VANITA VISHRAM WOMEN'S UNIVERSITY
SCHOOL OF SCIENCES
DEPARTMENT OF MICROBIOLOGY

MASTER OF SCIENCE (M.Sc.) MICROBIOLOGY PROGRAMME
under Learning Outcomes-based Curriculum Framework (LOCF)
for Post Graduate (PG) Education

SEMESTERS 3
Department Specific Elective (DE)

Syllabus applicable to the students seeking admission in the M.Sc.- Microbiology
under LOCF
w.e.f. the Academic Year 2021-2022

Structure of the Course

Semester III				
Number of Department Elective Courses	**Credits in each Elective Course**			
Course	Theory	Practical	Tutorial	Credits
MB24010: Biophysical and Biochemical Methods**	3+1	0	0	4
MB24020: Advance Instrumental Microbiology**	3+1	0	0	4
MB24030: Plant-Pathogen Interactions**	3+1	0	0	4
MB24040: Food Microbiology**	3+1	0	0	4
Elective course 'n'(total no) = 2	8	0	0	8
Total credits in Elective Courses	**8**			
** **Student must opt for any Two of the Four Elective Courses**				

Department Elective (DE)

1. MB24010: Biophysical and Biochemical Methods**
2. MB24020: Advance Instrumental Microbiology
3. MB24030: Plant-Pathogen Interactions**
4. MB24040: Food Microbiology**
5. MB24050: Research Methodology
6. MB24060: Scientific Writing

MASTER OF SCIENCE MICROBIOLOGY

SEMESTER 3
DEPARTMENT ELECTIVE COURSE PAPER 1
MB24010 BIOPHYSICAL AND BIOCHEMICAL METHODS

Course Objectives:

To introduce the student to the variety of biophysical and biochemical techniques currently available to probe the structure and function of the biological macromolecules, make them aware of the physical principles behind each technique and the instrumentation involved, make them familiar with various methods of analyzing the output data, and to build a strong foundation in the area of bacterial cell structure, division, survival and propagation.

Course learning outcomes : By the end of this course the students-

CO1: Be able to carry out the analysis of the data from CD and Fluorescence experiments to monitor the stability of the protein under different environmental conditions

CO2: Be familiar with the output of fluorescence and confocal microscopy

CO3: Be able to evaluate the quality and highlights of the structure reported/deposited in journals/structural databases.

CO4: Be able to design a multi-step purification protocol for a target protein

CO5: Be able to understand and correctly interpret the migration of protein molecule on PAGE under native and SDS conditions

CO6: Follow the safety precautions while using radioactive methods

THEORY COURSE
(3+1 Credits)

Unit-1	**Microscopy:** Basics of microscopy: image formation, magnification, resolution, Biological applications and instrumentation of various kinds of microscopy: Optical Microscopy, Fluorescence, Confocal and Electron Microscopy, AFM, STM	**12 Lectures**
Uni-2	**Spectroscopy:** Various theories exploring the concept of light: Corpuscular theory, Wave theory, Electromagnetic theory, Planck's concept and modern theory. Basic concepts, principles and biological applications of different types of spectroscopy: absorption spectroscopy, fluorescence spectroscopy, phosphorescence, Infrared and Raman spectroscopy, Optical Rotatory Dispersion (ORD), Circular Dichroism (CD).	**13 Lectures**
Unit-3	**Separation Techniques: Chromatography:** Basics principles and applications of various chromatography methods: Partition and Absorption chromatography, gel filtration, ion exchange and affinity chromatography. Biological applications of HPLC and FPLC.	**10 Lectures**

Unit-4	**Radioactive methods:** Basics of radioactive isotopes and radioactive decay, sample preparation, counting, Safety precautions during handling, biological applications.	**10 Lectures**

