systems.	K2, K3
CO3: Explain protein synthesis, translational regulation, inhibitors, and post-translational processing involved in functional protein formation.	K2, K4
CO4: Analyze regulation of gene expression in prokaryotes and eukaryotes, chromatin-mediated control, and the molecular basis of mutations.	K2, K5

Credits:4	Core Compulsory
Max. Marks:25+75	Min. Passing Marks: 40

Total No. of Lectures-Tutorials-Practical (in hours per week): L- 4/w

Unit	Topics	No. of Lectures= 60
I	**Structure, Properties, and Replication of DNA** DNA as the genetic blueprint, Physical and chemical structure of DNA, circular and super helical DNA, Denaturation and Renaturation of DNA, Hybridization, DNA replication, Semiconservative replication (experimental evidence), Unit of replication, enzymes involved, replication origin and replication fork, fidelity of replication, DNA damage and repair mechanisms.	15

II	**RNA Synthesis and Processing** RNA synthesis and processing – transcription factors and machinery, formation of initiation complex, transcription activator and repressor, RNA polymerases, capping, elongation, and termination, RNA processing, RNA editing, splicing, and polyadenylation, structure and function of different types of RNA, RNA transport, transcriptional inhibitors.	15
III	**Protein Synthesis and Post-Translational Processing** Protein synthesis and processing – Ribosome, formation of initiation complex, initiation factors and their regulation, elongation and elongation factors, termination, genetic code, aminoacylation of tRNA, tRNA-identity, aminoacyl tRNA synthetase, and translational proof-reading, translational inhibitors, Post-translational modification of proteins, Protein trafficking.	15
IV	**Regulation of Gene Expression and Mutations** Control of gene expression at transcription and translation level – regulating the expression of prokaryotic (lac, trp, ara operon) and eukaryotic genes response element, role of chromatin in gene expression and gene silencing, Types of Mutation, Mutagen.	15

Suggested Readings:

1. **Alberts B., Johnson A., Lewis J., Raff M., Roberts K., Walter P.** *Molecular Biology of the Cell.* Garland Science
2. **Lewin B.** *Genes XII.* Jones & Bartlett Learning.
3. **Watson J.D., Baker T.A., Bell S.P., Gann A., Levine M., Losick R.** *Molecular Biology of the Gene.* Pearson Education.
4. **Cooper G.M.** *The Cell: A Molecular Approach.* Sunderland (MA): Sinauer Associates.
5. **Lodish H., Berk A., Zipursky S.L., et al.** *Molecular Cell Biology.* W.H. Freeman.
6. **Primrose S.B. and Twyman R.M.** *Principles of Gene Manipulation and Genomics.* Blackwell Scientific Publications.
7. **Kornberg A. and Baker T.A.** *DNA Replication.* W.H. Freeman and Co. (specific focus on replication mechanisms).

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M.Sc. II Year (Semester III) Microbiology
Paper 3: ENVIRONMENTAL MICROBIOLOGY (MB10303T)

Programme/Class: Degree/M.Sc.	Year: 2nd year	M.Sc. 3rd Semester
Subject: Microbiology		
Course Code: MB10303T	**Course Title: ENVIRONMENTAL MICROBIOLOGY**	

Course outcomes	Bloom's taxonomy
CO1: Explain the principles of industrial microbiology and fermentation processes and analyze strategies for strain selection, improvement, and fermentation kinetics.	K2, K4
CO2: Explain the production of microbial metabolites and recombinant products and apply metabolic engineering principles for large-scale bioprocess development.	K2, K3
CO3: Explain the industrial production of fermented products and microbial enzymes and analyze their roles in biocatalysis and industrial applications.	K2, K4
CO4: Explain microbial production of biofuels and bioproducts and evaluate their potential in sustainable and emerging industrial applications.	K2, K5

