

**Manipal Institute of Virology (MIV)**

**MAHE, Manipal**

**MSc Clinical Virology**

***\*Outcomes Based Education (OBE)  
Framework\****

MANIPAL ACADEMY OF HIGHER EDUCATION

# MSc (Clinical Virology)

## Curriculum

Manipal Institute of Virology, MAHE,  
Manipal

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2021

## *Outcomes Based Education (OBE) Framework*

**Two Year Full Time Post Graduate Program**

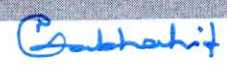
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# 1. NATURE AND EXTENT OF THE PROGRAM

## M.Sc. (Clinical Virology) Degree Programme

The two-year MSc Clinical Virology program is structured in four semesters for effective theoretical and practical learning. The entire program is of 80 credits. The program awards a degree with an international acclaim and world-wide recognition.

### Duration of the Programme

The programme is of four semesters. Duration of each semester is six months. Each semester is composed of a set of courses and each course depending on the nature and scope of the subject consists of Lectures/Tutorial/Practicals. The student has to carry out a project work in the fourth and final semester of the programme (6 months).

### Medium

The medium of instruction and examination is English.

### Eligibility

Bachelor's degree in Life Sciences (Microbiology / Biotechnology / Biochemistry / Botany / Zoology) or MBBS / BVSc / BSc-MLT or any other related subjects from a recognized University, with minimum 60% aggregate marks or an equivalent CGPA.

MSc Clinical Virology programme aims at training students in state of the art virological techniques useful in health, diagnostics, industrial, and academic sectors. Concepts of biosafety practices, outbreak investigations, clinical virology, etc. are also introduced, updated and strengthened through this programme. Students are practically trained to operate high end laboratory equipment for diagnostic and research work. Observation, communication, analysing information, problem-solving, critical thinking, logical reasoning, and perseverance are a few soft skills inculcated in students during the programme. The curriculum content involves extensive clinical, diagnostic, and laboratory practices in infectious diseases with virological aetiology. Special emphasis is laid on identifying and predicting future technological developments, changes in diagnostic service delivery and future patient/clinician/hospital requirements, to ensure that the curriculum is as robust and sustainable as possible. This is in relation to both scientific content and anticipated future developments and is reflective of the requirements of a specialized postgraduate program.



## 2. PROGRAM EDUCATION OBJECTIVE (PEO)

The overall objectives for M.Sc. Clinical Virology program are as follows.

PEO No.	Education Objectives
PEO 1	Students will be trained in syndromic approach of viral disease diagnosis with special emphasis on molecular and serological techniques.
PEO 2	Students will acquire fundamental and practical knowledge in subjects such as cell biology, molecular virology, virological techniques, biosafety and biosecurity, immunology, data analysis, disaster management, epidemiology and public health.
PEO 3	Students will learn and reflect ethical attitude, strong communication, and effective interpersonal skills in their professional practices and would be able to work cohesively in a team with multidisciplinary backgrounds.
PEO 4	Students will learn the importance of bioethics, research, innovation, and intellectual property rights in research.
PEO 5	Students will be able to achieve professional excellence by using their theoretical and technical competence in virology.
PEO 6	Students will be able to participate in lifelong learning process for a highly productive career and will be able to relate the concepts of virology in disease diagnosis and designing therapeutic strategies.



### 3. GRADUATE ATTRIBUTES

S. No.	Attribute	Description
1	<b>Disciplinary Knowledge</b>	Knowledge of all aspects of virology involving theoretical and practical techniques and other related areas of studies.
2	<b>Understanding different subsets of Virology</b>	Different areas of virology including, molecular virology, cell biology, bioinformatic, epidemiology, biosafety and biosecurity, biostatistics, bioethics.
3	<b>Measurable Skills and Industry-ready Professionals</b>	Strengthening skills and knowledge regarding current updates in virological research and development in industries and research organizations.
4	<b>Effective and Influencing communication</b>	Efficient in sharing thoughts, ideas and applied skills of communication in various forms such as written and verbal communication.
5	<b>Cooperation/Teamwork</b>	Ability to work in teams as well as independently.
6	<b>Critical/ Reflective thinking &amp; language efficiency</b>	Ability to employ critical and reflective thinking in diagnosing viral infections.
7	<b>Technologically Efficient Professional</b>	Capability to work with advanced techniques and high-end instruments used in diagnosis and research.
8	<b>Research-related Skills</b>	Trained to address research questions through short-term scientific projects.



## 4. QUALIFICATION DESCRIPTORS

### 1. Demonstrate

- (i) a systematic, extensive and coherent knowledge and understanding of virology, related disciplinary areas/subjects, and applications; including a critical understanding of the established theories, principles and concepts, and number of advanced and emerging issues in the field;
- (ii) procedural knowledge that creates different types of professionals related to virology, including research and development, teaching, government and public service;
- (iii) professional and communication skills.

2. Demonstrate comprehensive knowledge about current research, scholarly, and/or professional literature, relating to essential and advanced learning areas pertaining to virological techniques and skills required for identifying problems and related issues.

3. Demonstrate skills in identifying information needs, collection of relevant quantitative and/or qualitative data drawing on a wide range of sources, analysis and interpretation of data using methodologies as appropriate to the course(s) for formulating evidence-based solutions and arguments.

4. Use knowledge, understanding and skills for critical assessment of a wide range of ideas and complex problems and issues relating to virology.

5. Communicate the results of studies undertaken in an academic field accurately in a range of different contexts using the main concepts and techniques of virological studies.

6. Address one's own learning needs relating to current and emerging areas of study, making use of research, development and professional materials as appropriate, including those related to new frontiers of knowledge.

7. Develop the clinical, scientific, technical, management, communication and leadership skills required to run a diagnostic/research laboratory and deliver a high-quality clinical service.

8. Apply one's disciplinary knowledge and transferable skills to new/unfamiliar contexts and to identify and analyze problems and issues and seek solutions to real-life problems.



## 5. PROGRAM OUTCOMES

After successful completion of M.Sc. Clinical Virology program, students will be able to,

PO	Attribute	Competency
PO1	<b>Disciplinary knowledge</b>	Demonstrate comprehensive knowledge and understanding of courses that form a part of the postgraduate programme.
PO2	<b>Communication Skills</b>	Express thoughts and ideas effectively through written and verbal communication; establish communication link with others using appropriate media; share and express personal views confidently; reflect a good listener's trait; read and write analytically; process complex information and present it in a clear and concise manner.
PO3	<b>Critical thinking</b>	Apply a critical thinking process of identifying, analysing and reviewing clinical cases and demonstrate skills in mapping disease diagnosis algorithms.
PO4	<b>Problem solving</b>	Extrapolate from practical trouble-shooting experiences and apply the knowledge in solving various non-familiar problems.
PO5	<b>Analytical reasoning</b>	Evaluate the reliability and relevance of evidence; identify logical flaws and gaps in arguments; analyse and synthesise data from a variety of sources; draw valid conclusions and support them with evidence and examples, and address opposing viewpoints.
PO6	<b>Research-related skills</b>	Inquisitiveness to ask appropriate/relevant questions; ability to recognise and predict cause-and-effect relationships, define problems, formulate hypotheses, test hypotheses, analyse, interpret and draw conclusions from data; ability to plan, execute and report the results of an experiment or investigation. Ability to work in laboratory culture, learn to work independently and get exposure to scientific writing and publication through six-month dedicated research projects.
PO7	<b>Cooperation/ Teamwork</b>	Demonstrate leadership and teamwork with a positive attitude to effectively manage human resources.
PO8	<b>Scientific reasoning</b>	Ability to analyse, interpret and draw conclusions from quantitative/qualitative data; critically evaluate ideas, evidence and experiences through an open-minded and reasoned perspective.
PO9	<b>Reflective thinking</b>	Integrate theory and practice to develop work habits and attitude necessary for job success through practice school and professional events.





<b>PO10</b>	<b>Information/digital literacy</b>	Use ICT in a variety of learning situations, demonstrate ability to access, evaluate and use relevant information sources; apply appropriate software for analysis of data.
<b>PO11</b>	<b>Self-directed learning</b>	Students will acquire in-depth knowledge and understanding of viruses, the diseases caused by them and the mechanisms thereof. Students will be updated about trending online certificate courses and encouraged to complete such training modules, which help in overall capacity building. Students will be encouraged to participate as resource persons for the short-term training programmes and workshops conducted by MIV.
<b>PO12</b>	<b>Moral and ethical awareness/reasoning</b>	Value ethical practices in both personal and professional situations.
<b>PO13</b>	<b>Lifelong learning</b>	Investigate and provide independent learning skills necessary for continuous learning; use fundamental knowledge and technical competence in virology to achieve professional excellence.
<b>PO14</b>	<b>Multicultural competence</b>	Sensitively react towards values and beliefs of different cultures, effectively engage in a multicultural society and interact respectfully with diverse groups across the globe.



## 6. COURSE CURRICULUM AND STRUCTURE

Course Code	Course	Hours/ week			C	Course Code	Course	Hours/ week			C
		L	T	P				L	T	P	
<b>Semester – I (Courses: 7)</b>		<b>Duration = 15 weeks</b>				<b>Semester – II (Courses: 6)</b>		<b>Duration = 15 weeks</b>			
MIV501	Cell Biology	1	-	-	1	MIV502	Epidemiology	2	1	-	3
MIV503	Basic Virology	2	1	-	3	MIV504	Molecular Virology and Bioinformatics	2	1	-	3
MIV505	Biosafety and Biosecurity	1	1	-	2	MIV506	Virological Techniques	2	1	-	3
MIV507	Tissue/Cell culture	1	1	-	2	MIV508	Insect vectors of Viral diseases	1	1	2	3
MIV509	Systematic Virology-I	2	2	-	4	MIV510	Disease related risk communication	1	1	-	2
MIV511	Systematic Virology-II	2	2	-	4	MIV512	Emerging Viral Diseases and Public health response	2	1	-	3
MIV513	Immunology of Viral diseases	2	1	-	3	MIV514	Practical – II (Molecular Virology and Virological techniques)	-	-	6	2
MIV515	Practical – I (Tissue/Cell Culture)	-	-	2	1	MIV516	Laboratory Rotation-I	-	-	4	2
MIV517	Microbiology posting	1	1		2						
<b>Total</b>		<b>12</b>	<b>9</b>	<b>2</b>	<b>22</b>	<b>Total</b>		<b>10</b>	<b>6</b>	<b>12</b>	<b>20</b>

L: Lectures; T: Tutorials; P: Practicals; C: Credits



Course Code	Course	Hours/week			C	Course Code	Course	Hours/week			C
		L	T	P				L	T	P	
<b>Semester – III (Courses: 6)</b>		<b>Duration = 15 weeks</b>				<b>Semester – IV (Courses:6)</b>		<b>Duration = 15 weeks</b>			
MIV601	Clinical & Diagnostic Virology-I	2	1	-	3	MIV602	Bioethics	-	1	-	1
MIV603	Clinical & Diagnostic Virology-II	2	1	-	3	MIV604	Analytical methods	-	1	-	1
MIV605	Viral Vaccines & Antiviral Pharmacotherapy	2	2	-	4	MIV606	Biostatistics (outsourced)	1	1	-	2
						MIV608	Intellectual Property rights and patenting	-	1	-	1
MIV607	Application of GIS in viral disease epidemiology	1	1	-	2	MIV610	Disaster management	-	1	-	1
MIV609	Virology lab design and management	1	1	-	2	MIV699	Research Project	-	-	-	12
MIV611	Comprehensive Practical (Clinical and diagnostic Virology + Laboratory Rotation- II)	-	-	8	4						
<b>Total</b>		<b>8</b>	<b>6</b>	<b>8</b>	<b>18</b>	<b>Total</b>		<b>1</b>	<b>5</b>	<b>-</b>	<b>18</b>

L: Lectures; T: Tutorials; P: Practicals; C: Credits



## 7. DETAILED COURSEWISE INFORMATION

# FIRST SEMESTER

MANIPAL INSTITUTE OF VIROLOGY, MAHE





Manipal Institute of Virology

## CURRICULUM

<b>Name of the Program</b>	MSc Clinical Virology
<b>Course Title</b>	<b>Cell Biology</b>
<b>Course Code</b>	MIV501
<b>Academic Year</b>	2021-2023
<b>Semester</b>	I
<b>Course credits</b>	<b>1</b>
<b>Course Prerequisite</b>	First class/CGPA 6.5 at UG level (BSc Life Sciences/Health Sciences)
<b>Course Synopsis</b>	<ol style="list-style-type: none"><li>1. To understand basic concept of cell's structure, mechanism and function.</li><li>2. To understand the cellular mechanisms through knowledge of cell cycle, cell signalling, and cell differentiation is important.</li><li>3. To know the replication, transcription and translation to understand how they are important to cellular function.</li><li>4. To support the student to critically appraise scientific journal, article, review papers etc.</li></ol>
<b>Course Outcomes</b>	<p><b>CO 1:</b> Outline the basic concepts of eukaryotic and prokaryotic cell structure, mechanism, and function. (C2)</p> <p><b>CO 2:</b> Illustrate regulatory pathways in cell cycle, cell signalling and cell differentiation. (C2)</p> <p><b>CO 3:</b> Illustrate gene organization and chromosomal structure. (C2)</p> <p><b>CO 4:</b> Outline genetic code on the basis of its principle. (C2)</p> <p><b>CO 5:</b> Illustrate DNA replication in eukaryotic and prokaryotic cells. (C2)</p> <p><b>CO 6:</b> Explain RNA synthesis and processing in cells. (C2)</p> <p><b>CO 7:</b> Explain translation and post translational modifications of protein synthesis. (C2)</p>



Mapping of COs to POs														
COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14
CO 1	✓							✓			✓			
CO 2	✓										✓			
CO 3	✓										✓			
CO 4	✓										✓			
CO 5	✓							✓	✓		✓			
CO 6	✓							✓			✓			
CO 7	✓								✓		✓			

Learning Strategies, Contact Hours and Student Learning Time (SLT)	LEARNING STRATEGY	CONTACT HOURS	SLT
	Lecture	10	30
	Seminar	3	9
	Small Group Discussion (SGD)	1	3
	Self-directed learning (SDL)	1	3
	Problem Based Learning (PBL)	-	-
	Case Based Learning (CBL)	-	-
	Clinic	-	-
	Practical	-	-
	Revision	-	-
	Assessment	2	-
	<b>TOTAL</b>	<b>17</b>	<b>45</b>

Assessment Methods	FORMATIVE	SUMMATIVE
	Assignment	Mid semester exam
	Student presentation	
	Group discussion	

Mapping of assessment with COs							
Nature of assessment	CO 1	CO 2	CO 3	CO 4	CO 5	CO 6	CO 7
Assignments	✓						
Student presentations	✓	✓	✓	✓			
Mid-semester examination	✓	✓	✓	✓			
End-semester examination	x	x	x	x	x	x	x
Practical examination	x	x	x	x	x	x	x



<b>Feedback Methods</b>	Student feedback on Course and Course master
<b>Reference Materials</b>	<ul style="list-style-type: none"> <li>• Cell biology - Gerald Karp</li> <li>• The cell – A molecular approach - Cooper</li> <li>• Biochemistry - Jeremy M. Berg</li> <li>• Molecular biology of the cell - Bruce Alberts</li> <li>• International Review of Cell and Molecular Biology - Lorenzo Galluzzi</li> </ul>

<b>Course learning outcomes</b>			
<b>Content</b>	<b>Topics</b>	<b>Learning Outcomes</b>	<b>Hours (Lectures/Tutorials)</b>
<b>Unit 1</b>	Cell type, structure and organelles	<ul style="list-style-type: none"> <li>• Outline to cellular biology. (C2)</li> <li>• Recall the history of cell based on microscopic studies. (C1)</li> <li>• Explain the fundamental aspects of cell. (C2)</li> <li>• Illustrate the structure and functions of cell. (C2)</li> <li>• Identify the key difference between eukaryotic and prokaryotic cells. (C1)</li> <li>• Outline the mechanisms of cell organelles to contribute the cell function. (C2)</li> <li>• Explain the fundamental aspects of the cell organelles and its morphology and mechanism in cell. (C2)</li> </ul>	2 / 2 = 4
<b>Unit 2</b>	Macromolecules	<ul style="list-style-type: none"> <li>• Explain the role and type of macromolecules in cell. (C2)</li> <li>• Illustrate the structure and functions of macromolecules in cell. (C2)</li> </ul>	1
<b>Unit 3</b>	Cell signalling	<ul style="list-style-type: none"> <li>• Outline to cell signalling. (C2)</li> <li>• Classify signalling pathways in cells. (C2)</li> </ul>	1
<b>Unit 4</b>	Cell cycle and Regulation of cell cycle	<ul style="list-style-type: none"> <li>• Define cell cycle. (C1)</li> <li>• Outline the different phases of cell cycle. (C2)</li> </ul>	2 / 1 = 3



		<ul style="list-style-type: none"> <li>Summarize the fundamental aspects of mitosis and meiosis in cell division. (C2)</li> <li>Introduction to cell cycle. (C1)</li> <li>Illustrate the regulatory pathways in cell cycle. (C2)</li> <li>Explain the Role of cyclin-dependent kinases in cell cycle. (C2)</li> </ul>	
<b>Unit 5</b>	Cell differentiation	<ul style="list-style-type: none"> <li>Outline to eukaryotic cell differentiation. (C2)</li> <li>Identify the mammalian cell types. (C3)</li> <li>Explain mechanism of cell differentiation. (C2)</li> <li>Summarize epigenetic control over the stem cell differentiation. (C2)</li> </ul>	1
<b>Unit 6</b>	Organization of genes and chromosomes	<ul style="list-style-type: none"> <li>Explain gene organization in chromosomes. (C2)</li> <li>Illustrate the eukaryotic chromosome structure and function. (C2)</li> <li>Illustrate karyotyping in cytogenetics. (C2)</li> <li>Describe chromosomal aberrations. (C1)</li> </ul>	1
<b>Unit 7</b>	DNA Replication in eukaryotic and prokaryotic cells	<ul style="list-style-type: none"> <li>Outline DNA replication. (C2)</li> <li>Explain the different stages of DNA replication in eukaryotes and prokaryotes. (C2)</li> <li>Summarize the role different enzymatic factors in replication. (C2)</li> </ul>	1
<b>Unit 8</b>	RNA synthesis and processing	<ul style="list-style-type: none"> <li>Classify the types of RNA in cell. (C1)</li> <li>Explain the transcription mechanism in eukaryotes and prokaryotes. (C2)</li> </ul>	1





		<ul style="list-style-type: none"> <li>• Explain the post transcriptional mRNA processing. (C2)</li> </ul>	
<b>Unit 9</b>	Genetic code	<ul style="list-style-type: none"> <li>• Outline genetic code (C2)</li> <li>• Explain the hypothesis behind genetic code. (C2)</li> </ul>	1
<b>Unit 10</b>	Translation and post translational modifications	<ul style="list-style-type: none"> <li>• Classify proteins involved in cell machinery. (C1)</li> <li>• Classify the ribosome machineries in translation. (C2)</li> <li>• Explain the different stages of eukaryotic and prokaryotic protein translation. (C2)</li> <li>• Summarize the post translational modifications and its maturation in cell organelles. (C1)</li> </ul>	1





Manipal Institute of Virology

**CURRICULUM**

<b>Name of the Program</b>	MSc Clinical Virology
<b>Course Title</b>	<b>Basic Virology</b>
<b>Course Code</b>	MIV503
<b>Academic Year</b>	2021-2023
<b>Semester</b>	I
<b>Course credits</b>	<b>3</b>
<b>Course Prerequisite</b>	First class/CGPA 6.5 at UG level (BSc Life Sciences/Health Sciences)
<b>Course Synopsis</b>	<p>This module will help</p> <ol style="list-style-type: none"> <li>1. To develop an overall idea about the virus evolution, structure, and taxonomy and their interaction with the host.</li> <li>2. To develop operational and theoretical skills in different microscopic technique including Electron Microscopy.</li> <li>3. To critically appraise scientific journal, article, review papers, etc.</li> </ol>
<b>Course Outcomes</b>	<p><b>CO 1:</b> Describe the basic concepts of viruses, evolution of viruses. (C4, P1, A2)</p> <p><b>CO 2:</b> Classify viruses based on current classification system. (C2, P1)</p> <p><b>CO 3:</b> Describe the structure of viruses, genome organization. (C2, P1)</p> <p><b>CO 4:</b> Illustrate mathematical modelling of viruses. (C4, P2, A2)</p> <p><b>CO 5:</b> Explain the replication strategies of viruses. (C3, P1)</p> <p><b>CO 6:</b> Understand the principle, use, and application of various types of microscopy in virology. (C4, P3, A3)</p> <p><b>CO 7:</b> Conceptualize the need of electron microscopy in virology. (C3, P1)</p>

**Mapping of COs to POs**

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14
CO 1	✓										✓			
CO 2	✓										✓			
CO 3	✓										✓			
CO 4	✓		✓						✓		✓			



CO 5	✓		✓								✓			
CO 6	✓				✓	✓					✓			
CO 7	✓				✓	✓					✓			
<b>Learning Strategies, Contact Hours and Student Learning Time (SLT)</b>	<b>LEARNING STRATEGY</b>		<b>CONTACT HOUR</b>		<b>SLT</b>									
	Lecture		30		90									
	Seminar		8		24									
	Small Group Discussion (SGD)		3		9									
	Self-directed learning (SDL)		2		6									
	Problem Based Learning (PBL)		2		6									
	Case Based Learning (CBL)		-		-									
	Clinic		-		-									
	Practical		-		-									
	Revision		-		-									
	Assessment		-		-									
	<b>TOTAL</b>		<b>45</b>		<b>135</b>									
<b>Assessment Methods</b>	<b>FORMATIVE</b>				<b>SUMMATIVE</b>									
	Assignment				Mid semester exam									
	Student presentation				End semester exam									
	Group discussion													

<b>Mapping of assessment with COs</b>							
<i>Nature of assessment</i>	CO 1	CO 2	CO 3	CO 4	CO 5	CO 6	CO 7
Assignments	✓		✓	✓			
Student presentations					✓	✓	✓
Mid-semester examination	✓	✓	✓	✓			
End-semester examination	✓	✓	✓	✓	✓	✓	✓
Practical examination	x	x	x	x	x	x	x

<b>Feedback Methods</b>	Student feedback on Course and Course master
<b>Main Reference</b>	<ul style="list-style-type: none"> <li>• Fields Virology, Knipe David M</li> <li>• Principles of Virology Vol 1: Molecular Biology, Flint S J; Others</li> <li>• Topley and Wilson's Microbiology and Microbial Infections: Virology Vol 1&amp;2, Mahy Brian W J; Meulen Volker</li> </ul>



	<ul style="list-style-type: none"> <li>• Color Atlas of Virology, Versteeg J.</li> <li>• Journal of Medical Virology</li> <li>• Virology journal</li> </ul>
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Course learning outcomes			
Content	Topics	Learning Outcomes	Hours (Lectures/Tutorials)
<b>Unit 1</b>	Introduction, History and evolution of "Virology"	<ul style="list-style-type: none"> <li>• Discuss the history and evolution of virology. (C2, P1, A1)</li> <li>• Describe important landmarks in the study of viruses. (C2, P1, A1)</li> <li>• Explain the basic concepts and importance of viruses through time. (C4, P1, A2)</li> <li>• Introduction to modern virology and its principles. (C4, P2, A2)</li> </ul>	4
<b>Unit 2</b>	Virus structure (general) Virus Replication (general)	<ul style="list-style-type: none"> <li>• Explains the fundamental aspects of virology – morphology, classification and replication. (C6, P4, A3)</li> <li>• Describe the general properties of viruses. (C2, P1)</li> <li>• Discuss the structure-capsid symmetry and virus architecture of viral particles and genome, characteristics of the DNA and RNA genome. (C6, P5, A4)</li> <li>• Explain the life cycle of virus. (C4, P3, A2)</li> <li>• Illustrate/demonstrate handmade virus models for better understanding. (C6, P5, A4)</li> </ul>	6 / 5 = 11



		<ul style="list-style-type: none"> <li>Elucidate the mechanisms viruses use to replicate in their hosts. (C4, P5, A3)</li> </ul>	
<b>Unit 3</b>	Taxonomy and Classification of Viruses	<ul style="list-style-type: none"> <li>Explain the classification and taxonomy of viruses. (C4)</li> <li>Explain the Baltimore classification for viruses. (C2)</li> <li>Describe the ICTV classification. (C2)</li> </ul>	3 / 1 = 4
<b>Unit 4</b>	Bacteriophage- Structure, Replication etc.	<ul style="list-style-type: none"> <li>Introduction to bacteriophage. (C2, P1)</li> <li>Describe the distinguishing characteristics of bacteriophage. (C2, P1, A1)</li> <li>Explain about the host specificity and host range of bacteriophage. (C2)</li> <li>Identify modes of infection and phage-host interactions. (C4, P1)</li> <li>Describe the strategies of bacteriophage replication. (C2)</li> <li>Describe the phage life cycles -lytic and lysogenic cycles of bacteriophages. (C2)</li> <li>Diagnostic and therapeutic application of bacteriophages. (C3, P1, A2)</li> </ul>	4 / 3 = 7
<b>Unit 5</b>	Microscopy <ul style="list-style-type: none"> <li>Light Microscope(y)</li> <li>Fluorescence Microscope(y)</li> <li>Phase Contrast Microscope(y)</li> <li>Inverted Microscope</li> </ul>	<ul style="list-style-type: none"> <li>Discuss the history and introduction. (C1)</li> <li>Describe microscope basics, including parts of light microscope. (C2)</li> <li>Discuss on the types and functions of different types of microscopes / Explain the general principles,</li> </ul>	6 / 5 = 11