Reference Book

1. Fundamentals of Molecular Spectroscopy by Colin Banwell. 4th edition. McGraw Hill.1994.
2. Principles of Fluorescence Spectroscopy by J. Lakowicz, R. Joseph. 2nd edition.Springer.1999.
3. Molecular Fluorescence: principles and Applications by B. Valeur. 2nd edition. Wiley. 2013.
4. NMR – Conformation of Biological Molecules by G. Govil, R.V. Hosur. 1st edition. Springer- Verlag, 2011.
5. Biomolecular crystallography: Principles, practice and application to structural biology by B. Rupp. 1st edition. Garland Science. 2009.
6. Optical methods in Biology by E.M. Slayter. 1st edition. John Wiley. 1970. 7. NMR of proteins and nucleic Acids by K. Wuthrich. 1st edition. Wiley Interscience Publications. 1988.
8. Biophysical chemistry, Part 2: Techniques by C. R. Cantor, P. R. Schimmel. 1st edition. W.H Freeman and Co. 2008.

SEMESTER 3
DEPARTMENT ELECTIVE COURSE PAPER 2

MB24020 ADVANCED INSTRUMENTAL MICROBIOLOGY

Course Objectives:

To introduce the student to the variety of biophysical and biochemical techniques currently available to probe the structure and function of the biological macromolecules, make them aware of the physical principles behind each technique and the instrumentation involved, make them familiar with various methods of analyzing the output data, and to build a strong foundation in the area of bacterial cell structure, division, survival and propagation.

Course learning outcomes : By the end of this course the students-

CO1: Be able to carry out the analysis of the data from CD and Fluorescence experiments to monitor the stability of the protein under different environmental conditions

CO2: Be familiar with the output of fluorescence and confocal microscopy

CO3: Be able to evaluate the quality and highlights of the structure reported/deposited in journals/structural databases.

CO4: Be able to design a multi-step purification protocol for a target protein

CO5: Be able to understand and correctly interpret the migration of protein molecule on PAGE under native and SDS conditions

CO6: Follow the safety precautions while using radioactive methods

THEORY COURSE (3+1 Credits)		
Unit-1	**Separation techniques: Centrifugation Techniques:** Basics of centrifugation based methods: viscosity, diffusion, sedimentation equilibrium, dialysis, solvent fractionation, centrifugation, Biological applications and interpretations of Density Gradient methods, Ultracentrifugation methods.	**11 Lectures**
Uni-2	**Separation techniques: Electrophoretic Techniques:** Basics of electrophoresis: electrophoretic mobility and affecting factors, Biological applications and interpretation of different types of electrophoresis: PAGE, gradient gel, Agarose Gel Electrophoresis, 2D Electrophoresis, Dialectrophoresis, iso-electric focusing.	**12 Lectures**
Unit-3	**Macromolecular structure determination:** Basics of X-ray Crystallography: symmetry, space groups, unit cells, structure factors, reciprocal lattice, Fourier transform, electron density, phase problems and it's solutions, Biological applications and interpretations. Basics of Magnetic resonance spectroscopy: chemical shifts, resonance condition, relaxation studies, coupling and decoupling, biological application and interpretations of Nuclear Magnetic Resonance (NMR) & Electron Spin Resonance (ESR).	**14 Lectures**
Unit-4	**Molecular Diagnostics & microbial epidemiology:** Objectives of microbial epidemiology. Biochemical and Immunological tools - biotyping, serotyping, phage typing, multilocus enzyme electrophoresis (MLEE); Molecular typing: RAPD, rep (REP, ERIC, BOX)-PCR, IS based typing, RFLP, PFGE, AFLP, SSR, SNP, MLST, VNTR and whole genome sequence, use of geographical information system (GIS) for microbial epidemiology	**8 Lectures**

Reference Book

1. Fundamentals of Molecular Spectroscopy by Colin Banwell. 4th edition. McGraw Hill.1994.
2. Principles of Fluorescence Spectroscopy by J. Lakowicz, R. Joseph. 2nd edition.Springer.1999.
3. Molecular Fluorescence: principles and Applications by B. Valeur. 2nd edition. Wiley. 2013.
4. NMR – Conformation of Biological Molecules by G. Govil, R.V. Hosur. 1st edition. Springer- Verlag, 2011.
5. Biomolecular crystallography: Principles, practice and application to structural biology by B. Rupp. 1st edition. Garland Science. 2009.
6. Optical methods in Biology by E.M. Slayter. 1st edition. John Wiley. 1970.
7. NMR of proteins and nucleic Acids by K. Wuthrich. 1st edition. Wiley Interscience Publications. 1988.
8. Biophysical chemistry, Part 2: Techniques by C. R. Cantor, P. R. Schimmel. 1st edition. W.H Freeman and Co. 2008.