Credits:4	Core Compulsory
Max. Marks:25+75	Min. Passing Marks: 40

Total No. of Lectures-Tutorials-Practical (in hours per week): L- 4/w

Unit	Topics	No. of Lectures= 60
I	**Foundations of Environmental Microbiology and Microbial Diversity** Development of microbial ecology and the emergence of environmental microbiology; historical perspective and scope of environmental microbiology; significant applications of microorganisms in solving environmental pollution problems. Understanding microbial diversity in the environment using culture-dependent and culture-independent approaches; analysis by fatty acid methyl ester (FAME); assessment of metabolic capabilities using BIOLOG; G+C content analysis; slot-blot hybridization of community DNA; fluorescent in situ hybridization (FISH) of intact cells; metagenomic analysis of solid and aquatic sediments.	15

II	**Microbial Diversity in Natural and Extreme Environments** Occurrence, diversity, adaptations, and potential applications of microorganisms in extreme environments including oligotrophs, thermophiles, psychrophiles, organic solvent-tolerant and radiation-tolerant microbes, metallophiles, acidophiles, alkaliphiles, and halophiles; biotechnological applications of extremophiles. Soil and Water Microbiology: Importance of soil microorganisms; microbial-mediated nutrient transformation processes; plant–microbe symbiosis; microbial antagonism; biofilms and their biotechnological applications; drinking water microbiology and quality control	15
III	**Microbial Biomass and Waste Management** Biomass waste management of plant residues; lignocellulolytic microorganisms and enzymes; biotechnological applications in biopulping, biobleaching, textile processing, biofuel production, and animal feed production. Liquid and solid waste management; sewage treatment processes (primary, secondary, and tertiary); treatment of industrial effluents including distillery, textile, pulp, and paper industries; methods for detection of pollutants such as metals, sediments, toxins, and organic matter.	15
IV	**Bioremediation and Environmental Sustainability** Solid waste management strategies including composting, landfill development, incineration methods, composting for sustainable agriculture, biogas production; plastic-degrading microorganisms as tools for bioremediation; challenges in waste management. Bioremediation of environmental pollutants including petroleum hydrocarbons and pesticides; use of biosensors for pollutant detection; microbial enhanced oil recovery (MEOR); bioleaching of copper, gold, and uranium; electronic waste (e-waste) management.	15

Suggested Readings:

1. Microbial Ecology by R.M. Atlas, R. Bartha. 3rd edition. Benjamin Cummings Publishing Co, USA. 1993.
2. Environmental Microbiology by A.H. Varnam, M.G. Evans. Manson Publishing Ltd. 2000.
3. Manual of Environmental Microbiology edited by C.J. Hurst, R.L. Crawford, J.L. Garland, D.A. Lipson, A. L. Mills, L.D. Stetzenbach. 3rd edition. Blackwell Publishing. 2007.
4. Environmental Microbiology edited by R. Mitchell, J-D Gu. 2nd edition. Wiley-Blackwell. 2009.
5. Environmental Microbiology by R. Maier, I. Pepper, C. Gerba. 2nd edition. Academic Press. 2009.
6. Environmental Microbiology: Principles and Applications by P.K. Jjemba, Science Publishing Inc. 2004.
7. Lignocellulose Biotechnology: Future Prospects by R.C. Kuhad, A. Singh. I.K. International. 2007.
8. Environmental Microbiology of Aquatic & Waste systems by N. Okafor. 1stedition, Springer, New York. 2011.

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M.Sc. II Year (Semester III) Microbiology
Paper 4: LAB 3 (MB10304P)

Programme/Class: Degree/M.Sc.	Year: 2nd year	M.Sc. 3rd Semester
Subject: Microbiology		
Course Code: **MB10304P**	**Course Title: LAB 3**	

Course outcomes	Bloom's taxonomy
CO1: Perform isolation, qualitative analysis, and quantitative estimation of DNA using standard molecular biology techniques.	K3
CO2: Apply PCR amplification, restriction enzyme digestion, and agarose gel electrophoresis for DNA analysis and interpretation of results.	K4
CO3: Demonstrate core recombinant DNA techniques including preparation of competent cells, bacterial transformation, and calculation of transformation efficiency.	K3, K4
CO4: Conduct in vitro transcription and translation assays, basic host–pathogen interaction demonstrations, and perform statistical data analysis (mean, SD, variance).	K5