	<ul style="list-style-type: none"> <li>• Confocal Microscope (y)</li> </ul>	<p>properties, working and distinguishing features of different types of microscopes. (C3, P1)</p> <ul style="list-style-type: none"> <li>• Understand, set-up and handle microscopes. (C3, P2, A3)</li> <li>• Identify the key differences between bright field and dark field microscopy. (C2)</li> <li>• Outline different methods used for microscopic staining procedures (histochemical techniques). (C3, P1, A2)</li> <li>• Explain the different types of stains used. (C2)</li> <li>• Microscope maintenance and best practices for its proper care. (C2)</li> <li>• Explain the applications of different types of microscopes. (C3, P1)</li> <li>• Explain the advantages and limitations of different types of microscopes. (C2)</li> </ul>	
<b>Unit 6</b>	<p>Electron Microscope(y)</p> <ul style="list-style-type: none"> <li>- TEM</li> <li>- SEM</li> <li>- Other variants of EM</li> </ul>	<ul style="list-style-type: none"> <li>• Understanding the working principles of electron microscopy. (C3, P2, A2)</li> <li>• Outline the differences between the light microscope and the electron microscope. (C4, P1)</li> <li>• Describe the theory and applications of electron microscopy. (C4, P2)</li> <li>• Explain the principles of operation and basic instrumentation of TEM/SEM. (C3, P3, A2)</li> </ul>	4 / 1 = 5



		<ul style="list-style-type: none"> <li>• Demonstrate the theoretical knowledge working principle, care and use of SEM/TEM. (C4, P2)</li> <li>• Specimen preparation for EM – Liquid, tissue and other types of specimen. (C3, P3, A2)</li> <li>• Apply and interpret the experimental data. (C4, P1)</li> <li>• Understanding other types variants of EM and recent developments. (C3, P1)</li> <li>• Development of an EM lab-factors for consideration.</li> </ul>	
<b>Unit 7</b>	EM and its Applications in Virology	<ul style="list-style-type: none"> <li>• Role of EM in virology. (C3, P1)</li> <li>• Critically analyse the use of electron microscopy in virology. (C4, P1)</li> </ul>	3





Manipal Institute of Virology

**CURRICULUM**

<b>Name of the Program</b>	MSc Clinical Virology
<b>Course Title</b>	<b>Biosafety and Biosecurity</b>
<b>Course Code</b>	MIV505
<b>Academic Year</b>	2021-2023
<b>Semester</b>	I
<b>Course credits</b>	<b>2</b>
<b>Course Prerequisite</b>	First-class/CGPA 6.5 at UG level (BSc Life Sciences/Health Sciences)
<b>Course Synopsis</b>	<p>1. This module helps to understand the concepts of biosecurity and biosafety.</p> <p>2. To provide fundamental knowledge of principles of sterilization, disinfection, decontamination, and biomedical waste management.</p>
<b>Course Outcomes</b>	<p><b>CO 1:</b> Explain the concept of biosafety and biosecurity. (C2)</p> <p><b>CO 2:</b> Practice the various methods of sterilization, disinfection, and decontamination. (C3, P2)</p> <p><b>CO 3:</b> Illustrate safe transportation of infectious materials. (C3, P1)</p> <p><b>CO 4:</b> Classify biomedical waste. (C2)</p> <p><b>CO 5:</b> Employ the protocols of biomedical waste management. (C3, P1)</p> <p><b>CO 6:</b> Develop skills to prevent, mitigate and control laboratory accidents. (C3, P2)</p>

**Mapping of COs to POs**

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14
CO 1	✓		✓					✓	✓		✓			
CO 2	✓		✓			✓					✓			
CO 3	✓	✓				✓					✓			
CO 4	✓	✓	✓	✓		✓					✓			
CO 5	✓	✓	✓								✓			
CO 6	✓		✓	✓		✓					✓			





<b>Learning Strategies, Contact Hours and Student Learning Time (SLT)</b>	<b>LEARNING STRATEGY</b>	<b>CONTACT HOUR</b>	<b>SLT</b>	
	Lecture	15	45	
	Seminar	8	24	
	Small Group Discussion (SGD)	2	6	
	Self-directed learning (SDL)	3	9	
	Problem Based Learning (PBL)	2	6	
	Case Based Learning (CBL)	-	-	
	Clinic	-	-	
	Practical	-	-	
	Revision	-	-	
	Assessment	2	-	
	<b>TOTAL</b>	<b>32</b>	<b>90</b>	
<b>Assessment Methods</b>	<b>FORMATIVE</b>		<b>SUMMATIVE</b>	
	Assignment		Mid semester exam	
	Student presentation		End semester exam	
	Group discussion			

<b>Mapping of assessment with COs</b>						
<i>Nature of assessment</i>	<b>CO 1</b>	<b>CO 2</b>	<b>CO 3</b>	<b>CO 4</b>	<b>CO 5</b>	<b>CO 6</b>
Assignments					✓	
Student presentations		✓				
Mid-semester examination	✓	✓	✓			
End-semester examination	✓	✓	✓	✓	✓	✓
Practical examination	x	x	x	x	x	x

<b>Feedback Methods</b>	Student feedback on Course and Course master
<b>Main Reference</b>	<ul style="list-style-type: none"> <li>• Laboratory Biosafety Manual- WHO</li> <li>• Biosafety in Microbiological and Biomedical Laboratories- CDC NIH</li> <li>• Guidelines for Biosafety Laboratory Competency-MMWR CDC</li> <li>• Regulations and Guidelines on Biosafety of Recombinant DNA Research &amp; Biocontainment (DBT, India, 2017)</li> <li>• Proposed Framework for the Oversight of Dual Use Life Sciences Research: Strategies for Minimizing the Potential Misuse of Research Information (2007)</li> </ul>



Course learning outcomes			
Content	Topics	Learning Outcomes	Hours (Lectures/Tutorials)
<b>Unit 1</b>	Concept of Biosafety and Biosecurity; Principles of Sterilization and Disinfection	<ul style="list-style-type: none"> <li>• Discuss Biosafety and biosecurity in a laboratory. (C2)</li> <li>• Describe the different methods of sterilization. (C2, P1)</li> <li>• Distinguish between sterilization and disinfection. (C4)</li> <li>• Explain the procedures for decontamination of solid and liquid wastes. (C2, P1)</li> <li>• Explain disinfectants and test for disinfectants. (C2)</li> </ul>	4 / 4 = 8
<b>Unit 2</b>	Biosafety levels	<ul style="list-style-type: none"> <li>• Describe biosafety level. (C2)</li> <li>• Classify risk groups with suitable examples. (C2)</li> </ul>	2 / 2 = 4
<b>Unit 3</b>	Biosafety cabinets	<ul style="list-style-type: none"> <li>• Illustrate biosafety cabinets. (C3, P1)</li> <li>• Explain HEPA filters and their working principle. (C2)</li> </ul>	2 / 1 = 3
<b>Unit 4</b>	Biomedical waste and its management	<ul style="list-style-type: none"> <li>• Explain the need for biomedical waste management system in clinical laboratories. (C6, P1)</li> </ul>	2 / 1 = 3
<b>Unit 5</b>	Laboratory Containment	<ul style="list-style-type: none"> <li>• Explain laboratory containment at different biosafety levels. (C3, P1)</li> </ul>	2 / 2 = 4
<b>Unit 6</b>	Safe Transportation of infectious materials	<ul style="list-style-type: none"> <li>• Describe safe transportation of infectious materials. (C2, P1)</li> </ul>	2 / 1 = 4
<b>Unit 7</b>	Laboratory accidents and its prevention, mitigation, and control	<ul style="list-style-type: none"> <li>• Describe the use of Personnel Protective equipment. (C2, P1)</li> <li>• Develop skills to prevent, mitigate and control laboratory accidents. (C3, P2)</li> </ul>	2 / 1 = 4



<b>Unit 8</b>	Dual research of concern (DURC)	<ul style="list-style-type: none"> <li>• Define, outline, and identify the DURC. (C2)</li> <li>• Evaluate life sciences research for dual use. (C2)</li> <li>• Assess the risk under potentially dual research of concern and plan risk management. (C3)</li> <li>• Model institutional reviews and develop communication plans. (C3, P1)</li> <li>• Develop a code of conduct for Dual Research of concern. (C2)</li> </ul>	2
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MANIPAL INSTITUTE OF VIROLOGY, MAHE





Manipal Institute of Virology

**CURRICULUM**

<b>Name of Program</b>	MSc Clinical Virology
<b>Course Title</b>	<b>Tissue/Cell culture</b>
<b>Course Code</b>	MIV507
<b>Academic Year</b>	2021-2023
<b>Semester</b>	I
<b>No. of credits</b>	<b>2</b>
<b>Course Prerequisite</b>	First class/CGPA 6.5 at UG level (BSc Life Sciences/Health Sciences)
<b>Course Synopsis</b>	<ol style="list-style-type: none"> <li>1. This module helps to understand the basic requirements for a cell culture lab.</li> <li>2. To provide fundamental knowledge of various types of cell lines used for the propagation of viruses.</li> </ol>
<b>Course Outcomes</b>	<p><b>CO 1:</b> Describe the basic requirements for a cell culture lab. (C4, A2)</p> <p><b>CO 2:</b> Identify and differentiate cell culture methods and types of cell lines. (C4, P3)</p> <p><b>CO 3:</b> Demonstrate the techniques of sub culturing, media preparation, cell counting, cell preservation. (C3, P3)</p> <p><b>CO 4:</b> Explain the application of cell culture in virology. (C3, A2)</p> <p><b>CO 5:</b> Understand the quality control of cell lines. (C2, P3)</p>

**Mapping of COs to POs**

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14
CO 1	✓							✓			✓			
CO 2	✓					✓			✓		✓			
CO 3	✓		✓			✓					✓		✓	
CO 4	✓		✓		✓						✓			
CO 5	✓										✓			



<b>Learning Strategies, Contact Hours and Student Learning Time (SLT)</b>	<b>LEARNING STRATEGY</b>	<b>CONTACT HOUR</b>	<b>SLT</b>								
	Lecture	15	45								
	Seminar	7	21								
	Small Group Discussion (SGD)	2	6								
	Self-directed learning (SDL)	5	15								
	Problem Based Learning (PBL)	1	3								
	Case Based Learning (CBL)	-									
	Clinic	-									
	Practical	-	-								
	Revision	-									
	Assessment	1									
	<b>TOTAL</b>	<b>31</b>	<b>90</b>								
<b>Assessment Methods</b>	<table border="1"> <tr> <td><b>FORMATIVE</b></td> <td><b>SUMMATIVE</b></td> </tr> <tr> <td>Assignment</td> <td>Mid semester exam</td> </tr> <tr> <td>Student presentation</td> <td>End semester exam</td> </tr> <tr> <td>Group discussion</td> <td></td> </tr> </table>			<b>FORMATIVE</b>	<b>SUMMATIVE</b>	Assignment	Mid semester exam	Student presentation	End semester exam	Group discussion	
<b>FORMATIVE</b>	<b>SUMMATIVE</b>										
Assignment	Mid semester exam										
Student presentation	End semester exam										
Group discussion											

<b>Mapping of assessment with COs</b>					
<i>Nature of assessment</i>	<b>CO 1</b>	<b>CO 2</b>	<b>CO 3</b>	<b>CO 4</b>	<b>CO 5</b>
Assignments	✓				
Student presentations		✓			
Mid-semester examination	✓	✓	✓		
End-semester examination	✓	✓	✓	✓	✓
Practical examination	✓	✓	✓	✓	✓

<b>Feedback Methods</b>	Student feedback on Course and Course master
<b>Main Reference</b>	<ul style="list-style-type: none"> <li>• Culture of Animal Cells by R. Ian Freshney</li> <li>• Animal Cell Culture by John R. W. Masters</li> <li>• Cell and Tissue Culture by Alan Doyle and J. Bryan Griffiths</li> <li>• Fields virology</li> </ul>



Course learning outcomes			
Content	Topics	Learning Outcomes	Hours (Lecture/Tutorials)
<b>Unit 1</b>	Introduction to cell culture, Basic equipment and facilities	<ul style="list-style-type: none"> <li>• Discuss the terms cell culture, cell line and cell strain. (C2, P1, A1)</li> <li>• Discuss the different types of cell culture techniques and classification of mammalian cell lines (C2, P1, A2)</li> <li>• Explain the advantages and limitations of cell culture (C2)</li> <li>• Discuss the biosafety, aseptic techniques in a tissue culture laboratory (C4, A2)</li> <li>• Describe the layout and equipment required for a tissue culture laboratory (C4, A2)</li> <li>• Describe the morphology of cells in culture (C4, P3, A2)</li> </ul>	4 / 4 = 8
<b>Unit 2</b>	Cell culture media and Supplements	<ul style="list-style-type: none"> <li>• Describe the growth requirements for eukaryotic cells, including the culture environment, media and supplements and their preparation (C3, P3, A2)</li> </ul>	1 / 3 = 4
<b>Unit 3</b>	Cell counting and sub culturing of cell lines	<ul style="list-style-type: none"> <li>• Explain the principle and procedure for cell counting (C3, P3, A2)</li> <li>• Explain the life span, growth cycle and sub culturing of cell lines and its importance (C3, P3, A2)</li> </ul>	2 / 2 = 4
<b>Unit 4</b>	Characterization of cell culture	<ul style="list-style-type: none"> <li>• Identify the different types of cell culture and characterization mainly based on morphology (C4, P3, A2)</li> </ul>	1 / 2 = 3
<b>Unit 5</b>	Preservation of cell cultures	<ul style="list-style-type: none"> <li>• Discuss the principle and methods of preservation of cell lines, thawing and revival of frozen cells (C2, P3, A2)</li> </ul>	1 / 2 = 3
<b>Unit 6</b>	National / International cell culture collections	<ul style="list-style-type: none"> <li>• Describe the various National and International Cell culture collections and their role (C1)</li> </ul>	1



<b>Unit 7</b>	Genetic modification of cell lines	<ul style="list-style-type: none"> <li>Describe the method and principle of modified cell cultures such as shell vial culture, mixed cell culture, genetically engineered cell lines etc. with examples and its applications (C3, A2)</li> </ul>	1
<b>Unit 8</b>	Quality control of cell lines	<ul style="list-style-type: none"> <li>Discuss the measures taken to preserve the quality of reagents and cells (C2)</li> <li>Identify the potential sources, types of contamination and control of contamination (C4, P3, A2)</li> </ul>	2
<b>Unit 9</b>	Cell culture in Virology	<ul style="list-style-type: none"> <li>Describe the application of cell culture in Virology (C4, A2)</li> </ul>	1 / 2 = 3
<b>Unit 10</b>	Large scale production of cell cultures	<ul style="list-style-type: none"> <li>Discuss about the methods of large-scale culture of cell lines, its production and applications (C1)</li> </ul>	1





Manipal Institute of Virology

**CURRICULUM**

<b>Name of the Program</b>	MSc Clinical Virology
<b>Course Title</b>	<b>Systematic Virology-I</b>
<b>Course Code</b>	MIV509
<b>Academic Year</b>	2021-2023
<b>Semester</b>	I
<b>Course credits</b>	<b>4</b>
<b>Course Prerequisite</b>	First class/CGPA 6.5 at UG level (BSc Life Sciences/Health Sciences)
<b>Course Synopsis</b>	<p>1. The course will offer in-depth knowledge about the taxonomy, structure, genome, antigens, replication, animal/cell susceptibility.</p> <p>2. The course will provide an overview of epidemiology, clinical diseases, pathogenesis, lab diagnosis and prophylaxis.</p>
<b>Course Outcomes</b>	<p><b>CO 1:</b> Explain difference in structures between the enveloped and non-enveloped viruses. (C2)</p> <p><b>CO 2:</b> Recall various families of DNA and Retroviruses. (C1)</p> <p><b>CO 3:</b> Explain the replication strategies and interaction of DNA/retroviruses with the host. (C2)</p> <p><b>CO 4:</b> Illustrate the role of different viral proteins in attachment, fusion, uncoating, replication, assembly, and release. (C2)</p>

**Mapping of COs to POs**

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14
CO 1	✓	✓	✓		✓						✓			
CO 2	✓										✓			
CO 3	✓	✓	✓					✓			✓			
CO 4	✓		✓					✓			✓			

**Learning Strategies, Contact Hours and Student Learning Time (SLT)**

<b>LEARNING STRATEGY</b>	<b>CONTACT HOUR</b>	<b>SLT</b>
Lecture	30	90
Seminar	28	84
Small Group Discussion (SGD)	2	6
Self-directed learning (SDL)	-	-





	Problem Based Learning (PBL)	-	-	
	Case Based Learning (CBL)	-	-	
	Clinic	-	-	
	Practical	-	-	
	Revision	-	-	
	Assessment	2	-	
	<b>TOTAL</b>	<b>62</b>	<b>180</b>	
<b>Assessment Methods</b>	<b>FORMATIVE</b>		<b>SUMMATIVE</b>	
	Assignment		Mid semester exam	
	Student presentation		End semester exam	
	Group discussion			

<b>Mapping of assessment with COs</b>				
<i>Nature of assessment</i>	<b>CO 1</b>	<b>CO 2</b>	<b>CO 3</b>	<b>CO 4</b>
Assignments	✓			
Student presentations	✓		✓	✓
Mid-semester examination	✓	✓		
End-semester examination	✓	✓	✓	✓
Practical examination	x	x	x	x

<b>Feedback Methods</b>	Student feedback on the course and the course master
<b>Main Reference</b>	<ul style="list-style-type: none"> <li>• Fields Virology, Vol 1 &amp; 2</li> <li>• Principles of Virology, J Flint, Vol 1 &amp; 2</li> </ul>

<b>Course learning outcomes</b>			
<b>Content</b>	<b>Topics</b>	<b>Learning Outcomes</b>	<b>Hours (Lectures/Tutorials + Practicals)</b>
<b>Unit 1</b>	Introduction to DNA viruses and replication	<ul style="list-style-type: none"> <li>• Classify DNA virus families. (C2)</li> <li>• Explain the general replication strategies of DNA viruses. (C2)</li> </ul>	2 / 2 = 4
<b>Unit 2</b>	Adenoviridae	<ul style="list-style-type: none"> <li>• Classify the viruses in Adenoviridae family. (C2)</li> <li>• List the diseases caused by viruses in Adenoviridae. (C1)</li> <li>• Illustrate the structure of Adenoviruses. (C2)</li> <li>• Explain the replication of Adenovirus. (C2)</li> </ul>	3 / 4 = 7



		<ul style="list-style-type: none"> <li>Summarize in detail about the proteins involved in Adenovirus virus replication. (C2)</li> <li>Explain the epidemiology and pathogenesis of Adenoviruses. (C2)</li> <li>Explain the laboratory diagnosis and prophylaxis available for the viruses in Adenoviridae. (C2)</li> </ul>	
<b>Unit 3</b>	Parvoviridae	<ul style="list-style-type: none"> <li>Classify the viruses in Parvoviridae family. (C2)</li> <li>List the diseases caused by viruses in Parvoviridae. (C1)</li> <li>Illustrate the structure of Parvoviruses. (C2)</li> <li>Explain the replication of Primate erythroparvovirus 1. (C2)</li> <li>Summarize in detail about the proteins involved in Primate erythroparvovirus 1 replication. (C2)</li> <li>Explain the epidemiology and pathogenesis of Parvoviruses. (C2)</li> <li>Explain the laboratory diagnosis and prophylaxis available for the viruses in Parvoviridae. (C2)</li> </ul>	4 / 4 = 8
<b>Unit 4</b>	Poxviridae	<ul style="list-style-type: none"> <li>Classify the viruses in Poxviridae family. (C2)</li> <li>List the diseases caused by viruses in Poxviridae. (C1)</li> <li>Illustrate the structure of Poxviruses. (C2)</li> <li>Explain the replication of Poxvirus. (C2)</li> <li>Summarize in detail about the proteins involved in Poxvirus replication. (C2)</li> <li>Explain the epidemiology and pathogenesis of Poxviruses. (C2)</li> </ul>	4 / 3 = 7



		<ul style="list-style-type: none"> <li>• Explain the laboratory diagnosis and prophylaxis available for the viruses in Poxviridae. (C2)</li> </ul>	
<b>Unit 5</b>	Herpesviridae	<ul style="list-style-type: none"> <li>• Classify the viruses in Herpesviridae family. (C2)</li> <li>• List the diseases caused by Herpesviridae. (C1)</li> <li>• Illustrate the structure of Herpesviruses. (C2)</li> <li>• Explain the replication of Human alphaherpesviruses. (C2)</li> <li>• Summarize in detail about the proteins involved in Herpesvirus replication. (C2)</li> <li>• Explain the epidemiology and pathogenesis of Herpesviruses. (C2)</li> <li>• Explain the laboratory diagnosis and prophylaxis available for the viruses in Herpesviridae. (C2)</li> <li>• Explain the latency of Herpesviruses. (C2)</li> </ul>	3 / 3 = 6
<b>Unit 6</b>	Papillomaviridae	<ul style="list-style-type: none"> <li>• Classify the viruses in Papillomaviridae family. (C2)</li> <li>• List the diseases caused by viruses in Papillomaviridae. (C1)</li> <li>• Illustrate the structure of Papillomaviruses. (C2)</li> <li>• Explain the replication of Human Papillomavirus. (C2)</li> <li>• Summarize in detail about the proteins involved in Human Papillomavirus replication. (C2)</li> <li>• Explain the epidemiology and pathogenesis of Papillomaviruses. (C2)</li> <li>• Explain the laboratory diagnosis and prophylaxis available for the viruses in Papillomaviridae. (C2)</li> </ul>	3 / 3 = 6



<b>Unit 7</b>	Retroviruses – HIV structure and replication	<ul style="list-style-type: none"> <li>• Classify the retroviruses and explain about the replication strategies of retroviruses. (C2)</li> <li>• List the diseases caused by Human Immunodeficiency Virus (HIV). (C1)</li> <li>• Illustrate the structure of HIV. (C2)</li> <li>• Explain the replication of HIV. (C2)</li> <li>• Summarize in detail about the proteins involved in HIV replication and its reverse transcriptase activity. (C2)</li> <li>• Explain the epidemiology and pathogenesis of HIV. (C2)</li> <li>• Explain the evasion from host immune response by HIV. (C2)</li> <li>• Explain the laboratory diagnosis and prophylaxis available for HIV. (C2)</li> </ul>	4 / 4 = 8
<b>Unit 8</b>	Hepatitis B virus (HBV)	<ul style="list-style-type: none"> <li>• List the diseases caused by Hepatitis B virus (HBV). (C1)</li> <li>• Illustrate the structure of the HBV. (C2)</li> <li>• Explain the replication of HBV. (C2)</li> <li>• Summarize in detail about the proteins involved in HBV replication. (C2)</li> <li>• Explain the epidemiology and pathogenesis of HBV. (C2)</li> <li>• Explain the laboratory diagnosis and prophylaxis available for HBV. (C2)</li> </ul>	3 / 3 = 6
<b>Unit 9</b>	Rickettsiaceae	<ul style="list-style-type: none"> <li>• Classify the bacteria in the family Rickettsiaceae. (C2)</li> <li>• List the diseases caused by Rickettsiaceae. (C1)</li> <li>• Explain the replication strategies of Rickettsiae. (C2)</li> <li>• Demonstrate the epidemiology of Rickettsiae and list down various Rickettsial groups infecting humans. (C2)</li> </ul>	2 / 2 = 4



		<ul style="list-style-type: none"> <li>• Explain the lab diagnosis and prophylaxis available for Rickettsiae. (C2)</li> </ul>	
<b>Unit 10</b>	Chlamydiae	<ul style="list-style-type: none"> <li>• Explain the epidemiology of Chlamydiae. (C2)</li> <li>• List the diseases caused by Chlamydiae. (C1)</li> <li>• Explain the replication of Chlamydiae. (C2)</li> <li>• Explain the lab diagnosis and prophylaxis available for Chlamydiae. (C2)</li> </ul>	2 / 2 = 4