SEMESTER 3
DEPARTMENT ELECTIVE COURSE PAPER 3

MB24030 PLANT-PATHOGEN INTERACTIONS

Course Objectives:

The course will facilitate in understanding of how pathogens interact with various plants and effect plant physiology, photosynthesis, respiration, transpiration and translocation. The involvement of various enzymes and toxins and understanding the molecular interaction will help in designing biocontrol strategies and development of transgenic plants. The course covers the novel molecular diagnostic approaches and correct forecasting of plant diseases.

Course learning outcomes : By the end of this course the students-

Upon successful completion of the course, the student:

CO1: Will have acquired knowledge about cause of plant diseases and effect of microbial infections on plant physiology, photosynthesis, respiration, transpiration, translocation

CO2: Will have learnt about various enzymes and toxins in plant diseases and also role of phytoalexins.

CO3: Understands about crown gall, symptoms of viral diseases and their control, diseases of some important cereals, vegetables and crops

CO4: Will have gained insight into genetics of host-pathogen interactions, resistance genes,resistance mechanism in plants.

CO5: Will have been introduced to plant disease control, physical, chemical and biological methods of disease control

CO6: Will have attained knowledge about designing of molecular diagnosis of plant disease and development of transgenic plants with applications and constraints.

CO7: Is able to describe various important milestones in disease control and disease forecasting relevant in Indian farming.

THEORY COURSE
(3+1 Credits)

Unit-1	**Physiology and biochemical basis of plant diseases:** Causes of disease, pathogenesis, pathogenesis in relation to environment, effect of microbial infections on plant physiology, Enzymes and toxins in plant diseases, phytoalexins.	**10 Lectures**
Uni-2	**Some important plant diseases and their etiological studies:** Crown gall, symptoms of viral diseases and their control, diseases of some important cereals, vegetables and crops.	**12 Lectures**
Unit-3	**Disease control and forecasting:** Principles of plant disease control, physical and chemical methods of disease control, biocontrol, biocontrol agents - concepts and practices, fungal agents, *Trichoderma* as biocontrol agent, biocontrol agents – uses and practical constraints. History and important milestones in disease control, disease forecasting and its relevance in Indian farming.	**13 Lectures**

Unit-4	**Genetic basis and Molecular approach of plant diseases:** Genetics of host-pathogen interactions, resistance genes, resistance mechanisms in plants, Molecular diagnosis, transgenic approach for plant protection, futuristic vision of molecular diagnosis, applications and constraints.	**10 Lectures**

Reference Book

1. Plant Pathology by G. N. Agrios. 5th edition. Academic Press. 2005
2. Plant Pathology by R.S. Mehrotra, and A. Aggarwal, 3rd edition. Tata McGraw Hill. 2017
3. Bacterial plant pathology: cell and molecular aspects by D. C. Sigee. Cambridge University Press.1993.
4. Molecular plant pathology by M. Dickinson. BIOS Scientific Publishers, London. 2003.
5. The essentials of Viruses, Vectors and Plant diseases by A.N. Basu& B.K. Giri. Wiley Eastern Limited.1993.
6. Biocontrol of Plant Diseases (Vol. I) by K.G. Mukerji and K.L.Garg. CRC Press Inc.,USA.1988.
7. Molecular Biology of Filamentous Fungi by U. Stahl and P. Tudzyski. VCH VerlagsgesellschaftmbH. 1992.