Credits:4	Core Compulsory
Max. Marks:25+75	Min. Passing Marks: 40

Total No. of Lectures-Tutorials-Practical (in hours per week): L- 4/w

Unit	Topics	No. of Lectures= 60

	1. Isolation of DNA 2. Qualitative analysis of isolated DNA 3. Quantification of isolated DNA 4. PCR amplification 5. Digestion of DNA using restriction enzymes and analysis by agarose gel electrophoresis. 6. Preparation of competent cells for transformation. 7. Demonstration of Bacterial Transformation and calculation of transformation efficiency. 8. To demonstrate **in vitro** transcription assay and **in vitro** translation assay. 9. Data analysis: mean, SD, variance 10. Host–pathogen interaction assays (demo)	60

M.Sc. II Year (Semester III) Microbiology
Paper 5: RESEARCH PROJECT/ DISSERTATION (MB10305R)

Programme/Class: Degree/ MSc	**Year:** 2	**Semester : IV**
Subject: Microbiology (**Research project/internship/field or survey work**)		
CourseCode: **MB10305R**	Course Title: **Research project/internship/field or survey work**	
Topic will be decided		

M.Sc. II Year (Semester IV) Microbiology
Paper 1: MICROBIAL PHYSIOLOGY AND METABOLISM (MB10401T)

Programme/Class: Degree/M.Sc.	Year: 2nd year	M.Sc. 4th Semester
Subject: Microbiology		
Course Code: MB10401T	Course Title: **MICROBIAL PHYSIOLOGY AND METABOLISM**	

Course outcomes:	Bloom's taxonomy
CO1: Explain microbial growth kinetics and cell division and analyze membrane transport mechanisms and their regulation in microorganisms.	K2, K4
CO2: Explain the regulation of central carbon metabolic pathways and apply metabolic engineering concepts for industrial strain development.	K2, K3
CO3: Explain nitrogen, lipid, and nucleotide metabolism and analyze their regulation in microbial systems.	K2, K4
CO4: Explain enzyme kinetics and inhibition and evaluate microbial stress-response and intracellular signaling mechanisms.	K2, K5

Credits:4	Core Compulsory
Max. Marks:25+75	Min. Passing Marks: 40

Total No. of Lectures-Tutorials-Practical (in hours per week): L- 4/w

Unit	Topics	No. of Lectures= 60
I	**Microbial Growth, Cell Division, and Solute Transport** Measurement of microbial growth; growth physiology; cell division; growth yield; growth kinetics; steady-state growth; continuous and chemostat growth systems. Solute transport mechanisms: introduction to membrane transport; primary and secondary transport systems; transport kinetics. Membrane transport proteins: porins and aquaporins; mechanosensitive channels; ABC transporters; group translocation systems (PEP–PTS). Regulation of transport and metabolism: catabolite repression, inducer exclusion, and inducer expulsion.	15

II	**Central Carbon Metabolism and Metabolic Engineering** Central metabolic pathways and their regulation: glycolysis, gluconeogenesis, pentose phosphate pathway, Entner–Doudoroff pathway, citric acid cycle, alternate TCA pathways, glyoxylate cycle and its regulation. Metabolic engineering of carbon pathways for industrial strain development: co-metabolism of pentoses and hexoses; microbial production of succinic acid and citric acid.	15
III	**Nitrogen, Lipid, and Nucleotide Metabolism** Nitrogen metabolism: inorganic nitrogen assimilation including nitrate and ammonia assimilation; regulation of glutamate synthetase; general reactions of amino acids; Stickland reaction. Glutathione metabolism: distribution in bacteria, biosynthesis, and role in redox regulation. Amino acid metabolism: outline of amino acid biosynthesis; protein utilization; detailed biochemistry of glutamate-producing strains. Lipid metabolism: biosynthesis and degradation of lipids and their regulation in *Escherichia coli*; lipid accumulation in yeast. Nucleotide metabolism: purine and pyrimidine biosynthesis; deoxyribonucleotide synthesis; regulation of nucleotide biosynthesis; inhibitors of purine and pyrimidine biosynthesis.	15
IV	**Enzymes, Stress Responses, and Intracellular Signaling** Enzymes: introduction; activation energy; enzyme kinetics; Michaelis constant (Km); catalytic efficiency; turnover number. Methods for enzyme kinetics analysis: saturation kinetics, Lineweaver–Burk plot. Enzyme inhibition: models and types of inhibition. Physiological adaptation and intracellular signaling: two-component regulatory systems; response to physiological stress including aerobic–anaerobic shifts (Arc and Fnr systems) and osmotic homeostasis. Response to nutritional stress: phosphate limitation and Pho regulon; stringent response.	15