MANIPAL INSTITUTE OF VIROLOGY, MAHE





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**CURRICULUM**

<b>Name of the Program</b>	MSc Clinical Virology														
<b>Course Title</b>	<b>Systematic Virology-II</b>														
<b>Course Code</b>	MIV511														
<b>Academic Year</b>	2021-2023														
<b>Semester</b>	I														
<b>Course credits</b>	4														
<b>Course Prerequisite</b>	First class/CGPA 6.5 at UG level (BSc Life Sciences/Health Sciences)														
<b>Course Synopsis</b>	<p>1. The course will offer in-depth knowledge about the taxonomy, structure, genome, antigens, replication, animal/cell susceptibility.</p> <p>2. It will also provide an overview of epidemiology, clinical diseases, pathogenesis, lab diagnosis and prophylaxis.</p>														
<b>Course Outcomes</b>	<p><b>CO 1:</b> Explain the difference in virus structures between the enveloped and non-enveloped viruses. (C2)</p> <p><b>CO 2:</b> Recall various families of RNA viruses. (C1)</p> <p><b>CO 3:</b> Explain the replication strategies and interaction of RNA viruses and prions with the host. (C2)</p> <p><b>CO 4:</b> Illustrate the role of different viral proteins in attachment, fusion, uncoating, replication, assembly, and release. (C2)</p>														
<b>Mapping of COs to POs</b>															
<b>COs</b>	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>	<b>PO 9</b>	<b>PO 10</b>	<b>PO1 1</b>	<b>PO1 2</b>	<b>PO1 3</b>	<b>PO1 4</b>	
<b>CO 1</b>	✓	✓	✓		✓						✓				
<b>CO 2</b>	✓										✓				
<b>CO 3</b>	✓	✓	✓					✓			✓				
<b>CO 4</b>	✓		✓					✓			✓				
<b>Learning Strategies, Contact Hours and Student Learning Time (SLT)</b>	<b>LEARNING STRATEGY</b>									<b>CONTACT HOUR</b>			<b>SLT</b>		
	Lecture									30			90		
	Seminar									28			84		
	Small Group Discussion (SGD)									2			6		
	Self-directed learning (SDL)									-			-		



	Problem Based Learning (PBL)	-	-
	Case Based Learning (CBL)	-	-
	Clinic	-	-
	Practical	-	-
	Revision	-	-
	Assessment	2	-
	<b>TOTAL</b>	<b>62</b>	<b>180</b>
<b>Assessment Methods</b>	<b>FORMATIVE</b>	<b>SUMMATIVE</b>	
	Assignment	Mid semester exam	
	Student presentation	End semester exam	
	Group discussion		

<b>Mapping of assessment with COs</b>				
<i>Nature of assessment</i>	<b>CO 1</b>	<b>CO 2</b>	<b>CO 3</b>	<b>CO 4</b>
Assignments	✓			
Student presentations	✓		✓	✓
Mid-semester examination	✓	✓		
End-semester examination	✓	✓	✓	✓
Practical examination	✗	✗	✗	✗

<b>Feedback Methods</b>	Student feedback on the course and the course master
<b>Main Reference</b>	<ul style="list-style-type: none"> <li>Fields Virology, Vol 1 &amp; 2</li> <li>Principles of Virology, J Flint, Vol 1 &amp; 2</li> </ul>

<b>Course learning outcomes</b>			
<b>Content</b>	<b>Topics</b>	<b>Learning Outcomes</b>	<b>Hours (Lectures/Tutorials)</b>
<b>Unit 1</b>	Introduction to RNA viruses and replication	<ul style="list-style-type: none"> <li>Classify RNA virus families. (C2)</li> <li>Explain the general replication strategies of RNA viruses. (C2)</li> </ul>	2 / 1 = 3
<b>Unit 2</b>	Flaviviridae	<ul style="list-style-type: none"> <li>Classify the viruses in Flaviviridae family. (C2)</li> <li>List the diseases caused by viruses in Flaviviridae. (C1)</li> <li>Illustrate the structure of Flaviviruses. (C2)</li> <li>Explain the replication of Dengue virus and Hepatitis C virus. (C2)</li> </ul>	2 / 2 = 4



		<ul style="list-style-type: none"> <li>Summarize in detail about the proteins involved in Dengue virus and Hepatitis C virus replication. (C2)</li> <li>Explain the epidemiology and pathogenesis of Flaviviridae. (C2)</li> <li>Explain the laboratory diagnosis and prophylaxis available for viruses in Flaviviridae. (C2)</li> </ul>	
<b>Unit 3</b>	Picornaviridae	<ul style="list-style-type: none"> <li>Classify the viruses in Picornaviridae family. (C2)</li> <li>List the diseases caused by viruses in Picornaviridae. (C1)</li> <li>Illustrate the structure of Picornaviruses. (C2)</li> <li>Explain the replication of Enterovirus. (C2)</li> <li>Summarize in detail about the proteins involved in Enterovirus replication. (C2)</li> <li>Explain the epidemiology and pathogenesis of Picornaviridae. (C2)</li> <li>Explain the laboratory diagnosis and prophylaxis available for viruses in Picornaviridae. (C2)</li> </ul>	2 / 2 = 4
<b>Unit 4</b>	Reoviridae	<ul style="list-style-type: none"> <li>Illustrate the structure of Reoviruses. (C2)</li> <li>List the diseases caused by viruses in Reoviridae. (C1)</li> <li>Explain the replication of Rotavirus. (C2)</li> <li>Summarize in detail about the proteins involved in Rotavirus replication. (C2)</li> <li>Explain the epidemiology and pathogenesis of Reoviridae. (C2)</li> <li>Explain the laboratory diagnosis and prophylaxis available for viruses in Reoviridae. (C2)</li> </ul>	2 / 3 = 5





<b>Unit 5</b>	Filoviridae	<ul style="list-style-type: none"> <li>• Classify the viruses in the Filoviridae group. (C2)</li> <li>• List the diseases caused by viruses in Filoviridae. (C1)</li> <li>• Illustrate the structure of Filoviruses. (C2)</li> <li>• Explain the replication of the Ebola virus. (C2)</li> <li>• Summarize in detail about the proteins involved in Ebola virus replication. (C2)</li> <li>• Explain the epidemiology and pathogenesis of Filoviridae. (C2)</li> <li>• Explain the laboratory diagnosis and prophylaxis available for viruses in Filoviridae. (C2)</li> </ul>	2 / 2 = 4
<b>Unit 6</b>	Coronaviridae	<ul style="list-style-type: none"> <li>• Classify the viruses in Coronaviridae family. (C2)</li> <li>• List the diseases caused by viruses in Coronaviridae. (C1)</li> <li>• Illustrate the structure of Coronaviruses. (C2)</li> <li>• Explain the replication of Coronavirus. (C2)</li> <li>• Summarize in detail about the proteins involved in Coronavirus replication. (C2)</li> <li>• Explain the epidemiology and pathogenesis of Coronaviridae. (C2)</li> <li>• Explain the laboratory diagnosis and prophylaxis available for viruses in Coronaviridae. (C2)</li> </ul>	2 / 3 = 5
<b>Unit 7</b>	Paramyxoviridae	<ul style="list-style-type: none"> <li>• Classify the viruses in Paramyxoviridae family. (C2)</li> <li>• List the diseases caused by viruses in Paramyxoviridae. (C1)</li> <li>• Illustrate the structure of Mumps virus, Measles virus, Respiratory Syncytial Virus, Parainfluenza</li> </ul>	3 / 3 = 6



		<p>virus, Metapneumovirus and Nipah virus. (C2)</p> <ul style="list-style-type: none"> <li>• Explain the replication of different viruses in the Paramyxoviridae family. (C2)</li> <li>• Summarize in detail about the proteins involved in the replication of viruses in Paramyxoviridae family. (C2)</li> <li>• Explain the epidemiology and pathogenesis Paramyxoviridae. (C2)</li> <li>• Explain the laboratory diagnosis and prophylaxis available for viruses in Paramyxoviridae. (C2)</li> </ul>	
<b>Unit 8</b>	Nairoviridae	<ul style="list-style-type: none"> <li>• Classify the viruses in Nairoviridae family. (C2)</li> <li>• List the diseases caused by viruses in Nairoviridae. (C1)</li> <li>• Illustrate the structure of Nairoviruses. (C2)</li> <li>• Explain the replication of Crimean-Congo hemorrhagic fever orthonairovirus. (C2)</li> <li>• Summarize in detail about the proteins involved in Crimean-Congo hemorrhagic fever orthonairovirus replication. (C2)</li> <li>• Explain the epidemiology and pathogenesis of Nairoviridae. (C2)</li> <li>• Explain the laboratory diagnosis and prophylaxis available for viruses in Nairoviridae. (C2)</li> </ul>	2 / 2 = 4
<b>Unit 9</b>	Orthomyxoviridae	<ul style="list-style-type: none"> <li>• Classify the viruses in Orthomyxoviridae family. (C2)</li> <li>• List the diseases caused by viruses in Orthomyxoviridae. (C1)</li> <li>• Illustrate the structure of Orthomyxoviruses. (C2)</li> </ul>	2 / 2 = 4



		<ul style="list-style-type: none"> <li>• Explain the replication of Influenza virus. (C2)</li> <li>• Summarize in detail about the proteins involved in Influenza virus replication. (C2)</li> <li>• Explain the epidemiology and pathogenesis of Orthomyxoviridae. (C2)</li> <li>• Explain the laboratory diagnosis and prophylaxis available for viruses in Orthomyxoviridae. (C2)</li> </ul>	
<b>Unit 10</b>	Rhabdoviridae	<ul style="list-style-type: none"> <li>• Classify the viruses in Rhabdoviridae family. (C2)</li> <li>• List the diseases caused by viruses in Rhabdoviridae. (C1)</li> <li>• Illustrate the structure of Rabies lyssavirus. (C2)</li> <li>• Explain the replication of Rabies lyssavirus. (C2)</li> <li>• Summarize in detail about the proteins involved in Rabies lyssavirus replication. (C2)</li> <li>• Explain the epidemiology and pathogenesis of Rhabdoviridae. (C2)</li> <li>• Explain the laboratory diagnosis and prophylaxis available for viruses in Rhabdoviridae. (C2)</li> </ul>	2 / 2 = 4
<b>Unit 11</b>	Astroviridae	<ul style="list-style-type: none"> <li>• Classify the viruses in Astroviridae family. (C2)</li> <li>• List the diseases caused by viruses in Astroviridae. (C1)</li> <li>• Illustrate the structure of Mamastrovirus 1. (C2)</li> <li>• Explain the replication of Mamastrovirus 1. (C2)</li> <li>• Summarize in detail about the proteins involved in Mamastrovirus 1 replication. (C2)</li> </ul>	2 / 1 = 3



		<ul style="list-style-type: none"> <li>• Explain the epidemiology and pathogenesis of Astroviridae. (C2)</li> <li>• Explain the laboratory diagnosis and prophylaxis available for viruses in Astroviridae. (C2)</li> </ul>	
<b>Unit 12</b>	Caliciviridae	<ul style="list-style-type: none"> <li>• Classify the viruses in Caliciviridae family. (C2)</li> <li>• List the diseases caused by viruses in Caliciviridae. (C1)</li> <li>• Illustrate the structure of Norwalk virus. (C2)</li> <li>• Explain the replication of Norwalk virus. (C2)</li> <li>• Summarize in detail about the proteins involved in Norwalk virus replication. (C2)</li> <li>• Explain the epidemiology and pathogenesis of Caliciviridae. (C2)</li> <li>• Explain the laboratory diagnosis and prophylaxis available for viruses in Caliciviridae family. (C2)</li> </ul>	2 / 1 = 3
<b>Unit 13</b>	Prions and slow viral diseases	<ul style="list-style-type: none"> <li>• List different viruses causing slow viral infections. (C1)</li> <li>• List the diseases caused by Prions and slow viral infections. (C1)</li> <li>• Explain the structure and formation of cellular prion protein. (C2)</li> <li>• Explain in detail about the change from PrP<sup>C</sup> to PrP<sup>Sc</sup>.</li> <li>• Explain the epidemiology and pathogenesis of Prion diseases. (C2)</li> <li>• Explain the laboratory diagnosis and prophylaxis available for Prions. (C1)</li> </ul>	1 / 2 = 3



<b>Unit 14</b>	Togaviridae	<ul style="list-style-type: none"> <li>• Classify the viruses in Togaviridae family. (C2)</li> <li>• List the diseases caused by viruses in Togaviridae. (C1)</li> <li>• Illustrate the structure of Togaviruses. (C2)</li> <li>• Explain the replication of Chikungunya virus. (C2)</li> <li>• Summarize in detail about the proteins involved in Chikungunya virus replication. (C2)</li> <li>• Explain the epidemiology and pathogenesis of Togaviridae. (C2)</li> <li>• Explain the laboratory diagnosis and prophylaxis available for viruses in Togaviridae. (C2)</li> </ul>	1 / 1 = 2
<b>Unit 15</b>	Arenaviridae	<ul style="list-style-type: none"> <li>• Classify the viruses in Arenaviridae family. (C2)</li> <li>• List the diseases caused by viruses in Arenaviridae. (C1)</li> <li>• Illustrate the structure of Arenaviruses. (C2)</li> <li>• Explain the replication of Lymphocytic choriomeningitis mammarenavirus. (C2)</li> <li>• Summarize in detail about the proteins involved in Lymphocytic choriomeningitis mammarenavirus replication. (C2)</li> <li>• Explain the epidemiology and pathogenesis of Arenaviridae. (C2)</li> <li>• Explain the laboratory diagnosis and prophylaxis available for viruses in Arenaviridae. (C2)</li> </ul>	1 / 1 = 2
<b>Unit 16</b>	Deltavirus	<ul style="list-style-type: none"> <li>• List the diseases caused by Hepatitis delta virus. (C1)</li> <li>• Illustrate the structure of Hepatitis delta virus. (C2)</li> </ul>	1 / 1 = 2



		<ul style="list-style-type: none"> <li>• Explain the replication of Hepatitis delta virus. (C2)</li> <li>• Summarize in detail about the proteins involved in Hepatitis delta virus replication. (C2)</li> <li>• Explain the epidemiology and pathogenesis of Hepatitis delta virus. (C2)</li> <li>• Explain the laboratory diagnosis and prophylaxis available for Hepatitis Delta virus. (C2)</li> </ul>	
<b>Unit 17</b>	Hepeviridae	<ul style="list-style-type: none"> <li>• Classify the viruses in Hepeviridae family. (C2)</li> <li>• List the diseases caused by viruses in Hepeviridae. (C1)</li> <li>• Illustrate the structure of Orthohepevirus A. (C2)</li> <li>• Explain the replication of Orthohepevirus A. (C2)</li> <li>• Summarize in detail about the proteins involved in Orthohepevirus A replication. (C2)</li> <li>• Explain the epidemiology and pathogenesis of Hepeviridae. (C2)</li> <li>• Explain the laboratory diagnosis and prophylaxis available for viruses in Hepeviridae. (C2)</li> </ul>	1 / 1 = 2





**Manipal Institute of Virology**

**CURRICULUM**

<b>Name of the program</b>	MSc Clinical Virology
<b>Course Title</b>	<b>Immunology of Viral Diseases</b>
<b>Course Code</b>	MIV513
<b>Academic Year</b>	2021-2023
<b>Semester</b>	I
<b>Course credits</b>	<b>3</b>
<b>Course Prerequisite</b>	First class/CGPA 6.5 at UG level (BSc Life Sciences/Health Sciences)
<b>Course Synopsis</b>	<ol style="list-style-type: none"> <li>1. This module helps the student to understand the basic principles and key concepts of the immunology.</li> <li>2. It gives the overview of cellular and molecular events that control the function of immune system such as immune detection, activation and response to an infection.</li> <li>3. This course also emphasizes the host-virus interaction and specific immune response upon viral entry.</li> <li>4. This course imparts understanding of immunopathogenesis of viral diseases.</li> </ol>
<b>Course Outcomes</b>	<p><b>CO 1:</b> Explain the different cells and organs of immune system. (C1)</p> <p><b>CO 2:</b> Differentiate cellular and humoral immunity. (C2)</p> <p><b>CO 3:</b> Describe the process of B-cell and T-cell synthesis, maturation, activation, selection, proliferation and response. (C2)</p> <p><b>CO 4:</b> Elaborate the activators and suppressors of immune system. (C2)</p> <p><b>CO 5:</b> Define the specific immune response triggered upon viral infections. (C3)</p> <p><b>CO 6:</b> Explain cytokines in viral infections. (C2)</p> <p><b>CO 7:</b> Illustrate complement pathway. (C2)</p> <p><b>CO 8:</b> Outline antibody dependent enhancement. (C2)</p> <p><b>CO 9:</b> Analyse recognition of viruses by cellular sensors. (C4)</p> <p><b>CO 10:</b> Explain specific innate and adaptive response to viral infections and vaccination. (C5)</p>



Mapping of COs to POs														
COs	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PO 13	PO 14
CO 1	✓										✓			
CO 2	✓		✓								✓			
CO 3	✓		✓					✓			✓			
CO 4	✓										✓			
CO 5	✓							✓			✓			
CO 6	✓		✓								✓			
CO 7	✓										✓			
CO 8	✓										✓			
CO 9	✓		✓					✓			✓			
CO 10	✓		✓					✓	✓		✓			

Learning Strategies, Contact Hours and Student Learning Time (SLT)	LEARNING STRATEGY		CONTACT HOUR	SLT
	Lecture		30	90
	Seminar		9	27
	Small Group Discussion (SGD)		4	12
	Self-directed learning (SDL)		1	3
	Problem Based Learning (PBL)		1	3
	Case Based Learning (CBL)		-	-
	Clinic		-	-
	Practical		-	-
	Revision		-	-
	Assessment		2	-
<b>TOTAL</b>		<b>47</b>	<b>135</b>	

Assessment Methods	FORMATIVE		SUMMATIVE	
	Assignment		Mid semester exam	
	Student presentation		End semester exam	
	Group discussion			

Mapping of assessment with COs										
Nature of assessment	CO 1	CO 2	CO 3	CO 4	CO 5	CO 6	CO 7	CO 8	CO 9	CO 10
Assignments			✓				✓	✓	✓	
Student presentations		✓								✓
Mid-semester examination	✓	✓	✓	✓	✓					
End-semester examination	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Practical examination	x	x	x	x	x	x	x	x	x	x





<b>Feedback Methods</b>	<ul style="list-style-type: none"> <li>• Course feedback</li> <li>• Feedback after sessional exam</li> </ul>
<b>Main Reference</b>	<ul style="list-style-type: none"> <li>• Kuby's Immunology</li> <li>• Roitt's Essential Immunology</li> <li>• Cellular and molecular immunology: Abdul K. Abbas</li> <li>• Microbiology and Immunology: Subhash Chandra Parija</li> </ul>

<b>Course learning outcomes</b>			
<b>Content</b>	<b>Topics</b>	<b>Learning Outcomes</b>	<b>Hours (Lectures/Tutorials)</b>
<b>Unit 1</b>	1. Introduction to immunology	Make the student to understand the following. (C1) <ul style="list-style-type: none"> <li>• Basic terminologies.</li> <li>• History of immunology.</li> <li>• Types of immunity.</li> </ul>	2
	2. Immune system – structure and components (Immunoglobulins, cells, complement etc)	Explain the organisation of immune system. (C2) <ul style="list-style-type: none"> <li>• Cell of the immune system.</li> <li>• Tissues and organs of immune system.</li> <li>• Antigen.</li> <li>• Antibody.</li> <li>• Antigen-antibody reaction.</li> <li>• Complement system, activation, regulation and its effect.</li> </ul>	3
<b>Unit 2</b>	Immune response	Distinguish and interpret the various immune responses. (C2) <ul style="list-style-type: none"> <li>• Humoral immunity</li> <li>• B-cell synthesis, maturation, differentiation and activation.</li> <li>• Cell mediated immunity.</li> <li>• T-cell synthesis, maturation, differentiation and activation.</li> <li>• Major Histocompatibility Complex.</li> <li>• Transfer factor.</li> <li>• Immunological tolerance.</li> </ul>	3 / 2 = 5



<b>Unit 3</b>	Immunogenetics	Understand how diversity of T-cell receptors and antibodies arises. (C2) <ul style="list-style-type: none"> <li>Genetic mechanisms generating T cell receptor and antibody diversity.</li> <li>Antibody variable regions, and gene rearrangement.</li> <li>Impact of genetic variation at individual and population level on susceptibility or resistance to diseases.</li> </ul>	2
<b>Unit 4</b>	1. Hypersensitivity	Type I—IV hypersensitivity. (C2)	1
	2. Immunodeficiency	Define the immunodeficiency and its types. (C2) <ul style="list-style-type: none"> <li>Primary immunodeficiency.</li> <li>Secondary immunodeficiency.</li> </ul>	1
	3. Hybridoma technology	Apply acquired theoretical knowledge to develop mAbs in future. (C3) <ul style="list-style-type: none"> <li>Principle, method and applications of hybridoma technology.</li> </ul>	2
<b>Unit 5</b>	Host-virus interactions	Develop the hypothesis of immune response for any viruses. (C3) <ul style="list-style-type: none"> <li>Cellular receptors and virus entry virus morphogenesis.</li> <li>Host cell damage Cellular and viral gene expression.</li> </ul>	5
<b>Unit 6</b>	Recognition of viruses by cellular sensors	<ul style="list-style-type: none"> <li>Compare different pathogen recognition receptors (PRRs). (C2)</li> <li>Signal transduction mechanism of PRRs. (C2)</li> </ul>	1 / 1 = 2
<b>Unit 7</b>	Overview of Cytokines in Viral Infections	<ul style="list-style-type: none"> <li>Introduction to cytokines and cytokine nomenclature. (C2)</li> <li>Properties of cytokines. (C2)</li> <li>Cytokine-mediated effects. (C2)</li> </ul>	1 / 1 = 2



		<ul style="list-style-type: none"> <li>• Cytokine actions. (C2)</li> <li>• Regulation of immune response by cytokines. (C2)</li> <li>• Signal Transduction by cytokine receptors. (C2)</li> <li>• Cytokines in viral infections. (C2)</li> </ul>	
<b>Unit 8</b>	Complement pathway	<ul style="list-style-type: none"> <li>• Introduction to complement system. (C2)</li> <li>• Pathways of complement system. (C2) <ul style="list-style-type: none"> <li>○ Classical pathway (specific immune system).</li> <li>○ Alternative (non-specific immune system).</li> <li>○ Lectin pathway.</li> </ul> </li> <li>• Protective Roles for Complement during Viral Infections. (C2)</li> <li>• Role of complement system in enhancement of humoral immunity to viruses. (C2)</li> </ul>	2
<b>Unit 9</b>	Antibody dependent enhancement	<ul style="list-style-type: none"> <li>• Mechanism of antibody dependent enhancement. (C2)</li> <li>• ADEs in different viral infections. (C2)</li> </ul>	2
<b>Unit 10</b>	Immune response to Viral vaccines	<ul style="list-style-type: none"> <li>• Explain vaccines mediated protection. (C5)</li> <li>• Main effectors of vaccine response. (C4)</li> <li>• Activation of innate to adaptive immunity in response to vaccination. (C4)</li> <li>• Vaccine antibody response. (C3)</li> </ul>	2 / 1 = 3
<b>Unit 11</b>	Viral evasion of immune response	<ul style="list-style-type: none"> <li>• Mechanisms of viral evasion. (C2)</li> <li>• Virus specific evasion. (C2)</li> </ul>	3



<b>Unit 12</b>	Specific immune response to viral diseases	<ul style="list-style-type: none"> <li>• Coronavirus (C5)</li> <li>• Influenza</li> <li>• HIV</li> <li>• Hepatitis</li> <li>• Dengue</li> <li>• Japanese Encephalitis virus</li> </ul>	10
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MANIPAL INSTITUTE OF VIROLOGY, MAHE





Manipal Institute of Virology

**CURRICULUM**

<b>Name of Program</b>	MSc Clinical Virology														
<b>Course Title</b>	<b>Practical I (Tissue/Cell Culture)</b>														
<b>Course Code</b>	MIV515														
<b>Academic Year</b>	2021-2023														
<b>Semester</b>	I														
<b>No. of credits</b>	<b>1</b>														
<b>Course Prerequisite</b>	First class/CGPA 6.5 at UG level (BSc Life Sciences/Health Sciences)														
<b>Course Synopsis</b>	1. This module helps to understand the basic requirements for a cell culture lab. 2. To provide fundamental knowledge of various types of cell lines used for the propagation of viruses.														
<b>Course Outcomes</b>	<b>CO 1:</b> Identify and differentiate cell culture methods and types of cell lines. (P3) <b>CO 2:</b> Demonstrate the techniques of sub culturing, media preparation, cell counting, cell preservation. (P3) <b>CO 3:</b> Understand the quality control of cell lines. (C2, P3)														
<b>Mapping of COs to POs</b>															
<b>COs</b>	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>	<b>PO 9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>	<b>PO 13</b>	<b>PO 14</b>	
<b>CO 1</b>	✓					✓			✓		✓				
<b>CO 2</b>	✓		✓			✓					✓		✓		
<b>CO 3</b>	✓										✓				
<b>Learning Strategies, Contact Hours and Student Learning Time (SLT)</b>	<b>LEARNING STRATEGY</b>				<b>CONTACT HOUR</b>				<b>SLT</b>						
	Lecture														
	Seminar														
	Small Group Discussion (SGD)														
	Self-directed learning (SDL)														
	Problem Based Learning (PBL)														



	Case Based Learning (CBL)		
	Clinic		
	Practical	30	90
	Revision	-	
	Assessment	2	
	<b>TOTAL</b>	<b>32</b>	<b>90</b>
<b>Assessment Methods</b>	<b>FORMATIVE</b>		<b>SUMMATIVE</b>
	Assessment of Record Books		End semester exam
	Internal Assessment		

