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 4
Core Courses (CC)
Syllabus applicable to the students seeking admission in the M.Sc.- Microbiology
under LOCF
w.e.f. the Academic Year 2022-2023

Course Structure

Semester IV				
Number of Core Courses	**Credits in each Core Course**			
Course	Theory	Practical	Tutorial	Credits
MB21170: Computational Biology	4+1	0	0	5
MB21180: Molecular Virology	4+1	0	0	5
MB21190: Dissertation		16		16
Core course 'n' (total number) = 2T+1P	10	16	0	26
Total credits in Core Course	**26**			

MASTER OF SCIENCE MICROBIOLOGY

SEMESTER 4
CORE COURSE PAPER 11

MB21170 Computational Biology

Course Objectives:

The course will introduce the student to the variety of computational methods currently available for predicting functional behavior of biological systems. The algorithms behind each method and the shortcomings in present methods will be discussed. Students should be able to analyze the output data to predict a biologically relevant function.

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

CO1: Will be able to access and derive information from various primary and secondary databases CO2: Will be able to create and usefully interpret the results of a multiple sequence alignment. CO3: Can create and correctly interpret phylogenetic trees to gain insight into evolutionary path of the target molecule

CO4: Is able to use various algorithms for predicting genes in genomes

CO5: Knows about a variety of databases available that contain knowledge of various aspects of protein structure, function, evolution relationship.

CO6: Will be familiar with different algorithms available for structure comparison in proteins.

CO7: Will be able to create a model of the given target protein

THEORY COURSE
(4+1 Credits)

Unit-1	**Biological Databases:** Introduction. Types of databases in terms of biological information content. Protein and gene information resources. Different formats of molecular biology data. Specialized resources for genomics, proteomics and metabolomics.	**15 Lectures**
Uni-2	**Sequence Alignment & Molecular Phylogenetics:** Methods and algorithms of pairwise and multiple sequence alignment. Global and local alignment. Alignment scoring matrices. Database similarity searching. Different approaches of motif detection. Concept and use of protein families. Concept of orthology, paralogy and homology in gene and protein sequences. Methods and tools for phylogenetic analysis. Creation evaluation and interpretation of evolutionary trees. Advantages and disadvantages of phenetic and cladistic approaches.	**15 Lectures**
Unit-3	**Genomics and Gene Annotation:** Organization and structure of prokaryotic and eukaryotic genomes. Genome annotation and databases. Automated *in-silico* methods of finding gene and relevant features. Genome Sequencing using first and seconding generation sequencing methods. Advantages of genome sequencing projects in modern biological research.	**15 Lectures**
Unit-4	**Protein Structure Databases & Structure Prediction:** Different databases of macro-molecular biomolecules; Accessing and mining protein structure classification databases such as SCOP, CATH; Tools forviewing and interpreting macromolecular structures. Principles of secondary and tertiary structure predictions. *Ab-initio* and homology based methods of secondary and tertiary structure predictions. Homology modeling. Threading and *ab initio* protein structure prediction.	**15 Lectures**

Reference Book

1. Introduction to Computational Biology: An Evolutionary Approach by Haubold, Wiele. 1st edition. Springer International. 2006.
2. Introduction to Bioinformatics by A. Lesk. 3rd edition. OUP India. 2009.
3. Statistical methods in Bioinformatics: An introduction by W. Ewens, G.R. Grant. 2nd Edition. Springer-Verlag. 2006.
4. Bioinformatics: Sequence and genome analysis by D. Mount. 2nd edition. Cold Spring Harbor Lab Press. 2004.
5. Bioinformatics: A practical guide to the analysis of genes & proteins. Edited by Baxevanis, Outlette. 2nd edition. John Wiley and Sons. 2001.
6. An Introduction to Protein Informatics by K-H Zimmermann. 1st edition, Springer International. 2007.
7. Fundamental Concepts of Bioinformatics by Krane. 1st edition. Pearson Education. 2003.
8. Discovering Genomics, Proteomics and Bioinformatics by Campbell. 2nd edition. Campbell

Pearson Education. 2007.

9. Structural bioinformatics: an algorithmic approach by F. J. Burkowski. 1st edition, Chapman & Hall/CRC. 2009.

10. Structural Bioinformatics edited by J. Gu, P.E. Bourne. 2nd Edition. Wiley-Blackwell. 2009.

SEMESTER 4
CORE COURSE PAPER 12

MB21180 MOLECULAR VIROLOGY

Course Objectives:

The course will facilitate the understanding of molecular virology by examining common processes and principles in viruses to illustrate viral complexity, to understand viral reproduction. The course will teach the strategies by which viruses spread within a host, and are maintained within populations. It covers the molecular biology of viral reproduction and addresses the interplay between viruses and their host organisms

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

CO1: Is able to describe classification of viruses

CO2: Is able to describe tools for studying virus structure, process of virus attachment and entry, virus assembly and release

CO3: Is able to describe steps in replication of genome of RNA viruses, retroviruses, and DNA viruses

CO4: Is able to describe steps in virus infection, transmission, patterns of infection, virus virulence, and host defense against virus infection