Suggested Readings:

1. Biochemistry by Geoffrey L. Zubay. 4th Edition. Brown Co, USA. 1999.
2. Microbial Physiology by A.G. Moat, J. W. Foster, M. P. Spector. 3rd Edition. John Wiley & Sons. 2002
3. Lehninger Principles of Biochemistry by D. L. Nelson, M. M. Cox. 6th Edition. W. H. Freeman. 2012
4. The Physiology and Biochemistry of Prokaryotes by D. White, J. Drummond, C. Fuqua. 4th Edition. Oxford University Press. 2011.
5. Microbial Biochemistry by G. N. Cohen. 2nd Edition. Springer. 2014.
6. Lippincott's Illustrated Reviews: Biochemistry edited by D. R. Ferrier. 6th Edition. Lippincott Williams & Wilkins. 2013
7. Biochemical Calculations: by Irwin H. Segel. 2nd Edition. Wiley. 2004.
8. Understanding Enzymes by T. Palmer, E.Horwood. 3rd Edition. Wiley. 1991.

DEPARTMENT OF MICROBIOLOGY

M.Sc. II Year (Semester IV) Microbiology
Paper 2: PHARMACEUTICAL MICROBIOLOGY (MB10402T)

Programme/Class: Degree/M.Sc.	Year: 2nd year	M.Sc. 4th Semester
Subject: Microbiology		
Course Code: **MB10402T**	Course Title: PHARMACEUTICAL MICROBIOLOGY	

Course outcomes	Bloom's taxonomy
CO1: Explain the principles of pharmaceutical microbiology, antibiotics, antimicrobial agents, and resistance mechanisms.	K2, K4
CO2: Explain microbial contamination, sterilization, preservation methods, and regulatory requirements in pharmaceutical industries.	K2, K3
CO3: Analyze drug discovery processes including screening, bio-prospecting, toxicity evaluation, and rational drug design.	K2, K4
CO4:- Explain pharmacological principles, drug action, delivery systems, regulatory policies, and R&D management in pharmaceuticals.	K2, K5

Credits:4	Core Compulsory
Max. Marks:25+75	Min. Passing Marks: 40

Total No. of Lectures-Tutorials-Practical (in hours per week): L- 4/w

Unit	Topics	No. of Lectures= 60
I	**Antibiotics, Antimicrobial Agents, and Resistance** Antibiotics: Types of antibiotics with their mode of action: antibacterial, antifungal, antiviral, antiprotozoal, Development of antibiotic resistance; Mechanism of antibiotic resistance; Antimicrobial peptides: History, properties, sources, mode of action, application; History and development of chemotherapeutic agents, Properties of antimicrobial agents; Types of chemotherapeutic agents – Synthetic, Semisynthetic, Natural	15

II	**Microbial Contamination, Sterilization, and Preservation** Microbial contamination spoilage and hazard; Sources of contamination; Factors affecting survival and growth; Breakdown of active ingredients and general formulations; Principles of sterilizations with respect to pharmaceutical industries; Methods of sterilizations: Steam, dry heat, radiation, gaseous and filtration, antimicrobial preservatives and their properties: antimicrobial activity, factors affecting antimicrobial activity, Preservative monographs, Preservative stability and efficacy, Methods of preservative evaluation and testing	15
III	**Drug Screening, Discovery, and Development** Microbial, Recombinant, Biochemical and Molecular level screening systems and their construction/design strategies, Conventional process; bio-prospecting, Search of database/data mining for drug designing, Preclinical and clinical trials, Estimation of toxicity: LD50 and ED50, Rational drug design – Principle (Structure Activity Relationship - SAR) and Tools (applications of high throughput screening, combinatorial synthesis, Pharmaco-genomics)	15
IV	**Pharmaceutical Biotechnology, Regulation, and Drug Delivery Systems** Financing R&D capital and market outlook, IP, BP, USP, Government regulatory practices and policies, FDA, Reimbursement of drugs and biologicals, legislative perspective, Rational drug design, Immobilization procedures for pharmaceutical applications (liposomes), Macromolecular, cellular and synthetic drug carriers	15