<b>Mapping of assessment with COs</b>			
<i>Nature of assessment</i>	<b>CO 1</b>	<b>CO 2</b>	<b>CO 3</b>
Internal assessment (record books, technical skills, conduct in lab)	✓	✓	✓
End-semester practical examination	✓	✓	✓

<b>Feedback Methods</b>	Student feedback on Course and Course master
<b>Main Reference</b>	<ul style="list-style-type: none"> <li>• Culture of Animal Cells by R. Ian Freshney</li> <li>• Animal Cell Culture by John R. W. Masters</li> <li>• Cell and Tissue Culture by Alan Doyle and J. Bryan Griffiths</li> <li>• Fields virology</li> </ul>

<b>Course learning outcomes</b>		
<b>Topics</b>	<b>Learning Outcomes</b>	<b>Hours (Practical)</b>
Cell culture media and Supplements	<ul style="list-style-type: none"> <li>• Describe the growth requirements for eukaryotic cells, including the culture environment, media and supplements and their preparation (P3)</li> </ul>	7
Cell counting and sub culturing of cell lines	<ul style="list-style-type: none"> <li>• Explain the principle and procedure for cell counting (P3)</li> <li>• Explain the life span, growth cycle and sub culturing of cell lines and its importance (P3)</li> </ul>	7
Characterization of cell culture	<ul style="list-style-type: none"> <li>• Identify the different types of cell culture and characterization mainly based on morphology (P3)</li> </ul>	7



Preservation of cell cultures	<ul style="list-style-type: none"><li>• Discuss the principle and methods of preservation of cell lines, thawing and revival of frozen cells (P3)</li></ul>	7
Cell culture in Virology	<ul style="list-style-type: none"><li>• Describe the application of cell culture in Virology (C4, A2)</li></ul>	2

MANIPAL INSTITUTE OF VIROLOGY, MAHE





Manipal Institute of Virology

**CURRICULUM**

<b>Name of Program</b>	MSc Clinical Virology
<b>Course Title</b>	<b>Microbiology Posting</b>
<b>Course Code</b>	MIV517
<b>Academic Year</b>	2021-2023
<b>Semester</b>	I
<b>No. of credits</b>	<b>2</b>
<b>Course Prerequisite</b>	First class/CGPA 6.5 at UG level (BSc Life Sciences/Health Sciences)
<b>Course Synopsis</b>	This is a mandatory learning course (MLC) which will be designed and implemented by the Department of Microbiology, KMC, Manipal. It is credited but not graded. Transcript will show S/NS (Satisfactory/Not satisfactory) based on the participation and comprehensive evaluation. This course shall include several sub-categorical areas of microbial characterization and diagnostics.
<b>Course Outcomes</b>	<b>CO1:</b> To learn about the various topic covered under microbiology <b>CO2:</b> To understand the different microbiological techniques. <b>CO3:</b> To understand the different phases of analyses or diagnosis of diseases such as pre-analytical, analytical and post analytical

**Mapping of COs to POs**

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14
CO 1	✓					✓			✓		✓			
CO 2	✓		✓			✓					✓		✓	
CO 3	✓										✓			

Learning Strategies, Contact Hours and Student Learning Time (SLT)	LEARNING STRATEGY	CONTACT HOUR	SLT
	Lecture	15	45
Seminar	-	-	
Small Group Discussion (SGD)	-	-	
Self-directed learning (SDL)	-	-	
Problem Based Learning (PBL)	-	-	
Case Based Learning (CBL)	-	-	
Clinic	-	-	
Practical	15	45	
Revision	-	-	
Assessment	-	-	
<b>TOTAL</b>	<b>30</b>	<b>90</b>	





# SECOND SEMESTER

MANIPAL INSTITUTE OF VIROLOGY, MAHE





Manipal Institute of Virology

**CURRICULUM**

<b>Name of the Program</b>	MSc Clinical Virology														
<b>Course Title</b>	<b>Epidemiology</b>														
<b>Course Code</b>	MIV502														
<b>Academic Year</b>	2021-2023														
<b>Semester</b>	II														
<b>Course credits</b>	<b>3</b>														
<b>Course Prerequisite</b>	First class/CGPA 6.5 at UG level (BSc Life Sciences/Health Sciences)														
<b>Course Synopsis</b>	<ol style="list-style-type: none"> <li>1. This module introduces to the principles in epidemiology and public health surveillance.</li> <li>2. Basic concepts in infectious disease epidemiology.</li> <li>3. Epidemiological study designs and its applications.</li> <li>4. To understand the various steps of investigating an outbreak and management.</li> <li>5. To provide case-study based training to deepen the knowledge in applied epidemiology.</li> </ol>														
<b>Course Outcomes</b>	<p><b>CO 1:</b> Define epidemiology and its applications in public health. (C1)</p> <p><b>CO 2:</b> Outline basic terminologies used in disease occurrence and basic concepts in infectious disease epidemiology. (C2)</p> <p><b>CO 3:</b> Elaborate epidemiological study designs. (C6)</p> <p><b>CO 4:</b> Outline basic concepts in public health surveillance and identify the attributes and limitations of good surveillance mechanism. (C2)</p> <p><b>CO 5:</b> Outline fundamental principles and steps involved in investigating an outbreak. (C2)</p> <p><b>CO 6:</b> Utilize EpiInfo software to gather, analyse, and present data. (C3)</p> <p><b>CO 7:</b> Evaluate and discuss case studies in applied epidemiology. (C5)</p>														
<b>Mapping of COs to POs</b>															
	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>	<b>PO 9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>	<b>PO 13</b>	<b>PO 14</b>	
<b>CO 1</b>	✓		✓								✓				



CO 2	✓		✓				✓			✓			
CO 3	✓	✓								✓			
CO 4	✓	✓	✓	✓			✓		✓	✓	✓		✓
CO 5	✓	✓	✓	✓			✓			✓	✓	✓	✓
CO 6	✓		✓	✓	✓					✓	✓		
CO 7	✓		✓						✓		✓		
<b>Learning Strategies, Contact Hours and Student Learning Time (SLT)</b>	<b>LEARNING STRATEGY</b>						<b>CONTACT HOURS</b>			<b>SLT</b>			
	Lecture						20			60			
	Seminar						5			15			
	Small Group Discussion (SGD)						3			9			
	Self-directed learning (SDL)						2			6			
	Problem Based Learning (PBL)						5			15			
	Case Based Learning (CBL)						10			30			
	Clinic						-			-			
	Practical						-			-			
	Revision						-			-			
	Assessment						2			-			
<b>TOTAL</b>						<b>47</b>			<b>135</b>				
<b>Assessment Methods</b>	<b>FORMATIVE</b>						<b>SUMMATIVE</b>						
	Assignment						Mid semester exam						
	Student presentation						End semester exam						
	Group discussion												

<b>Mapping of assessment with COs</b>							
<i>Nature of assessment</i>	CO 1	CO 2	CO 3	CO 4	CO 5	CO 6	CO 7
Assignments						✓	✓
Student presentations		✓	✓	✓	✓		
Mid-semester examination	✓	✓	✓	✓			
End-semester examination	✓	✓	✓	✓	✓	✓	✓
Practical examination	x	x	x	x	x	x	x

<b>Feedback Methods</b>	Student feedback on Course and Course master
<b>Reference Materials</b>	<ul style="list-style-type: none"> <li>✓ Principles of Epidemiology in Public Health Practice (3rd edition)</li> <li>✓ Textbook of Preventive &amp; Social Medicine (by K Park)</li> <li>✓ Epidemiology (by Leon Gordis)</li> </ul>



	<ul style="list-style-type: none"> <li>✓ National Health Programs of India National Policies and Legislations Related to Health (by J. Kishore).</li> <li>✓ Chapter 53: Public Health Surveillance: A Tool for Targeting and Monitoring Interventions. Available at: <a href="https://www.ncbi.nlm.nih.gov/books/NBK11770/pdf/Bookshelf_NBK11770.pdf">https://www.ncbi.nlm.nih.gov/books/NBK11770/pdf/Bookshelf_NBK11770.pdf</a></li> <li>✓ The CDC Field Epidemiology Manual (by Sonja A. Rasmussen and Richard A. Goodman)</li> <li>✓ Control of Communicable Diseases Manual (20th Edition)</li> <li>✓ Modern Epidemiology (3rd edition) (by Kenneth J. Rothman)</li> </ul>
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Course learning outcomes			
Content	Topics	Learning Outcomes	Hours (Lectures/Tutorials + Practicals)
Unit 1	Introduction to Epidemiology	<ul style="list-style-type: none"> <li>• Define Epidemiology. (C1)</li> <li>• Illustrate the applications of Epidemiology in public health research. (C2)</li> <li>• Explain the key terms used in Infectious disease occurrence such as - Outbreak, Epidemic, Cluster, Pandemic, Endemic, Hyperendemic, Sporadic, Epizootic, and Enzootic etc...(C2)</li> <li>• Explain Descriptive Epidemiology. (C2)</li> <li>• Explain Analytical Epidemiology. (C2)</li> </ul>	2
Unit 2	Pandemics	<ul style="list-style-type: none"> <li>• Explain John Snow's work and his contribution to public health. (C2)</li> <li>• Examine the history of major pandemics. (C4) <ul style="list-style-type: none"> <li>- Black Death (Plague)</li> <li>- Spanish flu</li> <li>- COVID-19</li> </ul> </li> <li>• Analyse the factors influencing the spread of pandemics. (C4)</li> </ul>	3
Unit 3	Basic concepts in Infectious disease epidemiology	<ul style="list-style-type: none"> <li>• What is infection and disease? (C1)</li> </ul>	1



		<ul style="list-style-type: none"> <li>• Define epidemiological triad (Agent, host, and environmental factors). (C1)</li> <li>• Explain Iceberg phenomenon in infectious disease. (C2)</li> <li>• What are tools of measurements (Rate, ratios, and proportions)? (C1)</li> <li>• Summarize measures of disease frequency (Prevalence and Incidence). (C2)</li> <li>• Examine and analyse the determinants of health and disease in a population. (C4)</li> </ul>	
<b>Unit 4</b>	Infectious disease dynamics	<ul style="list-style-type: none"> <li>• Outline the modes of disease transmission. (C2)</li> <li>• Explain portal of entry and exit. (C2)</li> <li>• Define incubation period. (C1)</li> <li>• Define period of communicability. (C1)</li> <li>• Define reproductive number. (R0) (C1)</li> <li>• Who are Super spreaders? (C1)</li> <li>• How Contact tracing is carried out? (C1)</li> <li>• Outline Isolation and quarantine mechanisms. (C2)</li> <li>• How to break the chain of transmission in infectious diseases? (C1)</li> <li>• Elaborate on hand and respiratory hygiene practices. (C6, A3)</li> </ul>	2
<b>Unit 5</b>	Epidemiological study designs	<ul style="list-style-type: none"> <li>• Explain epidemiological study designs. (C2) <ul style="list-style-type: none"> <li>- Cross-sectional study</li> <li>- Case-control study</li> <li>- Cohort study</li> </ul> </li> <li>• Compare advantages and disadvantages of various study designs. (C5)</li> <li>• Measure strength of association. (C5)</li> </ul>	4



		<ul style="list-style-type: none"> <li>Analyse and interpret odds ratio, relative risk and attributable risk. (C5)</li> </ul>	
<b>Unit 6</b>	Introduction to Surveillance	<ul style="list-style-type: none"> <li>Define public health surveillance. (C1)</li> <li>Outline different types of surveillance. (C2) <ul style="list-style-type: none"> <li>Active</li> <li>Passive</li> <li>Sentinel</li> </ul> </li> <li>Compare syndromic and disease specific surveillance. (C2)</li> <li>Explain Integrated Disease Surveillance System. (C2)</li> <li>Explain National Vector Borne Disease Control Program. (C2)</li> <li>List the attributes of a good surveillance mechanism. (C4)</li> <li>Influence of disease surveillance in evidence-based decision making. (C5)</li> <li>Analyse global surveillance programmes. (FluNET, DenNET, and GLASS) (C4)</li> </ul>	3
<b>Unit 7</b>	Health care system in India	<ul style="list-style-type: none"> <li>Outline public health infrastructure in India. (C2)</li> <li>Analyse different health care systems in India (Public, private, PPP model). (C4)</li> <li>Importance of Public health workforce for communicable disease surveillance in India. (C5)</li> <li>Evaluate International Health Regulation (2005) and list of notifiable diseases. (C5)</li> </ul>	1
<b>Unit 8</b>	Outbreak Investigation	<ul style="list-style-type: none"> <li>Explain fundamentals of investigating an outbreak. (C2)</li> <li>What is an Outbreak? Why should we investigate an outbreak? (C1)</li> <li>Illustrate the steps of outbreak investigation. (C2)</li> </ul>	2



		<ul style="list-style-type: none"> <li>• Design and develop an outbreak investigation kit. (C6)</li> <li>• How to write a Single overriding communication objective (SOCO) statement? (C1)</li> </ul>	
<b>Unit 9</b>	How to conduct a scientific literature search	<ul style="list-style-type: none"> <li>• Make use of database such as Scopus, Web of Science, PubMed, Medline, Cochrane library, and Google scholar. (C3)</li> <li>• Utilize Boolean operators (AND, OR, NOT or AND NOT) for Literature search. (C3)</li> <li>• Utilize advanced search features in PubMed (Mesh terms). (C3)</li> <li>• Critical Appraisal of a Research Article. (C5)</li> </ul>	2
<b>Unit 10</b>	Epi Info™ 7 Exercise	Analyse the survey data collected from a foodborne outbreak investigation. (Salmonella outbreak tutorial is used to teach the Epi Info™ 7 software to the students and to illustrate how the program can be used to gather, analyse, and present data) (C4, P3)	5 (Tutorials)
<b>Unit 11</b>	Case studies in Applied Epidemiology	<p><b>Case study- 1 (CDC, No. 401-303)</b> Oswego – An Outbreak of Gastrointestinal Illness Following a Church Supper</p> <ul style="list-style-type: none"> <li>-Define the terms “cluster,” “outbreak,” and “epidemic”. (C1)</li> <li>-List the steps in the investigation of an outbreak. (C1)</li> <li>-Interpret, draw, and describe the value of an epidemic curve. (C2)</li> <li>-Compare and calculate food-specific attack rates to identify possible vehicles. (C2)</li> <li>-List reasons for investigating an outbreak that has apparently ended. (C4)</li> </ul>	5 (Tutorials)
		<p><b>Case study- 2 (CDC, No. 941-903)</b> Surveillance for E. coli O157:H7 Information for Action</p> <ul style="list-style-type: none"> <li>-Discuss the process and criteria for placing a disease or condition on a state or national notifiable disease list. (C6)</li> </ul>	5 (Tutorials)



		<ul style="list-style-type: none"><li>-List the categories of information that should be included in a surveillance instrument. (C4)</li><li>-Interpret and summarize surveillance data. (C5)</li><li>-Discuss and recognize difficulties in balancing public health concerns with consumer and industry considerations in emerging issues. (C6)</li></ul>	
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## CURRICULUM

<b>Name of the Program</b>	MSc Clinical Virology													
<b>Course Title</b>	<b>Molecular Virology and Bioinformatics</b>													
<b>Course Code</b>	MIV504													
<b>Academic Year</b>	2021-2023													
<b>Semester</b>	II													
<b>Course credits</b>	<b>3</b>													
<b>Course Prerequisite</b>	First class/CGPA 6.5 at UG level (BSc Life Sciences/Health Sciences)													
<b>Course Synopsis</b>	The course will offer in-depth knowledge about nucleic acid extraction, different types of PCR and their principles, basic bioinformatic analysis.													
<b>Course Outcomes</b>	<p><b>CO 1:</b> Explain the various methods of nucleic acid extraction. (C2, P2)</p> <p><b>CO 2:</b> Demonstrate knowledge of application and interpretation of PCR. (C3, P2)</p> <p><b>CO 3:</b> Interpret the use of bioinformatic tools in molecular biology. (C2, P2)</p> <p><b>CO 4:</b> Recall methods of sequencing and molecular cloning. (C1)</p>													
<b>Mapping of COs to POs</b>														
<b>COs</b>	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>	<b>PO 9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>	<b>PO 13</b>	<b>PO 14</b>
<b>CO 1</b>	✓										✓			
<b>CO 2</b>	✓	✓	✓	✓	✓				✓	✓	✓			
<b>CO 3</b>	✓		✓		✓	✓				✓	✓			
<b>CO 4</b>	✓			✓		✓				✓	✓			
<b>Learning Strategies, Contact Hours and Student Learning Time (SLT)</b>	<b>LEARNING STRATEGY</b>										<b>CONTACT HOURS</b>		<b>SLT</b>	
	Lecture										30		90	
	Seminar										7		21	
	Small Group Discussion (SGD)										-		-	
	Self-directed learning (SDL)										5		15	



	Problem Based Learning (PBL)	3	15
	Case Based Learning (CBL)	-	-
	Clinic	-	-
	Practical	-	-
	Revision	-	-
	Assessment	1	-
	<b>TOTAL</b>	<b>47</b>	<b>135</b>
<b>Assessment Methods</b>	<b>FORMATIVE</b>		
	Assignment		
	Student presentation		
	Group discussion		
	<b>SUMMATIVE</b>		
	Mid semester exam		
	End semester exam		

<b>Mapping of assessment with COs</b>				
<i>Nature of assessment</i>	<b>CO 1</b>	<b>CO 2</b>	<b>CO 3</b>	<b>CO 4</b>
Assignments			✓	✓
Student presentations			✓	
Mid-semester examination	✓	✓		
End-semester examination	✓	✓	✓	✓
Practical examination	✓	✓	✓	✓

<b>Feedback Methods</b>	Student feedback on Course and Course master
<b>Reference Materials</b>	<ul style="list-style-type: none"> <li>• Molecular Cloning- A laboratory manual: Sambrook and Russell</li> <li>• Molecular Cloning- A laboratory manual: Green and Sambrook</li> <li>• Gene cloning and DNA analysis- An introduction: TA Brown</li> <li>• Essential bioinformatics – Jin Xiong</li> <li>• Bioinformatics sequence and genome analysis: David W Mount</li> </ul>



Course learning outcomes			
Content	Topics	Learning Outcomes	Hours (Lectures/Tutorials)
Unit 1	Nucleic acid amplification and sequencing	<ul style="list-style-type: none"> <li>Explain the principle and various methods of nucleic acid extraction. (C2)</li> <li>Demonstrate in-house and kit-based method of nucleic acid extraction. (C2, P2)</li> <li>Outline different types of PCR and explain the principles. (C2)</li> <li>Demonstrate conventional and real-time PCR. (C2, P2)</li> <li>Explain the methods of nucleic acid sequencing. (C2)</li> </ul>	6 / 4 = 10
Unit 2	Molecular diagnostic Virology	<ul style="list-style-type: none"> <li>Apply PCR tests for diagnosis of viral infections. (C3, P3)</li> <li>Interpret results of PCR. (C2, P2)</li> </ul>	6 / 3 = 9
Unit 3	Phage library and Reverse Genetics	<ul style="list-style-type: none"> <li>Explain phage library and its application. (C2)</li> <li>Explain reverse genetics and its application. (C2)</li> </ul>	2 / 1 = 3
Unit 4	Prokaryotic and Eukaryotic gene expression	<ul style="list-style-type: none"> <li>Explain the methods of prokaryotic and eukaryotic gene expression. (C2)</li> </ul>	2 / 1 = 3
Unit 5	Cloning and cloning Vectors, expression vectors	<ul style="list-style-type: none"> <li>Explain cloning and expression vectors. (C2)</li> </ul>	2 / 1 = 3
Unit 6	Introduction to biological databases	<ul style="list-style-type: none"> <li>Explain different types biological databases and applications. (C2)</li> </ul>	2 / 1 = 3
Unit 7	Bioinformatics software	<ul style="list-style-type: none"> <li>Apply bioinformatic software for sequence search, primer and probe designing, and sequence alignment. (C3, P2)</li> </ul>	2 / 1 = 3



<b>Unit 8</b>	Sequence analysis	<ul style="list-style-type: none"> <li>Experiment with nucleic acid sequence data. (C3)</li> </ul>	3 / 1 = 4
<b>Unit 9</b>	Phylogenetics	<ul style="list-style-type: none"> <li>Select and utilize different software for phylogenetic analysis. (C3, P2)</li> </ul>	3/ 1 = 4
<b>Unit 10</b>	Structure based approach in drug design, vaccine targets / virus attachment	<ul style="list-style-type: none"> <li>Select and utilize different software for drug design, vaccine targets / virus attachment. (C3, P2)</li> </ul>	2 / 1 = 3

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**CURRICULUM**

<b>Name of the Program</b>	MSc Clinical Virology
<b>Course Title</b>	<b>Virological Techniques</b>
<b>Course Code</b>	MIV506
<b>Semester</b>	II
<b>Course credits</b>	<b>3</b>
<b>Academic Year</b>	2021-2023
<b>Course Prerequisite</b>	First class/CGPA 6.5 at UG level (BSc Life Sciences/Health Sciences)
<b>Course Synopsis</b>	<ol style="list-style-type: none"> <li>1. This module helps to understand the basic virological techniques.</li> <li>2. To provide fundamental knowledge of various classical and modern virological techniques used for propagation and quantification of viruses in laboratory setting.</li> </ol>
<b>Course Outcomes</b>	<p><b>CO 1:</b> Explain the various methods of isolation and quantification of viruses. (C2, P3)</p> <p><b>CO 2:</b> Describe the various methods to detect virus growth. (C2)</p> <p><b>CO 3:</b> Distinguish the advantages and disadvantages of the different quantification and propagation methods. (C4)</p> <p><b>CO 4:</b> Explain the various assays for neutralization of viruses. (C2, P3)</p> <p><b>CO 5:</b> Evaluate the techniques for isolation, quantification and neutralization of viruses in lab. (C5, P3)</p> <p><b>CO 6:</b> Describe various ELISA techniques. (C2, P2)</p>

Mapping of COs to POs														
COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14
CO 1	✓					✓		✓			✓		✓	
CO 2	✓					✓					✓			
CO 3	✓		✓			✓					✓		✓	
CO 4	✓					✓					✓			



CO 5	✓					✓			✓		✓			
CO 6	✓			✓	✓	✓					✓			
<b>Learning Strategies, Contact Hours and Student Learning Time (SLT)</b>	<b>LEARNING STRATEGY</b>		<b>CONTACT HOUR</b>		<b>SLT</b>									
	Lecture		30		90									
	Seminar		10		30									
	Small Group Discussion (SGD)		1		3									
	Self-directed learning (SDL)		3		9									
	Problem Based Learning (PBL)		1		3									
	Case Based Learning (CBL)		-											
	Clinic		-											
	Practical		-		-									
	Revision		-											
	Assessment		1											
	<b>TOTAL</b>		<b>47</b>		<b>135</b>									
<b>Assessment Methods</b>	<b>FORMATIVE</b>		<b>SUMMATIVE</b>											
	Assignment		Mid semester exam											
	Student presentation		End semester exam											
	Group discussion													

<b>Mapping of assessment with COs</b>						
<i>Nature of assessment</i>	CO 1	CO 2	CO 3	CO 4	CO 5	CO 6
Assignments		✓				
Student presentations						✓
Mid-semester examination	✓	✓	✓			
End-semester examination	✓	✓	✓	✓	✓	✓
Practical examination	✓	✓	✓	✓	✓	✓

<b>Feedback Methods</b>	Student feedback on Course and Course master
<b>Main Reference</b>	<ul style="list-style-type: none"> <li>• Diagnostic procedures for Viral, Rickettsial, and Chlamydial Infections- E H Lennette et al.</li> <li>• Color Atlas of Virology- Versteeg J.</li> <li>• Primer Practical Manual in Classical Viral isolation Techniques- Roshan. J. et al.</li> <li>• Clinical Virology Manual, fourth edition - Specter S et al.</li> <li>• Clinical Microbiology procedures- Handbook- Isenberg</li> <li>• WHO/CDC Manual</li> </ul>