SEMESTER 3
DEPARTMENT ELECTIVE COURSE PAPER 4
MB24040 FOOD MICROBIOLOGY

Course Objectives:

The course will enable students to understand the taxonomical classification, phenotypic and biochemical identification of food associated molds, yeasts, yeast-like fungi and bacteria. The course will teach the strategies to develop fermented and non-fermented milk products, plant based products, fish products, meat products bioactive compounds and malt beverages, wines, distilled liquors and vinegar. The role of microbes in food spoilage, preservation and various food borne diseases will be discussed

Course learning outcomes :By the end of this course the students-

CO1: Will know about production and evaluation of the quality of starter cultures and fermented milk products and understands the use and production of probiotics, prebiotics and nutraceuticals.

CO2: Is aware of fermentation protocols for production of microbial biomass such as edible yeasts, mushrooms, single cell proteins and single cell oils. The student also learns about production of microbial carotenoid pigments such as lycopene and β-carotene.

CO3: Gathers information regarding microbes causing food intoxications and food-borne infections.

CO4: Knows traditional food preservation techniques including drying, salting, pickling, refrigeration, freezing, oxidation, vacuum packaging, canning/bottling, smoking, sugaring, chemical preservation and irradiation.

CO5: Is able to utilize modern techniques viz. high-pressure processing (HHP),

bacteriocins,manosonication(MS) and pulsed electric field (PEF) for effective food preservation. Thestudent can also calculate kinetics of inactivation, process and product parameters.

CO6: Gains knowledge about conventional methods for food quality analysis and is able to use the most recent and non-invasive techniques of quantification and detection of food borne microbes and pathogens such asESS and various new imaging techniques.

CO7: Understands the relevance of microbial standards for food safety, quality assurance programs that revolutionize food safety.

THEORY COURSE
(3+1 Credits)

Unit-1	**Microbiology of foods fermented food:** Microbial habitat of specific food materials, adaptations and changes in microbiome of food. Production of fermented milk and milk products, plant-based products, fish products, meat products and nutraceuticals. Manufacture of starter cultures from lab to pilot scale. Batch submerged and solid-state fermentation of foods	**11 Lectures**
Uni-2	**Food beverages and enzymes:** Concept of human microbiome, probiotics and prebiotics. Insight into health benefits of fermented milk products. Understanding benefits of tradition and non-traditional fermented foods. Introduction to the concept of bioactive compounds and brief study of such compounds from fermented foods including malt beverages, wines, distilled liquors and vinegar.	**12 Lectures**
Unit-3	**Microbial spoilage of foods and Food preservation:** Types and causes of spoilage of cereals and cereals products, spoilage of vegetables and fruits, spoilage of meat and meat products, spoilage of eggs and other poultry products, spoilage of milk and milk products. Study of microorganisms responsible for spoilage and microbial succession during spoilage. General principles of food preservation, various physical, chemical, and biological methods of preservation. New developments in food preservation techniques. **8**	**12 Lectures**
Unit-4	**Food-borne diseases:** Food borne infections including bacterial, viral and fungal infections. Study of infections due to food borne parasites. In depth study of various types and causes of food intoxication. Summary of prevention of microbial food infections. Identification and first aid for specific types of food infections.	**10 Lectures**

Reference Book

1. Food Microbiology by W.C. Frazier, D.C. Westhoff , K.N. Vanitha. 5th edition. McGrawHill Education. 2013.
2. Modern Food Microbiology by J.M. Jay, M.J. Loessner, D.A. Golden. 7th edition. Springer. 2006.
3. Fundamental Food Microbiology by B. Rayand A. Bhunia. 5th edition. CRC press. 2013.
4. Food Microbiology by M. R. Adams, M. O. Moss, P. McClure. 4th edition. Royal Society

of Chemistry. 2015.

5. Food Microbiology: Fundamentals and Frontiers by M. P. Doyle, L. R. Beuchat. 3rd edition. ASM press. 2007.

6. Food Microbiology: An Introduction by T. Montville, K. Matthews, K.Kniel. 4th edition. ASM press. 2017.