Suggested Readings:Hugo and Russell. *Pharmaceutical Microbiology.* Blackwell Scientific Publications.

1. **W. B. Hugo and A. D. Russell.** *Principles and Practice of Disinfection, Preservation and Sterilization.* Blackwell Publishing.
2. **Katzung, Masters and Trevor.** *Basic and Clinical Pharmacology.* McGraw-Hill Education.
3. **Goodman and Gilman.** *The Pharmacological Basis of Therapeutics.* McGraw-Hill.
4. **V. Rang, M. Dale, J. Ritter and R. Flower.** *Rang & Dale's Pharmacology.* Elsevier.
5. **Patrick, G. L.** *An Introduction to Medicinal Chemistry.* Oxford University Press.
6. **Silverman, R. B. and Holladay, M. W.** *The Organic Chemistry of Drug Design and Drug Action.* Academic Press.

M.Sc. II Year (Semester IV) Microbiology
Paper 3: ADVANCED IMMUNOLOGY AND IMMUNOTECHNIQUES (MB10403T)

Programme/Class: Degree/M.Sc.	Year: 2nd year	M.Sc. 4th Semester
Subject: Microbiology		
Course Code: **MB10403T**	Course Title: ADVANCED IMMUNOLOGY AND IMMUNOTECHNIQUES	

Course outcomes	Bloom's taxonomy
CO1: Explain innate and adaptive immune responses, immune cells, antibodies, antigen receptors, immune tolerance, and mechanisms of autoimmunity.	K2, K4
CO2: Analyze mechanisms of immune diversity, immunogenetics, immunodeficiency, host defense against infections, tumors, and autoimmune diseases.	K2, K3
CO3: Apply immunological techniques, antibody-based assays, and immunomics tools for diagnosis, localization, and functional analysis of immune responses.	K2, K4
CO4: Evaluate vaccination strategies and immunotherapeutic approaches for disease prevention, transplantation, and cancer management.	K2, K5

Credits:4	Core Compulsory
Max. Marks:25+75	Min. Passing Marks: 40

Total No. of Lectures-Tutorials-Practical (in hours per week): L- 4/w

Unit	Topics	No. of Lectures= 60
I	**Fundamentals of Immunity and Immune Cells** Distinguishing features of innate and specific immune response, Passive and Active immunity, Primary and secondary lymphoid organs, Haematopoiesis, innate and acquired immune cells, Inflammation, Cytokines, Antimicrobial peptides, Antibody: Classes and subclasses, structure-function relationship, isotypes, idiotypes and allotypes. B cell receptor and B cell signalling, B cell differentiation, Burnet's cloning selection theory, TCR, T cell signaling, Types of T and B cells, Regulatory T cells, Immune tolerance – Central and Peripheral mechanisms, Autoimmunity mechanisms.	15