Course learning outcomes			
Content	Topics	Learning Outcomes	Hours (Lectures/Tutorials)
<b>Unit 1</b>	Propagation of Viruses - Animal inoculation, Chick - embryo inoculation, cell culture inoculation Detection of Virus growth - Cytopathic effect,	<ul style="list-style-type: none"> <li>• Discuss the various methods for isolation of viruses. (C3, P1)</li> <li>• Explain the advantages and disadvantages of various virus isolation methods. (C2)</li> <li>• Demonstrate virus isolation using cell culture. (C3, P3)</li> <li>• Identify the various cytopathic effects of viruses. (C3, P1)</li> </ul>	6 / 2 = 8
<b>Unit 2</b>	Quantitation of Viruses -TCID <sub>50</sub> , Hemagglutination assay, -Plaque assay	<ul style="list-style-type: none"> <li>• Describe the various methods for quantification of viruses. (C3, P1)</li> <li>• Discuss the advantages and disadvantages of the various quantification methods. (C2)</li> <li>• Practice the different virus quantification methods. (C3, P3)</li> <li>• Describe the principle and procedure for Hemagglutination assay. (C3, P3)</li> <li>• Explain the principle and procedure for Plaque assay. (C3, P3)</li> <li>• Discuss the principle and procedure for TCID<sub>50</sub> assay. (C3, P3)</li> </ul>	5 / 3 = 8
	Virus Neutralization Assay- Microneutralization Assay, Plaque reduction neutralization Assay	<ul style="list-style-type: none"> <li>• Describe the principle and procedure for Microneutralization Assay. (C2, P3)</li> <li>• Illustrate the applications of virus neutralization assay. (C3)</li> <li>• Describe the principle and procedure for Plaque</li> </ul>	5 / 2 = 7



		reduction neutralization Assay. (C3, P3)	
<b>Unit 3</b>	Hemagglutination Inhibition Assay (HAI)	<ul style="list-style-type: none"> <li>Describe the principle and procedure for Hemagglutination inhibition assay (C2, P3)</li> <li>Illustrate the applications of HAI. (C3)</li> </ul>	3 / 2 = 5
<b>Unit 4</b>	Complement fixation Assay	<ul style="list-style-type: none"> <li>Describe the technique of complement fixation. (C2)</li> </ul>	3 / 1 = 4
<b>Unit 5</b>	Virus Interference Assay	<ul style="list-style-type: none"> <li>Describe the technique of Virus Interference Assay. (C3)</li> </ul>	3 / 1 = 4
<b>Unit 6</b>	Immunofluorescence assay (IFA)	<ul style="list-style-type: none"> <li>Illustrate the steps for developing Immunofluorescence assay for the detection of IgG antibodies to measles virus. (C3, P3)</li> </ul>	3 / 2 = 5
<b>Unit 7</b>	Enzyme Linked Immunosorbent Assay (ELISA)	<ul style="list-style-type: none"> <li>Describe the principle of ELISA technique. (C2)</li> <li>Explain types of competitive and non-competitive ELISA's using appropriate diagrams. (C2, P3)</li> <li>Illustrate the applications of ELISA. (C3, P3)</li> </ul>	2 / 2 = 4







**Manipal Institute of Virology**

**CURRICULUM**

<b>Name of the Program</b>	MSc Clinical Virology
<b>Course Title</b>	<b>Insect vectors of Viral diseases</b>
<b>Course Code</b>	MIV508
<b>Academic Year</b>	2021-2023
<b>Semester</b>	II
<b>Course credits</b>	<b>3</b>
<b>Course Prerequisite</b>	First class/CGPA 6.5 at UG level (BSc Life Sciences/Health Sciences)
<b>Course Synopsis</b>	<ol style="list-style-type: none"> <li>1. To understand the basic concept of medical entomology, vector-borne disease (VBD) epidemiology and biology of arthropods.</li> <li>2. To understand the important VBD's transmission cycles, arthropod adaptation and diagnostic tools for VBD.</li> <li>3. To understand the taxonomy, surveillance methods and control programmes of important vectors.</li> <li>4. To understand the impact of climate and environment on proliferation of vectors and spread of VBDs.</li> </ol>
<b>Course Outcomes</b>	<p><b>CO 1:</b> Outline the basic terminologies of medical entomology and epidemiology. (C2)</p> <p><b>CO 2:</b> Explain biology and ecology of important arthropods. (C2)</p> <p><b>CO 3:</b> Explain the transmission cycle of important VBDs of India and its host adaptations. (C2)</p> <p><b>CO 4:</b> Outline the molecular and immunological tools for VBD detection in vectors. (C2)</p> <p><b>CO 5:</b> Explain the taxonomic classification and morphological characteristics of arthropods. (C2)</p> <p><b>CO 6:</b> Explain surveillance tools and control strategies of important public health vectors. (C2)</p> <p><b>CO 7:</b> Outline the impact of climate and environment on vector ecology. (C2)</p>



Mapping of COs to POs														
COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO 11	PO 12	PO 13	PO14
CO 1	✓										✓			
CO 2	✓										✓			
CO 3	✓		✓			✓		✓			✓			
CO 4	✓					✓					✓			
CO 5	✓										✓			
CO 6	✓		✓			✓					✓			
CO 7	✓		✓					✓			✓			
<b>Learning Strategies, Contact Hours and Student Learning Time (SLT)</b>	<b>LEARNING STRATEGY</b>		<b>CONTACT HOURS</b>		<b>SLT</b>									
	Lecture		15		45									
	Seminar		4		12									
	Small Group Discussion (SGD)		3		9									
	Self-directed learning (SDL)		2		6									
	Problem Based Learning (PBL)		-		-									
	Case Based Learning (CBL)		-		-									
	Clinic		-		-									
	Practical		30		90									
	Revision		2		6									
	Assessment		4		-									
	<b>TOTAL</b>		<b>75</b>		<b>213</b>									
<b>Assessment Methods</b>	<b>FORMATIVE</b>				<b>SUMMATIVE</b>									
	Assignment				Mid semester exam									
	Student presentation													
	Group discussion													

Mapping of assessment with COs							
Nature of assessment	CO 1	CO 2	CO 3	CO 4	CO 5	CO 6	CO 7
Assignments		✓	✓			✓	
Student presentations		✓	✓	✓	✓	✓	✓
Mid-semester examination	✓	✓	✓				
End-semester examination	x	x	x	x	x	x	x
Practical examination				✓	✓	✓	



<b>Feedback Methods</b>	Student feedback on Course and Course master
<b>Reference Materials</b>	<ul style="list-style-type: none"> <li>• Medical entomology for students – Mike William Service</li> <li>• Vector control: Methods for Use by Individuals and Communities – Jan A. Rozendaal</li> <li>• Guide to Entomology – Mike William Service</li> <li>• Medical Entomology: A Textbook on Public Health and Veterinary Problems Caused by Arthropods- B F Eldridge</li> </ul>

<b>Course learning outcomes</b>			
<b>Content</b>	<b>Topics</b>	<b>Learning Outcomes</b>	<b>Hours (Lectures/Tutorials + Practicals)</b>
<b>Unit 1</b>	Introduction to Medical Entomology	<ul style="list-style-type: none"> <li>• Outline the basic definitions and terminologies of medical Entomology and Epidemiology. (C2)</li> <li>• Explain the role of vectors in epidemiological trait. (C2)</li> <li>• List globally known arthropod vectors. (C1)</li> <li>• Classify different modes of vector-borne disease (VBD) transmission. (C2)</li> </ul>	1
<b>Unit 2</b>	Biology and ecology of medical important Arthropods	<ul style="list-style-type: none"> <li>• Explain the Life cycle, host seeking behaviour, resting behaviour, feeding behaviour, breeding Habitat types and Oviposition behaviour of Diptera (Mosquito, sandfly, tsetse fly, black fly and triatomine bug). (C2)</li> <li>• Explain the Life cycle, host seeking behaviour, resting behaviour, feeding behaviour, breeding Habitat types and Oviposition behaviour of Arachnids (Ticks and mites). (C2)</li> <li>• Explain the Life cycle, host seeking behaviour, resting behaviour, feeding behaviour, breeding Habitat types and Oviposition</li> </ul>	2 + 4 = 6



		behaviour of Siphonaptera. (Fleas) (C2)	
<b>Unit 3</b>	Common vector borne diseases	<ul style="list-style-type: none"> <li>Outline the global and national Importance of VBDs. (C2)</li> <li>Explain the transmission cycle, symptoms and treatment of Parasite origin VBDs (Malaria, Filariasis and Leishmaniasis). (C2)</li> <li>Explain the transmission cycle, symptoms, treatment, evolution and mutation of Arboviral origin VBDs (Dengue, Chikungunya, Japanese encephalitis, Kyasanur Forest Disease (KFD), West Nile, Crimean Congo Haemorrhagic fever (CCHF) and Yellow fever). (C2)</li> <li>Explain the transmission cycle, symptoms and treatment of Bacterial and rickettsial diseases. (C2)</li> <li>Outline the Interaction of Arboviruses with various hosts. (C2)</li> </ul>	3 + 6 = 9
<b>Unit 4</b>	Vector control programmes	<ul style="list-style-type: none"> <li>Outline the National Vector Borne-Disease Control Programmes of India. (C2)</li> <li>Explain the Malaria, Filaria and Kala-azar control strategies of India. (C2)</li> <li>Explain the Arbiviral control strategies of India. (C2)</li> </ul>	1 + 2 = 3
<b>Unit 5</b>	Vector surveillance	<ul style="list-style-type: none"> <li>Outline the arthropod Sampling methods. (C2)</li> <li>List the commonly used entomological measures. (C1)</li> <li>Outline the collection tools for various medically important arthropods (Mosquitoes, ticks, mites, sand flies, flea and other arthropods). (C2)</li> </ul>	2 + 20 = 22



		<ul style="list-style-type: none"> <li>• Demonstrate Adult mosquito collection tool. (C2)</li> <li>• Survey Mosquito Immature. (C4)</li> <li>• Demonstrate tick collection technique. (C2)</li> <li>• Explain the port surveillance and Xeno-monitoring. (C2)</li> <li>• Explain the VBD outbreak Investigation. (C2)</li> <li>• Utilize the Geographical information system (GIS) in vector Surveillance and control. (C3)</li> </ul>	
<b>Unit 6</b>	Arthropod taxonomy	<ul style="list-style-type: none"> <li>• Classify the taxonomy of Arthropoda. (C2)</li> <li>• Demonstrate morphological characterization of medically important arthropod species in India. (C2)</li> <li>• Identify morphology of Aedes mosquito. (C3)</li> <li>• Identify morphology of Culex mosquito. (C3)</li> <li>• Identify morphology of Ixodid ticks. (C3)</li> <li>• Explain molecular taxonomy and Preservation techniques of arthropods. (C2)</li> </ul>	2 + 10 = 12
<b>Unit 7</b>	Vector control	<ul style="list-style-type: none"> <li>• Outline the principles and types of vector control (Mechanical, Chemical, Biological, Environmental management and Transgenic insect technique). (C2)</li> <li>• Explain the integrated Vector Management (IVM), Insecticide resistance and management. (C2)</li> <li>• Explain personal protective measures against vectors. (C2)</li> </ul>	1 + 2 = 3
<b>Unit 8</b>	Diagnostics of vector-borne diseases	<ul style="list-style-type: none"> <li>• Demonstrate molecular diagnosis of VBDs (PCR and Sequencing). (C2)</li> </ul>	1 + 10 = 11



		<ul style="list-style-type: none"> <li>• Demonstrate Insect sample preparation and processing for molecular detection. (C2)</li> <li>• Demonstrate VBD immuno-diagnosis (ELISA, ICT, IFA and Neutralisation). (C2)</li> </ul>	
<b>Unit 9</b>	Impact of Environmental and Climatic on Vector ecology	<ul style="list-style-type: none"> <li>• Explain the inter-seasonal maintenance of arboviral diseases (C2)</li> <li>• Explain the impact of climatic changes on vector biodiversity and migration (C2)</li> <li>• Explain the impact of Pollution and Urbanization on Vector proliferation (C2)</li> <li>• Outline Emerging and re-emerging vector-borne diseases (C2)</li> <li>• Outline the notifiable diseases and Public health emergencies of international concern (PHEIC) (C2)</li> </ul>	2 + 6 = 8





Manipal Institute of Virology

## CURRICULUM

<b>Name of the Program</b>	MSc Clinical Virology														
<b>Course Title</b>	Disease related risk communication														
<b>Course Code</b>	MIV510														
<b>Academic Year</b>	2021-2023														
<b>Semester</b>	II														
<b>Course credits</b>	2														
<b>Course Prerequisite</b>	First class/CGPA 6.5 at UG level (BSc Life Sciences/Health Sciences)														
<b>Course Synopsis</b>	This module helps in the understanding of disease related risk communication.														
<b>Course Outcomes</b>	<p><b>CO 1:</b> Explain importance of emergency risk communication. (C2, P1)</p> <p><b>CO 2:</b> Summarize international health agreements. (C2)</p> <p><b>CO 3:</b> Outline risk communication strategies. (C2, P1)</p> <p><b>CO 4:</b> Explain Emergency risk communication (ERC) policy. (C2)</p> <p><b>CO 5:</b> Summarize systems approach to emergency risk communication. (C2)</p>														
<b>Mapping of COs to POs</b>															
<b>COs</b>	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>	<b>PO 9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>	<b>PO 13</b>	<b>PO 14</b>	
CO 1	✓	✓									✓				
CO 2	✓								✓		✓				
CO 3	✓	✓	✓					✓			✓	✓		✓	
CO 4	✓	✓	✓								✓				
CO 5	✓	✓	✓						✓		✓	✓		✓	
<b>Learning Strategies, Contact Hours and Student Learning Time (SLT)</b>	<b>LEARNING STRATEGY</b>										<b>CONTACT HOURS</b>		<b>SLT</b>		
	Lecture										15		45		
	Seminar										4		12		
	Small Group Discussion (SGD)										1		3		
	Self-directed learning (SDL)										10		30		



	Problem Based Learning (PBL)	-	-
	Case Based Learning (CBL)	-	-
	Clinic	-	-
	Practical	-	-
	Revision	-	-
	Assessment	2	-
	<b>TOTAL</b>	<b>32</b>	<b>90</b>
<b>Assessment Methods</b>	<b>FORMATIVE</b>	<b>SUMMATIVE</b>	
	Assignment	Mid semester exam	
	Student presentation		
	Group discussion		

<b>Mapping of assessment with COs</b>					
<i>Nature of assessment</i>	<b>CO 1</b>	<b>CO 2</b>	<b>CO 3</b>	<b>CO 4</b>	<b>CO 5</b>
Assignments				✓	
Student presentations			✓		
Mid-semester examination	✓	✓	✓		
End-semester examination	✗	✗	✗	✗	✗
Practical examination	✗	✗	✗	✗	✗

<b>Feedback Methods</b>	Student feedback on Course and Course master
<b>Reference Materials</b>	<ul style="list-style-type: none"> <li>• <a href="https://www.who.int/emergencies/risk-communications">https://www.who.int/emergencies/risk-communications</a></li> <li>• <a href="https://www.ncdc.gov.in/WriteReadData/l892s/File593.pdf">https://www.ncdc.gov.in/WriteReadData/l892s/File593.pdf</a></li> <li>• <a href="https://www.ecdc.europa.eu/en/health-communication/risk-communication">https://www.ecdc.europa.eu/en/health-communication/risk-communication</a></li> </ul>

<b>Course learning outcomes</b>			
<b>Content</b>	<b>Topics</b>	<b>Learning Outcomes</b>	<b>Hours (Lectures/Tutorials)</b>
<b>Unit 1</b>	Risk communication	<ul style="list-style-type: none"> <li>• Explain Emergency risk communication and the international health agreements. (C2, P1)</li> <li>• Infer building and maintaining trust. (C2)</li> <li>• Outline risk communication strategies. (C2, P1)</li> <li>• Illustrate public communication. (C2)</li> </ul>	8 / 7 = 15





		<ul style="list-style-type: none"> <li>• Demonstrate community engagement. (C2)</li> <li>• Show internal and external communication coordination. (C2)</li> <li>• Summarize dynamic listening and rumour management. (C2)</li> </ul>	
<b>Unit 2</b>	Risk communication capacities	<ul style="list-style-type: none"> <li>• Describe the systems approach to emergency risk communication. (C2)</li> <li>• Explain emergency risk communication (ERC) policy. (C2)</li> <li>• Illustrate strategies for emergency risk communication. (C2)</li> </ul>	7 / 8 = 15

MANIPAL INSTITUTE OF VIROLOGY, MAHE





Manipal Institute of Virology

**CURRICULUM**

<b>Name of the Program</b>	MSc Clinical Virology													
<b>Course Title</b>	<b>Emerging Viral Diseases and Public health response</b>													
<b>Course Code</b>	MIV512													
<b>Academic Year</b>	2021-2023													
<b>Semester</b>	II													
<b>Course credits</b>	<b>3</b>													
<b>Course Prerequisite</b>	First class/CGPA 6.5 at UG level (BSc Life Sciences/Health Sciences)													
<b>Course Synopsis</b>	This module helps in the understanding of emerging and re-emerging viral diseases of national and international concern.													
<b>Course Outcomes</b>	<p><b>CO 1:</b> Explain emerging and re-emerging viral diseases. (C2)</p> <p><b>CO 2:</b> Explain reasons for emergence and re-emergence of infectious viral diseases. (C2)</p> <p><b>CO 3:</b> Outline risk distribution of global emerging infectious diseases. (C2)</p> <p><b>CO 4:</b> Explain WHO's response to International Health Emergencies. (C2)</p> <p><b>CO 5:</b> Illustrate International Health Regulations. (C2)</p>													
<b>Mapping of COs to POs</b>														
<b>COs</b>	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>	<b>PO 9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>	<b>PO 13</b>	<b>PO 14</b>
<b>CO 1</b>	✓							✓			✓			
<b>CO 2</b>	✓		✓	✓				✓	✓		✓			
<b>CO 3</b>	✓										✓			
<b>CO 4</b>	✓							✓	✓		✓		✓	✓
<b>CO 5</b>	✓										✓			
<b>Learning Strategies, Contact Hours and Student Learning Time (SLT)</b>	<b>LEARNING STRATEGY</b>										<b>CONTACT HOURS</b>		<b>SLT</b>	
	Lecture										30		90	
	Seminar										5		15	
	Small Group Discussion (SGD)										3		9	



	Self-directed learning (SDL)	7	21
	Problem Based Learning (PBL)	-	-
	Case Based Learning (CBL)	-	-
	Clinic	-	-
	Practical	-	-
	Revision	-	-
	Assessment	2	-
	<b>TOTAL</b>	<b>47</b>	<b>135</b>
<b>Assessment Methods</b>	<b>FORMATIVE</b>	<b>SUMMATIVE</b>	
	Assignment	Mid semester exam	
	Student presentation	End semester exam	
	Group discussion		

<b>Mapping of assessment with COs</b>					
<i>Nature of assessment</i>	<b>CO 1</b>	<b>CO 2</b>	<b>CO 3</b>	<b>CO 4</b>	<b>CO 5</b>
Assignments	✓		✓		
Student presentations				✓	
Mid-semester examination	✓	✓	✓		
End-semester examination	✓	✓	✓	✓	✓
Practical examination	✗	✗	✗	✗	✗

<b>Feedback Methods</b>	Student feedback on Course and Course master
<b>Reference Materials</b>	<ul style="list-style-type: none"> <li>• <a href="https://www.ijmr.org.in/article.asp?issn=0971-5916;year=2019;volume=149;issue=4;spage=447;epage=467;aulast=Mourya">https://www.ijmr.org.in/article.asp?issn=0971-5916;year=2019;volume=149;issue=4;spage=447;epage=467;aulast=Mourya</a></li> <li>• <a href="https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3767269/">https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3767269/</a></li> <li>• <a href="https://www.who.int/zoonoses/diseases/en/">https://www.who.int/zoonoses/diseases/en/</a></li> <li>• <a href="https://www.pnas.org/content/97/23/12411">https://www.pnas.org/content/97/23/12411</a></li> </ul>



Course learning outcomes			
Content	Topics	Learning Outcomes	Hours (Lectures/Tutorials)
Unit 1	Emerging Viral Diseases	<ul style="list-style-type: none"> <li>Summarize emerging infectious diseases in the recent past. (C2)</li> <li>Outline emerging and re-emerging viral diseases in India. (C2)</li> <li>Explain the factors contributing to the emergence of viral diseases. (C2)</li> </ul>	5 / 5 = 10
Unit 2	Pandemic and epidemic-prone diseases	<ul style="list-style-type: none"> <li>Understanding the pandemic and epidemic-prone diseases. (C2)</li> </ul>	4/2 = 6
Unit 3	International Health Regulations	<ul style="list-style-type: none"> <li>Illustrate International Health Regulations. (C2)</li> </ul>	2 / 2 = 4
Unit 4	Public health response in Viral disease emergencies	<ul style="list-style-type: none"> <li>Summarize WHO's and ICMR's response to national and international health emergencies. (C2)</li> </ul>	4 / 6 = 10





Manipal Institute of Virology

## CURRICULUM

<b>Name of the Program</b>	MSc Clinical Virology
<b>Course Title</b>	<b>Practical II (Molecular and Virological Techniques)</b>
<b>Course Code</b>	<b>MIV514</b>
<b>Academic Year</b>	2021-2023
<b>Semester</b>	II
<b>Course credits</b>	<b>3</b>
<b>Course Prerequisite</b>	First class/CGPA 6.5 at UG level (BSc Life Sciences/Health Sciences)
<b>Course Synopsis</b>	<ol style="list-style-type: none"> <li>1. The course will offer in-depth knowledge about nucleic acid extraction, different types of PCR and their principles, basic bioinformatic analysis.</li> <li>2. This module also helps to understand the basic virological techniques.</li> <li>3. To provide fundamental knowledge of various classical and modern virological techniques used for propagation and quantification of viruses in laboratory setting.</li> </ol>
<b>Course Outcomes</b>	<p><b>Molecular techniques:</b></p> <p><b>CO 1:</b> Explain the various methods of nucleic acid extraction. (P2)</p> <p><b>CO 2:</b> Demonstrate knowledge of application and interpretation of PCR. (P2)</p> <p><b>CO 3:</b> Interpret the use of bioinformatic tools in molecular biology. (P2)</p> <p><b>Virological techniques:</b></p> <p><b>CO 4:</b> Explain the various methods of isolation and quantification of viruses. (P3)</p> <p><b>CO 5:</b> Explain the various assays for neutralization of viruses. (P3)</p> <p><b>CO 6:</b> Evaluate the techniques for isolation, quantification and neutralization of viruses in lab. (P3)</p> <p><b>CO 7:</b> Describe various ELISA techniques. (P2)</p>



Mapping of COs to POs (Molecular techniques)														
COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14
CO 1	✓										✓			
CO 2	✓	✓	✓	✓	✓				✓	✓	✓			
CO 3	✓		✓		✓	✓				✓	✓			

Mapping of COs to POs (Virological techniques)														
COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14
CO 4	✓					✓		✓			✓		✓	
CO 5	✓					✓					✓			
CO 6	✓					✓			✓		✓			
CO 7	✓			✓	✓	✓					✓			

**Learning Strategies,  
Contact Hours and  
Student Learning Time  
(SLT)**

LEARNING STRATEGY	CONTACT HOURS	SLT
Lecture		
Seminar		
Small Group Discussion (SGD)		
Self-directed learning (SDL)		
Problem Based Learning (PBL)		
Case Based Learning (CBL)		
Clinic		
Practical	90	270
Revision	-	-
Assessment	2	-
<b>TOTAL</b>	<b>92</b>	<b>270</b>

**Assessment Methods**

FORMATIVE	SUMMATIVE
Assessment of Record books	End semester exam
Internal Assessment	



<b>Feedback Methods</b>	Student feedback on Course and Course master
<b>Reference Materials</b>	<ul style="list-style-type: none"> <li>Refer to MIV504 and MIV506</li> </ul>

<b>Course learning outcomes (Molecular techniques)</b>			
<b>Content</b>	<b>Topics</b>	<b>Learning Outcomes</b>	<b>Practicals</b>
<b>Unit 1 (MIV504)</b>	Nucleic acid amplification and sequencing	<ul style="list-style-type: none"> <li>Explain the principle and various methods of nucleic acid extraction. (C2)</li> <li>Demonstrate in-house and kit-based method of nucleic acid extraction. (C2, P2)</li> <li>Outline different types of PCR and explain the principles. (C2)</li> <li>Demonstrate conventional and real-time PCR. (C2, P2)</li> <li>Explain the methods of nucleic acid sequencing. (C2)</li> </ul>	8
<b>Unit 2 (MIV504)</b>	Molecular diagnostic Virology	<ul style="list-style-type: none"> <li>Apply PCR tests for diagnosis of viral infections. (C3, P3)</li> <li>Interpret results of PCR. (C2, P2)</li> </ul>	7
<b>Unit 4 (MIV504)</b>	Prokaryotic and Eukaryotic gene expression	<ul style="list-style-type: none"> <li>Explain the methods of prokaryotic and eukaryotic gene expression. (C2)</li> </ul>	2
<b>Unit 5 (MIV504)</b>	Cloning and cloning Vectors, expression vectors	<ul style="list-style-type: none"> <li>Explain cloning and expression vectors. (C2)</li> </ul>	2
<b>Unit 6 (MIV504)</b>	Introduction to biological databases	<ul style="list-style-type: none"> <li>Explain different types biological databases and applications. (C2)</li> </ul>	2
<b>Unit 7 (MIV504)</b>	Bioinformatics software	<ul style="list-style-type: none"> <li>Apply bioinformatic software for sequence search, primer</li> </ul>	3



		and probe designing, and sequence alignment. (C3, P2)	
<b>Unit 8 (MIV504)</b>	Sequence analysis	<ul style="list-style-type: none"> <li>Experiment with nucleic acid sequence data. (C3)</li> </ul>	2
<b>Unit 9 (MIV504)</b>	Phylogenetics	<ul style="list-style-type: none"> <li>Select and utilize different software for phylogenetic analysis. (C3, P2)</li> </ul>	2
<b>Unit 10 (MIV504)</b>	Structure based approach in drug design, vaccine targets / virus attachment	<ul style="list-style-type: none"> <li>Select and utilize different software for drug design, vaccine targets / virus attachment. (C3, P2)</li> </ul>	2
<b>Course learning outcomes (Virological techniques)</b>			
<b>Content</b>	<b>Topics</b>	<b>Learning Outcomes</b>	<b>Hours (Practicals)</b>
<b>Unit 1 (MIV506)</b>	Propagation of Viruses - Animal inoculation, Chick - embryo inoculation, cell culture inoculation Detection of Virus growth - Cytopathic effect,	<ul style="list-style-type: none"> <li>Discuss the various methods for isolation of viruses. (C3, P1)</li> <li>Explain the advantages and disadvantages of various virus isolation methods. (C2)</li> <li>Demonstrate virus isolation using cell culture. (C3, P3)</li> <li>Identify the various cytopathic effects of viruses. (C3, P1)</li> </ul>	10
<b>Unit 2 (MIV506)</b>	Quantitation of Viruses -TCID <sub>50</sub> , Hemagglutination assay, -Plaque assay	<ul style="list-style-type: none"> <li>Describe the various methods for quantification of viruses. (C3, P1)</li> <li>Discuss the advantages and disadvantages of the various quantification methods. (C2)</li> <li>Practice the different virus quantification methods. (C3, P3)</li> <li>Describe the principle and procedure for Hemagglutination assay. (C3, P3)</li> <li>Explain the principle and procedure for Plaque assay. (C3, P3)</li> </ul>	10