CO5: Is able to describe methods of making virus vaccines and antiviral drugs, drivers of virus evolution, and emerging viruses

CO6: Is able to describe unusual infectious agents, virus mediated cellular transformation and oncogenesis

CO7: Is able to describe evasion strategies used by viruses, and learn to apply their knowledge to investigate virus outbreak

THEORY COURSE
(4+1 Credits)

Unit-1	**Virus Structure and Assembly:** General structure of virion &types,Virus attachment and entry, Initiation of infection, Affinity, Avidity, cellular receptor for viruses. Getting into the nucleus, virus disassembly, metastable structures, concentrating components for assembly, getting things to the right place. How do viruses make sub-assemblies, sequential and concerted assembly. Packaging signals, packaging of segmented genome, acquisition of an envelope, budding strategies.	**15 Lectures**
Uni-2	**RNA directed RNA synthesis, Reverse Transcription and**	**15**

	Integration, Translation, and genome replication of DNA viruses: Identification of RNA polymerase, how RNA synthesis occurs in viruses? Reverse transcriptase, retrovirus genome organization, steps of DNA synthesis in retroviruses. Regulation of translation in virus infected cells. Basic rules of genome replication in DNA viruses, viral origins of DNA replication. Generic steps in transcription, host polymerases, initiation, splicing, alternate splicing, promoter structure, steps in regulation of transcription, enhancers, virus coded transcriptional regulators, transcriptional cascade, export.	**Lectures**
Unit-3	**Virus Infections basics, interaction with host, acute and persistent infections:** Fundamental questions of viral pathogenesis. Virion defenses to hostile environment, viral spread, viremia, determinants of tissue tropism. Virus shedding, transmission of infection, host defense, innate immune response, virus virulence, identifying virulence genes. Toxic viral proteins, cellular virulence genes, immunopathology, systemic inflammatory response syndrome. Immune complexes, virus induced auto-immunity, general pattern of infection. Inapparent acute infections, defense against the acute infection. Influenza, Polio, Measles, Rotavirus, persistent infections, chronic and latent Infections.	**15 Lectures**
Unit-4	**Vaccines and antiViral drugs, virus evolution and emerging viruses:** Herd immunity, requirement of an effective vaccine, different ways of making vaccine. Inactivated vaccine, subunit vaccines, subunit vaccines, live attenuated vaccines, polio eradication. Antiviral drugs, search for antiviral drugs, the path for drug discovery, mechanism based screens, cell based screen, antiviral screening. Resistance to antiviral drugs, main drivers of virus evolution, the quasi-species concept, error threshold, genetic bottlenecks, Muller ratchet, genetic shift and drift. Theories on origin of virus, evolution of new viruses, emerging viruses, Factors that drive viral emergence, evolving host-virus relationship.	**15 Lectures**

Reference Book

1. Principles of Virology: Molecular Biology, Pathogenesis and Control of Animal Viruses by S.J. Flint, L.W. Enquist, V.R. Racaniello, A.M. Skalka. 4thedition. ASM Press. 2015.
2. Introduction to Modern Virology by N. Dimmock, A. Easton, K. Leppard. 7thedition. Blackwell Publishing. 2016.
3. Basic Virology by Edward K. Wanger, M. Hewiett, D. Bloom, D. Camerini. 3rdedition. Blackwell Publishing. 2007.
4. Principles of Molecular Virology by A.J. Cann. 6thedition. Elsevier Academic Press. 2015.

MB21190: Dissertation

Max marks: 400 **Duration: 240 hours (16 credits)**

Continuous evaluation (IA) 160 marks

Dissertation 200 marks

Presentation and *viva-voce* 40 marks

Total **400** marks

Course Objectives:

The primary object of this course is to expose the student to research culture and technology. The student learns how to choose a research problem, plan and perform experiments, collect data, and analyze the data qualitatively and quantitatively. The student gets trained in presenting the results in the form of an oral presentation as well as a thesis. The student presents his/ her research orally at the end of the semester, and this is coupled to a *viva-voce*. This not only equips the student fora career in research/ industry, but also fosters self-confidence and self-reliance in the student as he/she learns to work and think independently.

Course Learning Outcomes:

CO1. Student is able to conceive a problem based on current published research

CO2. Student is able to carry out comprehensive survey of literature on the topic of research

CO3. Student is able to make culture media for various microbes

CO4. Student is able to isolate microorganism from different environmental/ food sources

CO5. Student is able to identify the isolated microorganism using biochemical and molecular methods

CO6. Student is able to assess the microorganism's ability to produce various enzymes and becomes well-versed in different enzymatic assay systems

CO7. Student learns correct handling and use of instruments

CO8. Student learns correct handling of reagents and chemicals

CO9. Student learns how to execute experiments correctly.

CO10. Student learns the importance of including controls in all experiments

CO11. Student learns how to plot the results.

CO12. Student learns how to analyze data, using statistical tools where necessary

CO13. Student learns how to interpret the results from all possible angles.

CO14. Student learns how to present the project in the form of a slide show before and audience of 20-30 people.

CO15. Student is exposed to the science of thesis writing.