II	**Immune Diversity, Genetics, and Disease Associations** Antibody and T cell diversity generation, Blood groups and transplantation antigens, HLA polymorphism and disease association, diseases associated with immunodeficiency Genetic basis of Immunity to infection by viruses, bacteria, fungi and parasites, immunity to tumors, autoimmune diseases – aetiology, pathogenesis and treatment.	15
III	**Immunological Techniques and Applications** Antigen-antibody reactions – complement fixation, agglutination, precipitation, immuno-diffusion, immunoelectrophoresis, Immuno-fluorescence, enzyme-linked immunosorbent assay (ELISA), radioimmunoassay (RIA). Production and applications of monoclonal and polyclonal antibodies for diagnosis and therapy, immunofluorescence, immunoelectron microscopy – *in situ* cell localization by FISH and GISH, Cytotoxicity assays, apoptosis assays, Immunohistochemistry, Immunomics and Immunoinformatics tools	15
IV	**Vaccines and Immunotherapy** Vaccine, adjuvants, cytokines, DNA vaccines, recombinant vaccines, bacterial vaccines, viral vaccines, edible and plant vaccines, tumor vaccines, principles of vaccination, passive & active immunization, immunization programs & role of WHO in immunization programs. Vaccine & peptide therapy in Transplantation, Types of Immunotherapy for cancer treatment and diagnostics.	15

Suggested Readings:

1. **Abbas, A. K., Lichtman, A. H. and Pillai, S.** *Basic Immunology: Functions and Disorders of the Immune System.* Elsevier.
2. **Janeway, C. A., Travers, P., Walport, M. and Shlomchik, M.** *Immunobiology.* Garland Science.
3. **Kindt, T. J., Goldsby, R. A., Osborne, B. A. and Kuby, J.** *Kuby Immunology.* W.H. Freeman & Company.
4. **Delves, P. J., Martin, S. J., Burton, D. R. and Roitt, I. M.** *Roitt's Essential Immunology.* Wiley-Blackwell.
5. **Parham, P.** *The Immune System.* Garland Science.
6. **Paul, W. E.** *Fundamental Immunology.* Lippincott Williams & Wilkins.
7. **Playfair, J. H. L. and Chain, B. M.** *Immunology at a Glance.* Wiley-Blackwell.
8. **Murphy, K. and Weaver, C.** *Janeway's Immunobiology.* Garland Science.
9. **Rosenberg, S. A.** *Cancer Immunotherapy.* Springer.

M.Sc. II Year (Semester IV) Microbiology
Paper 4: LAB 4 (MB10404P)

Programme/Class: Degree/M.Sc.	Year: 2nd year	M.Sc. 3rd Semester
Subject: Microbiology		
Course Code: **MB10404P**	**Course Title: LAB 4**	

Course outcomes	Bloom's taxonomy
CO1: Perform microbiological and immunological assays including antibiotic assay/MIC determination, antigen–antibody reactions, ELISA, and antibiotic resistance profiling.	K3
CO2: Isolate and culture immune cells from human peripheral blood and assess cellular responses such as T-cell proliferation using MTT assay.	K4
CO3: Retrieve, analyze, and interpret protein and nucleic acid sequences using biological databases and bioinformatics tools such as BLAST, FASTA, multiple sequence alignment, and phylogenetic analysis.	K3, K4
CO4: Predict protein secondary and tertiary structures and perform molecular docking studies to analyze receptor–ligand interactions.	K5

Credits:4	Core Compulsory
Max. Marks:25+75	Min. Passing Marks: 40

Total No. of Lectures-Tutorials-Practical (in hours per week): L- 4/w

Unit	Topics	No. of Lectures= 60

	1. Antibiotic assay / MIC 2. Antigen–antibody reactions (precipitation, agglutination) 3. ELISA Test 4. Antibiotic resistance profiling 5. Isolation of monocyte cells by adherence from human peripheral blood 6. Estimation of proliferation of T cells from human peripheral blood using M.T. T. Assay 7. Retrieval of protein and nucleic acid sequences from biological databases by using BLAST and FASTA search tools. 8. Multiple sequence alignment and phylogenetic tree construction by using protein and nucleic acid sequences. 9. Secondary and tertiary structure prediction of given protein sequences. 10. Molecular docking between receptor and ligands.	60

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M.Sc. II Year (Semester IV) Microbiology

Paper 5: Research project/internship/field or survey work (MB10405R)

Programme/Class: Degree/ MSc	**Year:** 2	**Semester : IV**
Subject: Microbiology (**Research project/internship/field or survey work**)		
CourseCode: **MB10405R**	Course Title: **Research project/internship/field or survey work**	
Topic wll be decided		