		<ul style="list-style-type: none"> <li>• Discuss the principle and procedure for TCID<sub>50</sub> assay. (C3, P3)</li> </ul>	
	Virus Neutralization Assay- Microneutralization Assay, Plaque reduction neutralization Assay	<ul style="list-style-type: none"> <li>• Describe the principle and procedure for Microneutralization Assay. (C2, P3)</li> <li>• Illustrate the applications of virus neutralization assay. (C3)</li> <li>• Describe the principle and procedure for Plaque reduction neutralization Assay. (C3, P3)</li> </ul>	10
<b>Unit 3 (MIV506)</b>	Hemagglutination Inhibition Assay (HAI)	<ul style="list-style-type: none"> <li>• Describe the principle and procedure for Hemagglutination inhibition assay. (C2, P3)</li> <li>• Illustrate the applications of HAI. (C3)</li> </ul>	10
<b>Unit 6 (MIV506)</b>	Immunofluorescence assay (IFA)	<ul style="list-style-type: none"> <li>• Illustrate the steps for developing Immunofluorescence assay for the detection of IgG antibodies to measles virus. (C3, P3)</li> </ul>	10
<b>Unit 7 (MIV506)</b>	Enzyme Linked Immunosorbent Assay (ELISA)	<ul style="list-style-type: none"> <li>• Describe the principle of ELISA technique. (C2)</li> <li>• Explain types of competitive and non-competitive ELISA's using appropriate diagrams. (C2, P3)</li> <li>• Illustrate the applications of ELISA (C3, P3)</li> </ul>	10





Manipal Institute of Virology

CURRICULUM

<b>Name of Program</b>	MSc Clinical Virology
<b>Course Title</b>	<b>Laboratory Rotation - I</b>
<b>Course Code</b>	MIV516
<b>Academic Year</b>	2021-2023
<b>Semester</b>	II
<b>No. of credits</b>	<b>2</b>
<b>Course Prerequisite</b>	First class/CGPA 6.5 at UG level (BSc Life Sciences/Health Sciences)
<b>Course Synopsis</b>	This course will provide an overall view of the work flow in a diagnostic virology laboratory.
<b>Course outcomes</b>	<b>CO1: Outline the workflow in a diagnostic virology laboratory (C2)</b> <b>CO2: Recall and relate good laboratory practices (C2)</b> <b>CO3:</b>

Mapping of COs to POs

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PO 13	PO 14
CO 1	✓					✓			✓		✓			
CO 2	✓		✓			✓					✓		✓	

Learning Strategies, Contact Hours and Student Learning Time (SLT)	LEARNING STRATEGY	CONTACT HOUR	SLT
	Lecture	-	-
	Seminar	-	-
	Small Group Discussion (SGD)	-	-
	Self-directed learning (SDL)	-	-
	Problem Based Learning (PBL)	-	-
	Case Based Learning (CBL)	-	-
	Laboratory	60	180
	Practical	-	-
	Revision	-	-
	Assessment	1	
<b>TOTAL</b>	<b>61</b>	<b>180</b>	



<b>Assessment Methods</b>	<b>FORMATIVE</b>
	Assessment of Lab posting Log Books
	Internal Assessment- MCQs

<b>Feedback Methods</b>	Student feedback on Course and Course master
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<b>Course learning outcomes</b>			
<b>Posting</b>	<b>Sections</b>	<b>Learning Outcomes</b>	<b>Hours</b>
<b>1</b>	Serology	<ul style="list-style-type: none"> <li>Observe and understand the workflow in the diagnostic laboratory.</li> <li>Observe and understand the initial processing of clinical samples.</li> <li>Observe and understand the principle, methodology and technique of the different tests (serological, molecular and cell culture based) performed routinely in a diagnostic laboratory.</li> <li>Observe sample reception, barcoding and sample storage processes.</li> <li>Observe and understand the protocols of decontamination and discarding of biomedical waste.</li> </ul>	60 hours (12 hours in each section)
<b>2</b>	Sample processing and Extraction		
<b>3</b>	Molecular Diagnostics		
<b>4</b>	Tissue culture		
<b>5</b>	Sample reception, Barcoding, Sample Storage and Decontamination		



# THIRD SEMESTER

MANIPAL INSTITUTE OF VIROLOGY, MAHE





Manipal Institute of Virology

**CURRICULUM**

<b>Name of the Program</b>	MSc Clinical Virology													
<b>Course Title</b>	<b>Clinical &amp; Diagnostic Virology-I</b>													
<b>Course Code</b>	MIV601													
<b>Academic Year</b>	2021-2023													
<b>Semester</b>	III													
<b>Course credits</b>	<b>3</b>													
<b>Course Prerequisite</b>	First class/CGPA 6.5 at UG level (BSc Life Sciences/Health Sciences)													
<b>Course Synopsis</b>	<ol style="list-style-type: none"> <li>1. This module introduces to the principles of clinical and diagnostic virology.</li> <li>2. Differential diagnosis of various clinical presentations.</li> <li>3. To understand the syndromic approach towards diagnosis of viral infections.</li> <li>4. Understanding the diagnostic algorithms of various viral infections.</li> <li>5. Performing various tests required to diagnose various viral infections.</li> </ol>													
<b>Course Outcomes</b>	<p><b>CO 1:</b> Understand the basic concepts of clinical and diagnostic virology. (C1)</p> <p><b>CO 2:</b> Interpret &amp; infer information from patient case sheets from hospitals. (C2)</p> <p><b>CO 3:</b> Outline the clinical features of various clinical infections. (C2)</p> <p><b>CO 4:</b> Identify the differential diagnosis of various clinical presentations. (C3)</p> <p><b>CO 5:</b> Construct diagnostic algorithms of various viral infections. (C6)</p> <p><b>CO 6:</b> Demonstrate laboratory skills to perform various diagnostic tests. (C2, P5)</p> <p><b>CO 7:</b> Evaluate and discuss case studies in clinical virology. (C5)</p>													
<b>Mapping of COs to POs</b>														
<b>COs</b>	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>	<b>PO 9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>	<b>PO 13</b>	<b>PO 14</b>
<b>CO 1</b>	✓										✓			
<b>CO 2</b>	✓		✓					✓	✓		✓			



CO 3	✓									✓			
CO 4	✓		✓					✓	✓		✓		
CO 5	✓		✓	✓				✓	✓		✓		
CO 6	✓		✓	✓		✓			✓		✓	✓	
CO 7	✓		✓	✓				✓	✓		✓		
<b>Learning Strategies, Contact Hours and Student Learning Time (SLT)</b>		<b>LEARNING STRATEGY</b>				<b>CONTACT HOURS</b>				<b>SLT</b>			
		Lecture				45				135			
		Seminar				6				18			
		Small Group Discussion (SGD)				3				9			
		Self-directed learning (SDL)				2				6			
		Problem Based Learning (PBL)				2				6			
		Case Based Learning (CBL)				2				6			
		Clinic				-				-			
		Practical				-				-			
		Revision				-				-			
		Assessment				1				-			
		<b>TOTAL</b>				<b>61</b>				<b>180</b>			
<b>Assessment Methods</b>		<b>FORMATIVE</b>						<b>SUMMATIVE</b>					
		Assignment						Mid semester exam					
		Student presentation						End semester exam					
		Group discussion											

<b>Mapping of assessment with COs</b>							
<i>Nature of assessment</i>	CO 1	CO 2	CO 3	CO 4	CO 5	CO 6	CO 7
Assignments							✓
Student presentations		✓	✓	✓	✓		✓
Mid-semester examination	✓	✓	✓	✓			
End-semester examination	✓	✓	✓	✓	✓	✓	✓
Practical examination						✓	

<b>Feedback Methods</b>	Student feedback on Course and Course master
<b>Reference Materials</b>	<ul style="list-style-type: none"> <li>✓ Lennette's Laboratory diagnosis of viral infections (4<sup>th</sup> edition)</li> <li>✓ Harrison's Principles of Internal Medicine Vol. (19<sup>th</sup> edition)</li> <li>✓ Mandell, Douglas &amp; Bennett's Principles and Practice of Infectious Diseases (9<sup>th</sup> edition)</li> <li>✓ Ananthanarayan &amp; Panicker's Textbook of Microbiology (10<sup>th</sup> edition)</li> <li>✓ Principles &amp; Practice of Clinical Virology (6<sup>th</sup> edition)</li> </ul>



<b>Course learning outcomes</b>			
<b>Content</b>	<b>Topics</b>	<b>Learning Outcomes</b>	<b>Hours (Lectures/Tutorials + Practicals)</b>
<b>Unit 1</b>	Basic anatomy and physiology	<ul style="list-style-type: none"> <li>Recall basic concepts of human anatomy and physiology. (C1)</li> </ul>	5
<b>Unit 2</b>	Principles of Diagnostic Virology	<ul style="list-style-type: none"> <li>Illustrate clinical features of viral infections. (C2)</li> <li>Interpret case sheets from hospitals. (C2)</li> <li>Outline differential diagnoses of various clinical presentations. (C2)</li> </ul>	3
<b>Unit 3</b>	Collection, transport and processing of clinical samples	<ul style="list-style-type: none"> <li>Demonstrate various sample collection techniques. (C2)</li> <li>Demonstrate sample packaging and transportation techniques. (C2)</li> <li>Demonstrate sample processing techniques. (C2)</li> </ul>	2
<b>Unit 4</b>	Diagnostic algorithms and selection of assays, Disease kinetics, Syndromic approach.	<ul style="list-style-type: none"> <li>Summarize diagnostic algorithms of viral infections. (C2)</li> <li>Explain disease kinetics of viral infections. (C2)</li> <li>Explain syndromic approach for diagnosis of viral disease. (C2)</li> </ul>	2 / 1 = 3
<b>Unit 5</b>	Viral encephalitis / meningitis / meningoencephalitis - Etiology, epidemiology, laboratory diagnosis, management, prevention and control	<ul style="list-style-type: none"> <li>Explain viral encephalitis, meningitis and meningoencephalitis, illustrate their etiologies and clinical features. (C2)</li> <li>Explain epidemiology and pathogenesis of viruses causing encephalitis. (C2)</li> <li>Summarize diagnostic algorithm for lab diagnosis of viral encephalitis. (C2)</li> <li>Explain the management, prevention and control measures. (C2)</li> </ul>	5 / 2 = 7
<b>Unit 6</b>	Viral diarrhea / Viral food borne illness -	<ul style="list-style-type: none"> <li>Explain viral diarrhea and Viral food borne illness, illustrate</li> </ul>	5 / 2 = 7



	Etiology, epidemiology, laboratory diagnosis, management, prevention and control	<p>their etiologies and clinical features. (C2)</p> <ul style="list-style-type: none"> <li>• Explain epidemiology and pathogenesis of viruses causing diarrhea and food borne illness. (C2)</li> <li>• Summarize diagnostic algorithm for lab diagnosis of viral diarrhea and food borne illness. (C2)</li> <li>• Explain the management, prevention and control measures. (C2)</li> </ul>	
<b>Unit 7</b>	Exanthems; Etiology, epidemiology, laboratory diagnosis, management, prevention and control	<ul style="list-style-type: none"> <li>• Explain exanthems, illustrate their etiologies and clinical features. (C2)</li> <li>• Explain epidemiology and pathogenesis of viruses causing exanthems. (C2)</li> <li>• Summarize diagnostic algorithm for lab diagnosis of exanthems. (C2)</li> <li>• Explain the management, prevention and control measures. (C2)</li> </ul>	5 / 3 = 8
<b>Unit 8</b>	Rickettsial Diseases- Etiology, epidemiology, laboratory diagnosis, management, prevention and control	<ul style="list-style-type: none"> <li>• Explain Rickettsial diseases, illustrate their etiologies and clinical features. (C2)</li> <li>• Explain epidemiology and pathogenesis of viruses causing Rickettsial diseases. (C2)</li> <li>• Summarize diagnostic algorithm for lab diagnosis of Rickettsial diseases. (C2)</li> <li>• Explain the management, prevention and control measures. (C2)</li> </ul>	5 / 2 = 7
<b>Unit 9</b>	Congenital viral infections - Etiology, epidemiology, laboratory diagnosis, management,	<ul style="list-style-type: none"> <li>• Explain congenital viral infections, illustrate their etiologies and clinical features. (C2)</li> <li>• Explain epidemiology and pathogenesis of viruses causing congenital viral infections. (C2)</li> </ul>	5 / 2 = 7





	prevention and control	<ul style="list-style-type: none"> <li>• Summarize diagnostic algorithm for lab diagnosis of congenital viral infections. (C2)</li> <li>• Explain the management, prevention and control measures. (C2)</li> </ul>	
<b>Unit 10</b>	Viral haemorrhagic fevers - Etiology, epidemiology, laboratory diagnosis, management, prevention and control	<ul style="list-style-type: none"> <li>• Explain viral haemorrhagic fevers, illustrate their etiologies and clinical features. (C2)</li> <li>• Explain epidemiology and pathogenesis of viruses causing viral haemorrhagic fevers. (C2)</li> <li>• Summarize diagnostic algorithm for lab diagnosis of viral haemorrhagic fevers. (C2)</li> <li>• Explain the management, prevention and control measures. (C2)</li> </ul>	5 / 2 = 7
<b>Unit 11</b>	Quality control in Diagnostic Virology laboratory	<ul style="list-style-type: none"> <li>• Explain quality control measures in diagnostic virology (molecular and serology). (C2)</li> </ul>	3 / 1 = 4





**Manipal Institute of Virology**

**CURRICULUM**

<b>Name of the Program</b>	MSc Clinical Virology
<b>Course Title</b>	<b>Clinical &amp; Diagnostic Virology-II</b>
<b>Course Code</b>	MIV603
<b>Academic Year</b>	2021-2023
<b>Semester</b>	III
<b>Course credits</b>	<b>3</b>
<b>Course Prerequisite</b>	First class/CGPA 6.5 at UG level (BSc Life Sciences/Health Sciences)
<b>Course Synopsis</b>	<ol style="list-style-type: none"> <li>1. The course will familiarise students with advanced clinical and diagnostic virology.</li> <li>2. The course will impart the knowledge of differential diagnosis of various clinical presentations.</li> <li>3. The course will enable students to understand the syndromic approach towards diagnosis of viral infections and make diagnostic algorithms of various viral infections.</li> <li>4. The course will enable students to perform various tests required to diagnose various viral infections and selected bacterial infections.</li> <li>5. The course will make students aware about emerging infectious diseases.</li> <li>6. Students will learn about the zoonotic infections and concept of one health.</li> </ol>
<b>Course Outcomes</b>	<p><b>CO 1:</b> Understand the concepts of clinical and diagnostic virology. (C1)</p> <p><b>CO 2:</b> Interpret &amp; infer information from patient case sheets from hospitals. (C2)</p> <p><b>CO 3:</b> Outline the clinical features of various clinical infections. (C2)</p> <p><b>CO 4:</b> Apply syndromic approach in differential diagnosis of various clinical presentations. (C3)</p> <p><b>CO 5:</b> Construct diagnostic algorithms of various viral infections. (C6)</p> <p><b>CO 6:</b> Demonstrate laboratory skills to perform various diagnostic tests. (C2, P5)</p> <p><b>CO 7:</b> Evaluate and discuss case studies in clinical virology. (C5)</p>



Mapping of COs to POs															
COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO1 3	PO1 4	
CO 1	✓										✓				
CO 2	✓		✓					✓	✓		✓				
CO 3	✓										✓				
CO 4	✓		✓					✓	✓		✓				
CO 5	✓		✓	✓				✓	✓		✓				
CO 6	✓		✓	✓		✓			✓		✓		✓		
CO 7	✓		✓	✓				✓	✓		✓				
<b>Learning Strategies, Contact Hours and Student Learning Time (SLT)</b>	<b>LEARNING STRATEGY</b>			<b>CONTACT HOURS</b>			<b>SLT</b>								
	Lecture			45			135								
	Seminar			6			18								
	Small Group Discussion (SGD)			3			9								
	Self-directed learning (SDL)			2			6								
	Problem Based Learning (PBL)			2			6								
	Case Based Learning (CBL)			2			6								
	Clinic			-			-								
	Practical			-			-								
	Revision			-			-								
	Assessment			1			-								
	<b>TOTAL</b>			<b>61</b>			<b>180</b>								
<b>Assessment Methods</b>	<b>FORMATIVE</b>					<b>SUMMATIVE</b>									
	Assignment					Mid semester exam									
	Student presentation					End semester exam									
	Group discussion														

Mapping of assessment with COs							
Nature of assessment	CO 1	CO 2	CO 3	CO 4	CO 5	CO 6	CO 7
Assignments							✓
Student presentations		✓	✓	✓	✓		✓
Mid-semester examination	✓	✓	✓	✓			
End-semester examination	✓	✓	✓	✓	✓	✓	✓
Practical examination						✓	



<b>Feedback Methods</b>	Student feedback on Course and Course master
<b>Reference Materials</b>	<ul style="list-style-type: none"> <li>✓ Lennette's Laboratory diagnosis of viral infections (4<sup>th</sup> edition)</li> <li>✓ Harrison's Principles of Internal Medicine Vol. (19<sup>th</sup> edition)</li> <li>✓ Mandell, Douglas &amp; Bennett's Principles and Practice of Infectious Diseases (9<sup>th</sup> edition)</li> <li>✓ Ananthanarayan &amp; Panicker's Textbook of Microbiology (10<sup>th</sup> edition)</li> <li>✓ Principles &amp; Practice of Clinical Virology (6<sup>th</sup> edition)</li> </ul>

<b>Course learning outcomes</b>			
<b>Content</b>	<b>Topics</b>	<b>Learning Outcomes</b>	<b>Hours (Lectures/Tutorials + Practicals)</b>
<b>Unit 1</b>	Viral infections of Respiratory tract- Etiology, epidemiology, laboratory diagnosis, management, prevention and control	<ul style="list-style-type: none"> <li>• Explain viral infections of respiratory tract, illustrate their etiologies and clinical features. (C2)</li> <li>• Explain epidemiology and pathogenesis of viruses causing infections of respiratory tract. (C2)</li> <li>• Summarize diagnostic algorithm for lab diagnosis of viral infections of respiratory tract. (C2)</li> <li>• Explain the management, prevention and control measures. (C2)</li> </ul>	7 / 3 = 10
<b>Unit 2</b>	Viral STIs including HIV; Chlamydia - Etiology, epidemiology, laboratory diagnosis, management, prevention and control	<ul style="list-style-type: none"> <li>• Explain viral STIs, illustrate their etiologies and clinical features. (C2)</li> <li>• Explain epidemiology and pathogenesis of viruses causing STIs. (C2)</li> <li>• Summarize diagnostic algorithm for lab diagnosis of viral STIs. (C2)</li> <li>• Explain the management, prevention and control measures. (C2)</li> </ul>	7 / 2 = 9



<b>Unit 3</b>	Human Retroviruses Except HIV- Etiology, epidemiology, laboratory diagnosis, management, prevention and control	<ul style="list-style-type: none"> <li>• Explain diseases caused by human retroviruses, illustrate their etiologies and clinical features. (C2)</li> <li>• Explain epidemiology and pathogenesis of human retroviruses. (C2)</li> <li>• Summarize diagnostic algorithm for lab diagnosis of viral infections caused by human retroviruses. (C2)</li> <li>• Explain the management, prevention and control measures. (C2)</li> </ul>	7 / 2 = 9
<b>Unit 4</b>	Viruses and cancer - Etiology, epidemiology, laboratory diagnosis, management, prevention and control	<ul style="list-style-type: none"> <li>• Explain cancers caused by viruses, illustrate their etiologies and clinical features. (C2)</li> <li>• Explain epidemiology and pathogenesis of viruses causing cancers. (C2)</li> <li>• Summarize diagnostic algorithm for lab diagnosis of cancers caused by viruses. (C2)</li> <li>• Explain the management, prevention and control measures. (C2)</li> </ul>	7 / 2 = 9
<b>Unit 5</b>	Slow Viral diseases - Etiology, epidemiology, laboratory diagnosis, management, prevention and control	<ul style="list-style-type: none"> <li>• Explain slow viral diseases, illustrate their etiologies and clinical features. (C2)</li> <li>• Explain epidemiology and pathogenesis of viruses causing slow viral diseases. (C2)</li> <li>• Summarize diagnostic algorithm for lab diagnosis of slow viral diseases. (C2)</li> <li>• Explain the management, prevention and control measures. (C2)</li> </ul>	7 / 2 = 9
<b>Unit 6</b>	Prion Diseases- Etiology, epidemiology,	<ul style="list-style-type: none"> <li>• Explain prion diseases, illustrate their etiologies and clinical features. (C2)</li> </ul>	6 / 2 = 8



	laboratory diagnosis, management, prevention and control	<ul style="list-style-type: none"> <li>• Explain epidemiology and pathogenesis of viruses causing prion diseases. (C2)</li> <li>• Summarize diagnostic algorithm for lab diagnosis of prion diseases. (C2)</li> <li>• Explain the management, prevention and control measures. (C2)</li> </ul>	
<b>Unit 7</b>	Zoonotic Viral infections - Etiology, epidemiology, laboratory diagnosis, management, prevention and control	<ul style="list-style-type: none"> <li>• Explain zoonotic viral infections, illustrate their etiologies and clinical features. (C2)</li> <li>• Explain epidemiology and pathogenesis of viruses causing zoonotic viral infections. (C2)</li> <li>• Summarize diagnostic algorithm for lab diagnosis of viral infections of zoonotic origin. (C2)</li> <li>• Explain the management, prevention and control measures. (C2)</li> </ul>	4 / 2 = 6





**Manipal Institute of Virology**

**CURRICULUM**

<b>Name of the Program</b>	MSc Clinical Virology
<b>Course Title</b>	<b>Viral Vaccines &amp; Anti-Viral Pharmacotherapy</b>
<b>Course Code</b>	MIV605
<b>Academic Year</b>	2021-2023
<b>Semester</b>	III
<b>Course credits</b>	<b>4</b>
<b>Course Prerequisite</b>	First class/CGPA 6.5 at UG level (BSc Life Sciences/Health Sciences)
<b>Course Synopsis</b>	<ol style="list-style-type: none"> <li>1. The course will offer an overview of viral vaccines.</li> <li>2. The course will describe the history of vaccine, viral vaccines, types, and newer technologies.</li> <li>3. The course will offer an overview of antiviral therapeutics.</li> <li>4. The course will describe the history of antivirals, types and newer technologies in antiviral drug discovery.</li> </ol>
<b>Course Outcomes</b>	<p><b>CO 1:</b> Outline the historical events in vaccine development, basic principles of vaccination and various types of viral vaccines available. (C2)</p> <p><b>CO 2:</b> Explain the mechanism of action of various viral vaccines and comment on their dosage, side effects, immune response provoked, etc. (C2)</p> <p><b>CO 3:</b> Explain the newer technologies available, challenges faced in vaccine development, industrial production of vaccines and ways to perform quality check on vaccines. (C2)</p> <p><b>CO 4:</b> Analyse and interpret scientific journal and learn to present scientific work with an emphasis on public communication skills. (C4)</p> <p><b>CO 5:</b> Explain the principles of anti-viral therapy and classify the various anti-viral drugs.</p> <p><b>CO 6:</b> Illustrate the indications, dosage forms, side effects, contraindications etc. of various anti-viral drugs. (C2)</p> <p><b>CO 7:</b> Summarize the newer technologies available, challenges faced in anti-viral drug development, manufacturing of drugs and ways to perform quality check. (C2)</p> <p><b>CO 8:</b> Illustrate anti-viral susceptibility testing methods and explain anti-viral drug resistance. (C2)</p>



Mapping of COs to POs															
COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14	
CO 1	✓										✓				
CO 2	✓		✓			✓		✓	✓		✓				
CO 3	✓		✓			✓		✓			✓		✓		
CO 4	✓	✓						✓	✓		✓				
CO 5	✓	✓							✓		✓				
CO 6	✓	✓							✓		✓				
CO 7	✓	✓			✓	✓	✓	✓	✓		✓		✓		
CO 8	✓	✓				✓	✓	✓	✓		✓				
Learning Strategies, Contact Hours and Student Learning Time (SLT)	<b>LEARNING STRATEGY</b>		<b>CONTACT HOURS</b>		<b>SLT</b>										
	Lecture		20		60										
	Seminar		30		90										
	Small Group Discussion (SGD)		3		9										
	Self-directed learning (SDL)		7		21										
	Problem Based Learning (PBL)		-		-										
	Case Based Learning (CBL)		-		-										
	Clinic		-		-										
	Practical		-		-										
	Revision		-		-										
	Assessment		2		-										
<b>TOTAL</b>		<b>62</b>		<b>180</b>											
Assessment Methods	<b>FORMATIVE</b>					<b>SUMMATIVE</b>									
	Assignment					Mid semester exam									
	Student presentation					End semester exam									
	Group discussion														

Mapping of assessment with course outcomes								
Nature of assessment	CO 1	CO 2	CO 3	CO 4	CO 5	CO 6	CO 7	CO 8
Assignments			✓		✓		✓	✓
Student presentations		✓	✓		✓			
Mid-semester examination	✓	✓			✓	✓	✓	
End-semester examination	✓	✓	✓		✓	✓	✓	✓
Practical examination	x	x	x	x	x	x	x	x





<b>Feedback Methods</b>	Student feedback on Course and Course master
<b>Reference Materials</b>	<ul style="list-style-type: none"> <li>• Vaccines, 6th &amp; 7th edition - Stanley Plotkin, Walter Orenstein, Paul Offit</li> <li>• <a href="https://www.who.int/topics/vaccines/en/">https://www.who.int/topics/vaccines/en/</a></li> <li>• <a href="https://www.cdc.gov/vaccines/pubs/pinkbook/prinvac.html">https://www.cdc.gov/vaccines/pubs/pinkbook/prinvac.html</a></li> <li>• <a href="https://www.pnas.org/content/pnas/111/34/12283.full.pdf">https://www.pnas.org/content/pnas/111/34/12283.full.pdf</a></li> </ul>

<b>Course learning outcomes</b>			
<b>Content</b>	<b>Topics</b>	<b>Learning Outcomes</b>	<b>Hours (Lectures/Tutorials)</b>
<b>Unit 1</b>	History, principles and types of vaccine	<ul style="list-style-type: none"> <li>• Outline the historical events in vaccine development. (C2)</li> <li>• Explain the basic principle of vaccination. (C2)</li> <li>• Classify the types of viral vaccines available. (C2)</li> <li>• Explain different types of immune response triggered in a host by various types of vaccines. (C2)</li> <li>• Summarise the national immunisation schedule India 2020. (C2)</li> </ul>	3
<b>Unit 2: Viral vaccine-case studies</b>	Measles, Mumps and Rubella	<ul style="list-style-type: none"> <li>• Outline the history of Measles, Mumps and Rubella vaccines and controversy related to MMR vaccine. (C2)</li> <li>• Explain the types of vaccine available for Measles, Mumps and Rubella. (C2)</li> <li>• Demonstrate the mechanism of action, the immune response induced, side effects if any and dosage of MMR vaccine respectively. (C2)</li> <li>• List the approved vaccines and vaccines under trials for Measles, Mumps and Rubella. (C1)</li> </ul>	2
	Dengue and Zika	<ul style="list-style-type: none"> <li>• Outline the history of Dengue vaccine and make a note on Philippines event. (C2)</li> </ul>	2



		<ul style="list-style-type: none"> <li>• Outline the history of Zika virus vaccine. (C1)</li> <li>• Explain the types of vaccines available for Dengue and Zika. (C2)</li> <li>• Demonstrate the mechanism of action, the immune response induced, side effects if any and dosage of Zika and Dengue vaccine respectively. (C2)</li> <li>• List the approved vaccines and vaccines under trials for Zika and Dengue. (C1)</li> <li>• Explain the challenges faced in development of Dengue vaccine. (C2)</li> </ul>	
	HAV, HBV and HEV	<ul style="list-style-type: none"> <li>• Outline the history of Hepatitis A Virus (HAV), Hepatitis B Virus (HBV) and Hepatitis E Virus (HEV) vaccine. (C2)</li> <li>• Explain the types of vaccines available for HAV, HBV and HEV. (C2)</li> <li>• Demonstrate the mechanism of action, the immune response induced, side effects if any and dosage of HAV, HEV and HBV vaccine respectively. (C2)</li> <li>• List the approved vaccine and vaccines under trials for HAV, HEV and HBV. (C1)</li> </ul>	2
	Influenza and HPV	<ul style="list-style-type: none"> <li>• Outline the long history of Influenza vaccines and explain the need for a flu shot every year. (C2)</li> <li>• Outline the history of Human Papillomavirus (HPV) vaccine and controversies related to it. (C2)</li> <li>• Explain the types of vaccines available for Influenza and HPV. (C2)</li> </ul>	2



		<ul style="list-style-type: none"> <li>• Demonstrate the mechanism of action, the immune response induced, side effects if any and dosage for Influenza and HPV vaccine respectively. (C2)</li> <li>• List the approved vaccine and vaccines under trials for Influenza and HPV. (C1)</li> </ul>	
	Rota and Rabies	<ul style="list-style-type: none"> <li>• Outline the history of Rotavirus vaccines and controversies related to it. (C2)</li> <li>• Outline the history of Rabies vaccine. (C2)</li> <li>• Explain the types of vaccines available for Rota and Rabies. (C2)</li> <li>• Demonstrate the mechanism of action, the immune response induced, side effects if any and dosage for Rota and Rabies vaccine respectively. (C2)</li> <li>• List the approved vaccines and vaccines under trial for Rota and Rabies. (C1)</li> <li>• Summarize the post-exposure prophylaxis of Rabies. (C2)</li> </ul>	2
	KFD and JEV	<ul style="list-style-type: none"> <li>• Outline the history of Kyasanur Forest Disease (KFD) and Japanese Encephalitis Virus (JEV) vaccines. (C2)</li> <li>• Explain the types of vaccines available for KFD and JEV. (C2)</li> <li>• Demonstrate the mechanism of action, the immune response induced, side effects if any and dosage of KFD and JEV vaccine respectively. (C2)</li> <li>• List the approved vaccines and vaccines under trial for KFD and JEV. (C1)</li> </ul>	2



	Polio and VZV	<ul style="list-style-type: none"> <li>• Outline the history of Polio vaccine and controversies related to it. (C2)</li> <li>• Outline the history of Varicella-Zoster Virus vaccine (VZV). (C2)</li> <li>• Explain the types of vaccines available for Polio and VZV. (C2)</li> <li>• Demonstrate the mechanism of action, the immune response induced, side effects if any and dosage of Polio and VZV vaccines respectively. (C2)</li> <li>• List the approved vaccines and vaccines under trial for Polio and VZV. (C1)</li> </ul>	2
	Ebola and Smallpox	<ul style="list-style-type: none"> <li>• Outline the history of Smallpox vaccine. (C1)</li> <li>• Outline the history of Ebola virus vaccine. (C1)</li> <li>• Explain the types of vaccines available for Smallpox and Ebola virus. (C2)</li> <li>• Demonstrate the mechanism of action, the immune response induced, side effects if any and dosage for Ebola and Smallpox vaccines. (C2)</li> <li>• List the approved vaccines and vaccines under trial for Ebola and Smallpox. (C1)</li> </ul>	2
	HIV	<ul style="list-style-type: none"> <li>• Outline the history of HIV vaccines. (C1)</li> <li>• Explain the types of vaccines available for HIV. (C2)</li> <li>• Demonstrate the mechanism of action, immune response induced, side effects if any and dosage for HIV vaccine. (C2)</li> <li>• List the approved vaccines and vaccines under trial for HIV. (C1)</li> </ul>	2



		<ul style="list-style-type: none"> <li>• Explain the challenges faced to develop a vaccine for HIV. (C2)</li> </ul>	
	SARS CoV-2	<ul style="list-style-type: none"> <li>• Explain the different types of vaccines developed/ being developed for SARS-CoV-2. (C2)</li> <li>• Demonstrate the mechanism of action, the immune response induced, side effects if any and dosage for SARS-CoV-2 vaccine. (C2)</li> <li>• List the vaccines that have completed the clinical trials. (C1)</li> </ul>	2
<b>Unit 3</b>	Newer technologies, challenges and vaccine trial	<ul style="list-style-type: none"> <li>• Demonstrate the different new technologies that have been used in recent years or the ones that can be used for vaccine development. (C2)</li> <li>• Explain the challenges faced in the development of a vaccine. (C2)</li> <li>• Outline the various steps involved in vaccine trials. (C2)</li> <li>• Explain in brief about each phase involved in vaccine trials. (C2)</li> </ul>	2 / 1 = 3
<b>Unit 4</b>	Industrial production and quality checking of vaccines	<ul style="list-style-type: none"> <li>• Demonstrate the process of industrial production of vaccines. (C2)</li> <li>• Explain in brief the different techniques used at various stages of vaccine production for conducting quality check. (C2)</li> </ul>	2/ 1 = 3
<b>Unit 5</b>	Introduction and Antiviral drugs - classification	<ul style="list-style-type: none"> <li>• Outline concept of antiviral therapy and historical perspectives. (C2)</li> <li>• Translate process of antiviral drug development. (C2)</li> <li>• Classify antiviral drugs based upon their site of attack on viral replication cycle. (C2)</li> </ul>	3/1 =4



<p><b>Unit 6</b></p>	<p>Mechanism of action, therapeutic indications, adverse side effects of anti-viral drugs and potential drug interactions</p>	<ul style="list-style-type: none"> <li>• Explain mechanism and therapeutic actions of different antiviral drugs. (C2)</li> <li>• Illustrate different antiviral dosage forms. (C2)</li> <li>• Summarize adverse side effects, potential drug interactions and contraindications. (C2)</li> </ul>	<p>3/1 = 4</p>
<p><b>Unit 7</b></p>	<p>Antiviral susceptibility testing methods and Antiviral drug resistance</p>	<ul style="list-style-type: none"> <li>• Describe the different antiviral susceptibility testing methods. (C2)</li> <li>• Explain antiviral drug resistance. (C2)</li> <li>• Illustrate the factors contributing to antiviral drug resistance. (C2)</li> </ul>	<p>3/1 = 4</p>
<p><b>Unit 8</b></p>	<p>Emerging trends, challenges and prospects in antiviral research with a focus on ongoing antiviral drug trials and newer drugs in pipeline</p>	<ul style="list-style-type: none"> <li>• Summarize trends, challenges and prospects in antiviral drug discovery and development. (C2)</li> <li>• Outline antiviral drug trials and drugs in pipeline. (C2)</li> </ul>	<p>2/1 = 3</p>





Manipal Institute of Virology

**CURRICULUM**

<b>Name of the Program</b>	MSc Clinical Virology
<b>Course Title</b>	<b>Application of GIS in viral disease epidemiology</b>
<b>Course Code</b>	MIV607
<b>Academic Year</b>	2021-2023
<b>Semester</b>	III
<b>Course credits</b>	<b>2</b>
<b>Course Prerequisite</b>	First class/CGPA 6.5 at UG level (BSc Life Sciences/Health Sciences)
<b>Course Synopsis</b>	<ol style="list-style-type: none"> <li>1. To understand basic concepts of Geographical Information System (GIS).</li> <li>2. To know the different types of data formats used in GIS.</li> <li>3. To understand the methods of spatial analysis and its interpretations.</li> <li>4. To support the students to utilize and apply GIS concepts in viral disease epidemiology.</li> </ol>
<b>Course Outcomes</b>	<p><b>CO 1:</b> Outline the basic concepts of GIS, History of mapping, geo co-ordinate system and software. (C2)</p> <p><b>CO 2:</b> Classify different types of data formats used in GIS. (C2)</p> <p><b>CO 3:</b> Analyse the distribution, dependency, and interaction between spatial data. (C4)</p> <p><b>CO 4:</b> Interpret the output of spatial analysis performed in GIS. (C2)</p> <p><b>CO 5:</b> Illustrate the applications of GIS in viral disease epidemiology. (C2)</p>

**Mapping of COs to POs**

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14
CO 1	✓									✓	✓		✓	
CO 2	✓		✓	✓						✓	✓			
CO 3	✓		✓			✓			✓	✓	✓			



CO 4	✓			✓					✓	✓	✓			
CO 5	✓		✓			✓			✓	✓	✓			
<b>Learning Strategies, Contact Hours and Student Learning Time (SLT)</b>	<b>LEARNING STRATEGY</b>		<b>CONTACT HOURS</b>		<b>SLT</b>									
	Lecture		10		30									
	Seminar		3		9									
	Small Group Discussion (SGD)		2		6									
	Self-directed learning (SDL)		6		18									
	Problem Based Learning (PBL)		-		-									
	Case Based Learning (CBL)		2		6									
	Clinic		-		-									
	Practical		6		18									
	Revision		-		-									
	Assessment		2		-									
<b>TOTAL</b>		<b>31</b>		<b>87</b>										
<b>Assessment Methods</b>	<b>FORMATIVE</b>				<b>SUMMATIVE</b>									
	Assignment				Mid semester exam									
	Student presentation													
	Group discussion													

<b>Mapping of assessment with COs</b>					
<i>Nature of assessment</i>	CO 1	CO 2	CO 3	CO 4	CO 5
Assignments			✓		✓
Student presentations		✓	✓	✓	✓
Mid-semester examination	✓	✓	✓		
End-semester examination	x	x	x	x	x
Practical examination		✓	✓	✓	✓

<b>Feedback Methods</b>	Student feedback on Course and Course master
<b>Reference Materials</b>	<ul style="list-style-type: none"> <li>• GIS tutorial for Health - Kristen S. Kurland</li> <li>• Understanding GIS – Christian Harder</li> <li>• Fundamentals of GIS – Nick Santos (UC DAVIS)</li> </ul>





Course learning outcomes			
Content	Topics	Learning Outcomes	Hours (Lectures/ Tutorials + Practicals)
Unit 1	Basic concepts of GIS	<ul style="list-style-type: none"> <li>Define Geographical information system. (C1)</li> <li>Recall the history of mapping and John snow's work on Cholera. (C1)</li> <li>Explain the fundamental of Geo-Positioning System (GPS). (C2)</li> <li>List of different GIS software available. (C1)</li> <li>Outline the applications of GIS in public health. (C2)</li> </ul>	1
Unit 2	GIS Data formats and Vector data	<ul style="list-style-type: none"> <li>Explain Vector, Raster, shapefile, excels, textfile, etc..., with examples. (C2)</li> <li>Demonstrate the user interface of ArcGIS software package. (C2)</li> <li>Explain point data, line data and polygon data with examples. (C2)</li> </ul>	1+1 = 2
Unit 3	Raster Data	<ul style="list-style-type: none"> <li>Explain raster data with example. (C2)</li> <li>Demonstrate the base map, surface map and thematic map. (C2)</li> </ul>	1+1 = 2
Unit 4	Common tools used in ArcGIS and Attribute table	<ul style="list-style-type: none"> <li>List common tools used in ArcGIS .(C1)</li> <li>Demonstrate the "Add data" tool, "Folder connection" and "Layers". (C2)</li> <li>Demonstrate the "Edit", "Selection", "Join", "draw", "Display XY", "Export" and "Merge" tools. (C2)</li> <li>Demonstrate the "Properties" tab. (C2)</li> <li>Define Attribute table. (C1)</li> </ul>	2 + 1 = 3



		<ul style="list-style-type: none"> <li>Outline the ways to create, add and edit columns in attribute table. (C2)</li> </ul>	
<b>Unit 5</b>	Symbology and label	<ul style="list-style-type: none"> <li>Define “Symbology” tab. (C1)</li> <li>Demonstrate “Quantitative” symbology (Graduated colours, symbols, and Dot density). (C2)</li> <li>Demonstrate “Chart” symbology (Pie, Bar, Stack). (C2)</li> <li>Demonstrate “Multiple” attribute symbology. (C2)</li> <li>Demonstrate “Label” feature. (C2)</li> </ul>	1+1 = 2
<b>Unit 6</b>	Spatial analysis	<ul style="list-style-type: none"> <li>Demonstrate health data visualization such as choropleth map, dot-density map, etc. (C2)</li> <li>Explain “Spatial analyst” toolbox. (C2)</li> <li>Explain “Spatial statistics” toolbox. (C2)</li> <li>Analyse hotspot. (C4)</li> <li>Analyse cluster. (C4)</li> </ul>	2+1 = 3
<b>Unit 7</b>	Application of GIS in Public health	<ul style="list-style-type: none"> <li>Explain the application of GIS in epidemiology and disease surveillance. (C2)</li> <li>Explain the application of GIS Prediction model, risk and response assessment. (C2)</li> <li>Analyse important viral diseases of India using GIS. (C4)</li> </ul>	2+1 = 3





Manipal Institute of Virology

**CURRICULUM**

<b>Name of the Program</b>	MSc Clinical Virology
<b>Course Title</b>	<b>Virology lab design and management</b>
<b>Course Code</b>	MIV609
<b>Academic Year</b>	2021-2023
<b>Semester</b>	III
<b>Course credits</b>	<b>2</b>
<b>Course Prerequisite</b>	First class/CGPA 6.5 at UG level (BSc Life Sciences/Health Sciences)
<b>Course Synopsis</b>	This course intends to acquaint students with the minimum requirements for establishing a national virology laboratory, keeping in view the emergence of new viral pathogens.
<b>Course Outcomes</b>	<b>CO 1:</b> Illustrate key elements of a virology laboratory. (C2) <b>CO 2:</b> Explain requirements in designing a diagnostic virology lab. (C3) <b>CO 3:</b> Outline quality systems applicable in a diagnostic lab. (C2)

**Mapping of COs to POs**

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14
CO 1	✓		✓	✓	✓		✓	✓			✓			
CO 2	✓		✓			✓		✓	✓		✓			
CO 3	✓		✓		✓				✓		✓			

<b>Learning Strategies, Contact Hours and Student Learning Time (SLT)</b>	<b>LEARNING STRATEGY</b>	<b>CONTACT HOURS</b>	<b>SLT</b>
	Lecture	15	45
	Seminar	7	21
	Small Group Discussion (SGD)	3	9
	Self-directed learning (SDL)	3	9
	Problem Based Learning (PBL)	2	6
	Case Based Learning (CBL)	-	-
	Clinic	-	-
	Practical	-	-
	Revision	-	-
	Assessment	2	
	<b>TOTAL</b>	<b>32</b>	<b>91</b>



<b>Assessment Methods</b>	<b>FORMATIVE</b>	<b>SUMMATIVE</b>
	Assignment	Mid semester exam
	Student presentation	
	Group discussion	

<b>Mapping of assessment with course outcomes</b>			
<i>Nature of assessment</i>	<b>CO 1</b>	<b>CO 2</b>	<b>CO 3</b>
Assignments		✓	
Student presentations	✓		
Mid-semester examination	✓	✓	
End-semester examination	x	x	x
Practical examination	x	x	x

<b>Feedback Methods</b>	Student feedback on Course and Course master
<b>Reference Materials</b>	<ul style="list-style-type: none"> <li>Guidelines on establishment of virology laboratory in developing countries</li> <li>Guideline Document for design of BSL-2 Labs (District Hospitals, Chc And Phc) Level</li> </ul>

<b>Course learning outcomes</b>			
<b>Content</b>	<b>Topics</b>	<b>Learning Outcomes</b>	<b>Hours (Lectures/Tutorials)</b>
<b>Unit 1</b>	Introduction to virology lab	<ul style="list-style-type: none"> <li>Explain key components of a virology lab. (C2)</li> <li>Compare and contrast requirements of a diagnostic and research virology lab. (C2)</li> <li>Summarize biosafety principles. (C2)</li> <li>Outline primary barriers of biosafety. (C2)</li> <li>Illustrate requirements of facility design and construction. (C2)</li> <li>Outline requirements for different biosafety level laboratories. (C2)</li> </ul>	5 / 5 = 10
<b>Unit 2</b>	Virology lab design	<ul style="list-style-type: none"> <li>Develop a model of virology lab with BSL-2 facility. (C3)</li> <li>Develop a model of virology lab with BSL-3 facility. (C3)</li> </ul>	5 / 5 = 10



<p><b>Unit 3</b></p>	<p>Quality systems in a diagnostic virology lab</p>	<ul style="list-style-type: none"> <li>• Outline components of quality management. (C2)</li> <li>• Explain concepts of pre-analytical, analytical and post analytical quality parameters. (C2)</li> <li>• Summarize lab accreditation guidelines/policies. (C2)</li> </ul>	<p>5 / 5 = 10</p>
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MANIPAL INSTITUTE OF VIROLOGY, MAHE





Manipal Institute of Virology

**CURRICULUM**

<b>Name of the Program</b>	MSc Clinical Virology
<b>Course Title</b>	<b>Comprehensive Practical (Clinical &amp; Diagnostic Virology and Laboratory rotation -II)</b>
<b>Course Code</b>	MIV611
<b>Academic Year</b>	2021-2023
<b>Semester</b>	III
<b>Course credits</b>	<b>4</b>
<b>Course Prerequisite</b>	First class/CGPA 6.5 at UG level (BSc Life Sciences/Health Sciences)
<b>Course Synopsis</b>	Refer to MIV601 and MIV603
<b>Course Outcomes</b>	<p><b>CO 1:</b> Analyse clinical cases and design diagnostic algorithms. (C4)</p> <p><b>CO 2:</b> Demonstrate laboratory skills to perform various diagnostic tests. (P5)</p> <p><b>CO 4:</b> Understand the syndromic approach of finding the etiological agents. (C2)</p> <p><b>CO 5:</b> Understand the choice of tests depending on different patient parameters. (C2)</p> <p><b>CO 6:</b> Correlate the clinical picture with the laboratory findings. (C4)</p> <p><b>CO 7:</b> Understand appropriate reporting of test results. (C3)</p>

**Mapping of COs to POs**

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14
CO 1	✓		✓	✓		✓			✓		✓		✓	
CO 2	✓		✓	✓		✓			✓		✓		✓	
CO 3	✓										✓			
CO 4	✓		✓					✓	✓		✓			
CO 5	✓		✓	✓				✓	✓		✓			



CO 6	✓		✓	✓		✓			✓		✓		✓	
CO 7	✓		✓	✓				✓	✓		✓			
<b>Learning Strategies, Contact Hours and Student Learning Time (SLT)</b>	<b>LEARNING STRATEGY</b>		<b>CONTACT HOURS</b>		<b>SLT</b>									
	Lecture		-		-									
	Seminar		-		-									
	Small Group Discussion (SGD)		-		-									
	Self-directed learning (SDL)		-		-									
	Problem Based Learning (PBL)		-		-									
	Case Based Learning (CBL)		-		-									
	Clinic		-		-									
	Practical		120		360									
	Revision		-		-									
	Assessment		2		-									
	<b>TOTAL</b>		<b>122</b>		<b>270</b>									
<b>Assessment Methods</b>	<b>FORMATIVE</b>		<b>SUMMATIVE</b>											
	Internal assessment		End semester exam											

<b>Feedback Methods</b>	Student feedback on Course and Course master
<b>Reference Materials</b>	Refer to MIV601 and MIV603

<b>Course learning outcomes</b>			
<b>Content</b>	<b>Topics</b>	<b>Learning Outcomes</b>	<b>Hours (Practicals)</b>
<b>Unit 2 (MIV601)</b>	Principles of Diagnostic Virology	<ul style="list-style-type: none"> <li>• Illustrate clinical features of viral infections. (C2)</li> <li>• Interpret case sheets from hospitals. (C2)</li> <li>• Outline differential diagnoses of various clinical presentations. (C2)</li> </ul>	3
<b>Unit 3 (MIV601)</b>	Collection, transport and processing of clinical samples	<ul style="list-style-type: none"> <li>• Demonstrate various sample collection techniques. (C2)</li> <li>• Demonstrate sample packaging and transportation techniques. (C2)</li> </ul>	3



		<ul style="list-style-type: none"> <li>• Demonstrate sample processing techniques. (C2)</li> </ul>	
<b>Unit 5 (MIV601)</b>	Viral encephalitis / meningitis / meningoencephalitis - Etiology, epidemiology, laboratory diagnosis, management, prevention and control	<ul style="list-style-type: none"> <li>• Explain viral encephalitis, meningitis and meningoencephalitis, illustrate their etiologies and clinical features. (C2)</li> <li>• Explain epidemiology and pathogenesis of viruses causing encephalitis. (C2)</li> <li>• Summarize diagnostic algorithm for lab diagnosis of viral encephalitis. (C2)</li> <li>• Explain the management, prevention and control measures. (C2)</li> </ul>	4
<b>Unit 6 (MIV601)</b>	Viral diarrhea / Viral food borne illness - Etiology, epidemiology, laboratory diagnosis, management, prevention and control	<ul style="list-style-type: none"> <li>• Explain viral diarrhea and Viral food borne illness, illustrate their etiologies and clinical features. (C2)</li> <li>• Explain epidemiology and pathogenesis of viruses causing diarrhea and food borne illness. (C2)</li> <li>• Summarize diagnostic algorithm for lab diagnosis of viral diarrhea and food borne illness. (C2)</li> <li>• Explain the management, prevention and control measures. (C2)</li> </ul>	4
<b>Unit 7 (MIV601)</b>	Exanthems; Etiology, epidemiology, laboratory diagnosis, management, prevention and control	<ul style="list-style-type: none"> <li>• Explain exanthems, illustrate their etiologies and clinical features. (C2)</li> <li>• Explain epidemiology and pathogenesis of viruses causing exanthems. (C2)</li> <li>• Summarize diagnostic algorithm for lab diagnosis of exanthems. (C2)</li> <li>• Explain the management, prevention and control measures. (C2)</li> </ul>	4





<b>Unit 8 (MIV601)</b>	Ricketssial Diseases- Etiology, epidemiology, laboratory diagnosis, management, prevention and control	<ul style="list-style-type: none"> <li>• Explain Ricketssial diseases, illustrate their etiologies and clinical features. (C2)</li> <li>• Explain epidemiology and pathogenesis of viruses causing Ricketssial diseases. (C2)</li> <li>• Summarize diagnostic algorithm for lab diagnosis of Ricketssial diseases. (C2)</li> <li>• Explain the management, prevention and control measures. (C2)</li> </ul>	4
<b>Unit 9 (MIV601)</b>	Congenital viral infections - Etiology, epidemiology, laboratory diagnosis, management, prevention and control	<ul style="list-style-type: none"> <li>• Explain congenital viral infections, illustrate their etiologies and clinical features. (C2)</li> <li>• Explain epidemiology and pathogenesis of viruses causing congenital viral infections. (C2)</li> <li>• Summarize diagnostic algorithm for lab diagnosis of congenital viral infections. (C2)</li> <li>• Explain the management, prevention and control measures. (C2)</li> </ul>	4
<b>Unit 10 (MIV601)</b>	Viral haemorrhagic fevers - Etiology, epidemiology, laboratory diagnosis, management, prevention and control	<ul style="list-style-type: none"> <li>• Explain viral haemorrhagic fevers, illustrate their etiologies and clinical features. (C2)</li> <li>• Explain epidemiology and pathogenesis of viruses causing viral haemorrhagic fevers. (C2)</li> <li>• Summarize diagnostic algorithm for lab diagnosis of viral haemorrhagic fevers. (C2)</li> <li>• Explain the management, prevention and control measures. (C2)</li> </ul>	4



<b>Course learning outcomes</b>			
<b>Content</b>	<b>Topics</b>	<b>Learning Outcomes</b>	<b>Hours (Practicals)</b>
<b>Unit 1 (MIV603)</b>	Viral infections of Respiratory tract- Etiology, epidemiology, laboratory diagnosis, management, prevention and control	<ul style="list-style-type: none"> <li>• Explain viral infections of respiratory tract, illustrate their etiologies and clinical features. (C2)</li> <li>• Explain epidemiology and pathogenesis of viruses causing infections of respiratory tract. (C2)</li> <li>• Summarize diagnostic algorithm for lab diagnosis of viral infections of respiratory tract. (C2)</li> <li>• Explain the management, prevention and control measures. (C2)</li> </ul>	5
<b>Unit 2 (MIV603)</b>	Viral STIs including HIV; Chlamydia - Etiology, epidemiology, laboratory diagnosis, management, prevention and control	<ul style="list-style-type: none"> <li>• Explain viral STIs, illustrate their etiologies and clinical features. (C2)</li> <li>• Explain epidemiology and pathogenesis of viruses causing STIs. (C2)</li> <li>• Summarize diagnostic algorithm for lab diagnosis of viral STIs. (C2)</li> <li>• Explain the management, prevention and control measures. (C2)</li> </ul>	5
<b>Unit 3 (MIV603)</b>	Human Retroviruses Except HIV- Etiology, epidemiology, laboratory diagnosis, management, prevention and control	<ul style="list-style-type: none"> <li>• Explain diseases caused by human retroviruses, illustrate their etiologies and clinical features. (C2)</li> <li>• Explain epidemiology and pathogenesis of human retroviruses. (C2)</li> <li>• Summarize diagnostic algorithm for lab diagnosis of viral infections caused by human retroviruses. (C2)</li> <li>• Explain the management, prevention and control measures. (C2)</li> </ul>	4



<b>Unit 4 (MIV603)</b>	Viruses and cancer - Etiology, epidemiology, laboratory diagnosis, management, prevention and control	<ul style="list-style-type: none"> <li>• Explain cancers caused by viruses, illustrate their etiologies and clinical features. (C2)</li> <li>• Explain epidemiology and pathogenesis of viruses causing cancers. (C2)</li> <li>• Summarize diagnostic algorithm for lab diagnosis of cancers caused by viruses. (C2)</li> <li>• Explain the management, prevention and control measures. (C2)</li> </ul>	4
<b>Unit 5 (MIV603)</b>	Slow Viral diseases - Etiology, epidemiology, laboratory diagnosis, management, prevention and control	<ul style="list-style-type: none"> <li>• Explain slow viral diseases, illustrate their etiologies and clinical features. (C2)</li> <li>• Explain epidemiology and pathogenesis of viruses causing slow viral diseases. (C2)</li> <li>• Summarize diagnostic algorithm for lab diagnosis of slow viral diseases. (C2)</li> <li>• Explain the management, prevention and control measures. (C2)</li> </ul>	4
<b>Unit 6 (MIV603)</b>	Prion Diseases- Etiology, epidemiology, laboratory diagnosis, management, prevention and control	<ul style="list-style-type: none"> <li>• Explain prion diseases, illustrate their etiologies and clinical features. (C2)</li> <li>• Explain epidemiology and pathogenesis of viruses causing prion diseases. (C2)</li> <li>• Summarize diagnostic algorithm for lab diagnosis of prion diseases. (C2)</li> <li>• Explain the management, prevention and control measures. (C2)</li> </ul>	4
<b>Unit 7 (MIV603)</b>	Zoonotic Viral infections - Etiology, epidemiology, laboratory diagnosis, management, prevention and control	<ul style="list-style-type: none"> <li>• Explain zoonotic viral infections, illustrate their etiologies and clinical features. (C2)</li> <li>• Explain epidemiology and pathogenesis of viruses causing zoonotic viral infections. (C2)</li> </ul>	4



		<ul style="list-style-type: none"> <li>• Summarize diagnostic algorithm for lab diagnosis of viral infections of zoonotic origin. (C2)</li> <li>• Explain the management, prevention and control measures. (C2)</li> </ul>	
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<b>Laboratory Rotation -II</b>			
<b>Posting</b>	<b>Sections</b>	<b>Learning Outcomes</b>	<b>Hours</b>
<b>1</b>	Serology	<ul style="list-style-type: none"> <li>• Observe and understand the workflow in the diagnostic laboratory.</li> <li>• Observe, understand and develop skills of processing clinical samples.</li> <li>• Observe and understand the principle, methodology and technique of the different tests (serological, molecular and cell culture based) performed routinely in a diagnostic laboratory. Develop skills to perform diagnostic tests independently.</li> <li>• Perform sample reception independently, and observe barcoding and sample storage processes.</li> <li>• Observe, understand and perform the protocols of decontamination and discarding of biomedical waste.</li> </ul>	60 hours (12 hours in each section)
<b>2</b>	Sample processing and Extraction		
<b>3</b>	Molecular Diagnostics		
<b>4</b>	Tissue culture		
<b>5</b>	Sample reception, Barcoding, Sample Storage and Decontamination		



# FOURTH SEMESTER

MANIPAL INSTITUTE OF VIROLOGY, MAHE





Manipal Institute of Virology

**CURRICULUM**

<b>Name of the Program</b>	MSc Clinical Virology														
<b>Course Title</b>	Bioethics														
<b>Course Code</b>	MIV602														
<b>Academic Year</b>	2021-2023														
<b>Semester</b>	IV														
<b>Course Credits</b>	1														
<b>Course Prerequisite</b>	First class/CGPA 6.5 at UG level (BSc Life Sciences/Health Sciences)														
<b>Course Synopsis</b>	<p>1. This module helps to understand the importance of ethical principles and practices in scientific research.</p> <p>2. To provide detailed information about the breeding and maintenance of laboratory animals and additional information is provided about genetically modified animals.</p>														
<b>Course Outcomes</b>	<p><b>CO 1:</b> Explain ethical principles and practices in scientific research. (C2)</p> <p><b>CO 2:</b> Outline the ethics in animal and human research. (C2)</p> <p><b>CO 3:</b> Explain the Central animal research facility available in the University. (C2)</p> <p><b>CO 4:</b> Illustrate use of transgenic animals in research. (C2)</p> <p><b>CO 5:</b> Develop experimental protocols and project proposals. (C3)</p> <p><b>CO 6:</b> Explain application of database and research metrics. (C2)</p>														
<b>Mapping of COs to POs</b>															
<b>COs</b>	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>	<b>PO 9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>	<b>PO 13</b>	<b>PO 14</b>	
CO 1	✓										✓	✓		✓	
CO 2	✓										✓	✓			
CO 3	✓					✓		✓			✓	✓			
CO 4	✓					✓		✓	✓		✓	✓			
CO 5	✓	✓	✓		✓	✓	✓	✓	✓		✓	✓			
CO 6	✓		✓						✓	✓	✓	✓			
<b>Learning Strategies, Contact Hours and</b>	<b>LEARNING STRATEGY</b>				<b>CONTACT HOUR</b>				<b>SLT</b>						



<b>Student Learning Time (SLT)</b>	Lecture	-	-
	Seminar	7	21
	Small Group Discussion (SGD)	3	9
	Self-directed learning (SDL)	2	6
	Problem Based Learning (PBL)	3	9
	Case Based Learning (CBL)	-	-
	Clinic	-	-
	Practical	-	-
	Revision	-	-
	Assessment	2	-
	<b>TOTAL</b>	<b>17</b>	<b>45</b>
<b>Assessment Methods</b>	<b>FORMATIVE</b>		<b>SUMMATIVE</b>
	Assignment		-
	Student presentation		
	Group discussion		
	Internal Assessment		

<b>Mapping of assessment with COs</b>						
<i>Nature of assessment</i>	CO 1	CO 2	CO 3	CO 4	CO 5	CO 6
Assignments					✓	
Student presentations						✓
Internal assessment	✓	✓	✓	✓	✓	✓
End-semester examination	x	x	x	x	x	x
Practical examination	x	x	x	x	x	x

<b>Feedback Methods</b>	Student feedback on Course and Course master
<b>Main Reference</b>	<ul style="list-style-type: none"> <li>National Academy of Sciences. On Being a Scientist: A Guide to Responsible Conduct in Research: Third Edition, 2009</li> <li>Research Ethics Training Curriculum, Second Edition by Roberto Rivera and David Borasky</li> <li>ICMR Ethical guidelines for Biomedical Research on Human Participants</li> <li>Fundamentals of Experimental Pharmacology. 3rd ed by M.N.Ghosh</li> </ul>



Course learning outcomes			
Content	Topics	Learning Outcomes	Hours (Tutorials)
<b>Unit 1</b>	<b>Research Ethics</b> Principles of Research Ethics <b>Scientific misconduct</b> Case studies: Violation of scientific standards	<ul style="list-style-type: none"> <li>• Explain the Importance of Research Ethics. (C1)</li> <li>• Infer different types of research misconduct. (C2)</li> <li>• Demonstrate how scientific misconduct can affect various stakeholders of research. (C2)</li> </ul>	3
<b>Unit 2</b>	<b>Institutional ethics committees for Animal and Human trials</b> <ul style="list-style-type: none"> <li>• Human Subject Research</li> <li>• Care, breeding and experimentation on Laboratory animals</li> </ul>	<ul style="list-style-type: none"> <li>• Explain the ethics in animal Research. (C1)</li> <li>• Explain the Ethical principles in the Research involving humans. (C1)</li> <li>• Explain the international declarations on human rights and Human subject Research. (C1)</li> </ul>	3
<b>Unit 3</b>	Visit to the Central Animal House Facility	<ul style="list-style-type: none"> <li>• Illustrate awareness of the animal research facilities. (C2)</li> <li>• Explain key components of the Central Animal House and guidelines followed. (C1)</li> </ul>	2
<b>Unit 4</b>	<b>Genetically modified animals</b> <ul style="list-style-type: none"> <li>• Transgenic animals</li> <li>• Cloning</li> <li>• Guidelines for the use of genetically modified animals</li> </ul>	<ul style="list-style-type: none"> <li>• Show the theory behind generating Transgenic animals. (C2)</li> <li>• Outline different types of vectors and their use in cloning. (C2)</li> <li>• Explain the guidelines followed for the use of genetically modified animals. (C1)</li> </ul>	2
<b>Unit 5</b>	<b>Protocol development</b>	<ul style="list-style-type: none"> <li>• Interpret the basic components of protocol. (C2)</li> <li>• Develop experimental protocols and project proposals. (C3)</li> </ul>	2
<b>Unit 6</b>	<b>Publication Ethics</b>	<ul style="list-style-type: none"> <li>• Outline the Publication Misconduct. (C1)</li> <li>• Apply plagiarism software like Turnitin. (C3)</li> <li>• Outline Indexing Database: Scopus. (C2)</li> </ul>	3







Manipal Institute of Virology

## CURRICULUM

<b>Name of the Program</b>	MSc Clinical Virology																																										
<b>Course Title</b>	<b>Analytical methods</b>																																										
<b>Course Code</b>	MIV604																																										
<b>Academic Year</b>	2021-2023																																										
<b>Semester</b>	IV																																										
<b>Course credits</b>	<b>1</b>																																										
<b>Course Prerequisite</b>	First class/CGPA 6.5 at UG level (BSc Life Sciences/Health Sciences)																																										
<b>Course Synopsis</b>	<ol style="list-style-type: none"> <li>1. This course provides an understanding of the principles and practical applications of some of the main analytical techniques used in biomedical research and clinical diagnostics.</li> <li>2. This course will train students to interpret the results derived from the analytical methods.</li> <li>3. The course will help students to understand advantages and disadvantages of the different techniques and their use.</li> </ol>																																										
<b>Course Outcomes</b>	<p><b>CO 1:</b> Explain principle, instrumentation and analytical applications of Western blotting. (C2)</p> <p><b>CO 2:</b> Demonstrate principle, instrumentation and analytical applications of Electrophoresis. (C2)</p> <p><b>CO 3:</b> Illustrate principle, instrumentation and analytical applications of Chromatography. (C2)</p> <p><b>CO 4:</b> Outline principle, instrumentation and analytical applications of Flow cytometry. (C2)</p> <p><b>CO 5:</b> Explain principle, instrumentation and analytical applications of Microarray. (C2)</p> <p><b>CO 6:</b> Demonstrate principle, instrumentation and analytical applications of Spectrophotometry. (C2)</p> <p><b>CO 7:</b> Illustrate principle, instrumentation and analytical applications of Ultra centrifugation. (C2)</p>																																										
<b>Mapping of COs to POs</b>																																											
<b>COs</b>	<table border="1"> <thead> <tr> <th>PO 1</th> <th>PO 2</th> <th>PO 3</th> <th>PO 4</th> <th>PO 5</th> <th>PO 6</th> <th>PO 7</th> <th>PO 8</th> <th>PO 9</th> <th>PO 10</th> <th>PO 11</th> <th>PO 12</th> <th>PO 13</th> <th>PO 14</th> </tr> </thead> <tbody> <tr> <td>CO 1</td> <td>✓</td> <td></td> <td>✓</td> <td>✓</td> <td>✓</td> <td>✓</td> <td>✓</td> <td></td> <td>✓</td> <td>✓</td> <td></td> <td></td> <td></td> </tr> <tr> <td>CO 2</td> <td>✓</td> <td></td> <td>✓</td> <td>✓</td> <td>✓</td> <td>✓</td> <td>✓</td> <td></td> <td>✓</td> <td>✓</td> <td></td> <td></td> <td></td> </tr> </tbody> </table>	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14	CO 1	✓		✓	✓	✓	✓	✓		✓	✓				CO 2	✓		✓	✓	✓	✓	✓		✓	✓			
PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14																														
CO 1	✓		✓	✓	✓	✓	✓		✓	✓																																	
CO 2	✓		✓	✓	✓	✓	✓		✓	✓																																	



CO 3	✓		✓	✓	✓	✓		✓		✓	✓			
CO 4	✓		✓	✓	✓	✓		✓		✓	✓			
CO 5	✓		✓	✓	✓	✓		✓		✓	✓			
CO 6	✓		✓	✓	✓	✓		✓		✓	✓			
CO 7	✓		✓	✓	✓	✓		✓		✓	✓			
<b>Learning Strategies, Contact Hours and Student Learning Time (SLT)</b>	<b>LEARNING STRATEGY</b>		<b>CONTACT HOURS</b>		<b>SLT</b>									
	Lecture		-		-									
	Seminar		7		21									
	Small Group Discussion (SGD)		1		3									
	Self-directed learning (SDL)		7		21									
	Problem Based Learning (PBL)		-		-									
	Case Based Learning (CBL)		-		-									
	Clinic		-		-									
	Practical		-		-									
	Revision		-		-									
	Assessment		2		-									
	<b>TOTAL</b>		<b>17</b>		<b>45</b>									
<b>Assessment Methods</b>	<b>FORMATIVE</b>			<b>SUMMATIVE</b>										
	Assignment			-										
	Student presentation													
	Group discussion													
	Internal Assessment													

<b>Mapping of assessment with COs</b>							
<i>Nature of assessment</i>	CO 1	CO 2	CO 3	CO 4	CO 5	CO 6	CO 7
Assignments			✓			✓	
Student presentations	✓	✓		✓	✓		✓
Internal assessment	✓	✓	✓	✓	✓	✓	✓
End-semester examination	x	x	x	x	x	x	x
Practical examination	x	x	x	x	x	x	x

<b>Feedback Methods</b>	Student feedback on Course and Course master
<b>Reference Materials</b>	<ul style="list-style-type: none"> <li>• <a href="https://www.classcentral.com/course/swayam-analytical-techniques-13896">https://www.classcentral.com/course/swayam-analytical-techniques-13896</a></li> <li>• Instrumental methods of analysis H.H.Wilard, L.L.Merritt, J A Dean.</li> <li>• Instrumental Methods of Chemical analysis.</li> <li>• Introduction of instrumental analysis. R.P.Braun</li> </ul>



	<ul style="list-style-type: none"> <li>Principles of Instrumental Analysis Fifth edition Skoog, Holler, Niemay.</li> <li>Spectroscopic methods in Organic Chemistry, D.H. Williams and Ian Fleming, 4 Edition.</li> </ul>
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Course learning outcomes			
Content	Topics	Learning Outcomes	Hours (Tutorials)
Unit 1	Western blotting	<ul style="list-style-type: none"> <li>Explain principle of Western blotting. (C3)</li> <li>Outline instrumentation. (C3)</li> <li>List analytical applications. (C3)</li> </ul>	2
Unit 2	Electrophoresis	<ul style="list-style-type: none"> <li>Demonstrate principle of electrophoresis. (C3)</li> <li>Outline instrumentation. (C3)</li> <li>List analytical applications. (C3)</li> </ul>	2
Unit 3	Chromatography	<ul style="list-style-type: none"> <li>Illustrate principle of Chromatography. (C3)</li> <li>Outline instrumentation. (C3)</li> <li>List analytical applications. (C3)</li> </ul>	2
Unit 4	Flow cytometry	<ul style="list-style-type: none"> <li>Outline principle of Flow cytometry. (C3)</li> <li>Illustrate instrumentation. (C3)</li> <li>List analytical applications. (C3)</li> </ul>	1
Unit 5	Microarray	<ul style="list-style-type: none"> <li>Explain principle of Microarray. (C3)</li> <li>Outline instrumentation. (C3)</li> <li>List analytical applications. (C3)</li> </ul>	1
Unit 6	Spectrophotometry	<ul style="list-style-type: none"> <li>Demonstrate principle of Spectrophotometry. (C3)</li> <li>Outline instrumentation. (C3)</li> <li>List analytical applications. (C3)</li> </ul>	1
Unit 7	Ultra-centrifugation	<ul style="list-style-type: none"> <li>Illustrate principle of Ultra centrifugation. (C3)</li> <li>Outline instrumentation. (C3)</li> <li>List analytical applications. (C3)</li> </ul>	1





Manipal Institute of Virology

**CURRICULUM**

<b>Name of the Program</b>	MSc Clinical Virology													
<b>Course Title</b>	<b>Biostatistics</b>													
<b>Course Code</b>	MIV606													
<b>Academic Year</b>	2021-2023													
<b>Semester</b>	IV													
<b>Course credits</b>	<b>2</b>													
<b>Course Prerequisite</b>	First class/CGPA 6.5 at UG level (BSc Life Sciences/Health Sciences)													
<b>Course Synopsis</b>	<ol style="list-style-type: none"> <li>1. This module introduces to the concepts in Biostatistics.</li> <li>2. To understand the applications of biostatistics in research and public health.</li> <li>3. To introduce statistical packages for data analysis in MS Excel, SPSS, and Epi Info.</li> </ol>													
<b>Course Outcomes</b>	<p><b>CO 1:</b> Outline basic terminologies used in biostatistics. (C2)</p> <p><b>CO 2:</b> Explain basic concepts in biostatistics– Variables, types of variables, scales of measurements, descriptive statistics, and inferential biostatistics etc. (C2)</p> <p><b>CO 3:</b> Discover various methods of data collection. (C4)</p> <p><b>CO 4:</b> Summarize various methods of sample size calculation. (C2)</p> <p><b>CO 5:</b> Identify the variables in a dataset and classify variables. (C3)</p> <p><b>CO 6:</b> Create graphs &amp; diagrams using datasets. (C6)</p> <p><b>CO 7:</b> Use statistical software for data analysis and interpretation. (C4, P3)</p>													
<b>Mapping of COs to POs</b>														
<b>COs</b>	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>	<b>PO 9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>	<b>PO 13</b>	<b>PO 14</b>
<b>CO 1</b>	✓										✓			
<b>CO 2</b>	✓			✓						✓	✓			
<b>CO 3</b>	✓			✓	✓			✓	✓	✓	✓			



CO 4	✓		✓	✓	✓				✓	✓	✓			
CO 5	✓			✓	✓					✓	✓			
CO 6	✓		✓	✓	✓				✓	✓	✓			
CO 7	✓		✓	✓	✓				✓	✓	✓			

<b>Learning Strategies, Contact Hours and Student Learning Time (SLT)</b>	<b>LEARNING STRATEGY</b>	<b>CONTACT HOURS</b>	<b>SLT</b>
	Lecture	14	42
	Seminar	3	9
	Small Group Discussion (SGD)	1	3
	Self-directed learning (SDL)	1	3
	Problem Based Learning (PBL)	-	-
	Case Based Learning (CBL)	-	-
	Clinic	-	-
	Practical	11	33
	Revision	-	-
	Assessment	2	-
	<b>TOTAL</b>	<b>32</b>	<b>90</b>
<b>Assessment Methods</b>	<b>FORMATIVE</b>	<b>SUMMATIVE</b>	
	Assignment	-	
	Student presentation		
	Group discussion		
	Internal Assessment		

<b>Mapping of assessment with COs</b>							
<i>Nature of assessment</i>	CO 1	CO 2	CO 3	CO 4	CO 5	CO 6	CO 7
Assignments						✓	✓
Student presentations		✓	✓	✓	✓		
Internal assessment	✓	✓	✓	✓	✓	✓	✓
End-semester examination	✗	✗	✗	✗	✗	✗	✗
Practical examination	✗	✗	✗	✗	✗	✗	✗



<b>Feedback Methods</b>	Student feedback on Course and Course master
<b>Reference Materials</b>	<ul style="list-style-type: none"> <li>✓ <b>An Introduction to Biostatistics.</b> A manual for students in health sciences. (P.S.S. Sundar Rao &amp; J. Richard)</li> <li>✓ <b>Principles and Practice of Biostatistics.</b> (B. Antonisamy)</li> <li>✓ IBM SPSS Statistics v20, User Manual.</li> <li>✓ Getting started with EpiInfo 7, User guide from CDC</li> </ul>

<b>Course learning outcomes</b>			
<b>Content</b>	<b>Topics</b>	<b>Learning Outcomes</b>	<b>Hours (Lectures/Tutorials)</b>
<b>Unit 1</b>	Introduction to Biostatistics	<ul style="list-style-type: none"> <li>• Define of Biostatistics and key terms used in biostatistics. (C1)</li> <li>• Applications of Biostatistics in research. (C3)</li> </ul>	1
	Data collection methods	<ul style="list-style-type: none"> <li>• What is Data, dataset, and data table? (C1)</li> <li>• Explain Variables and types of variables. (C2)</li> <li>• Understand various methods of data collection (Qualitative and Quantitative). (C2)</li> <li>• Develop research questionnaire. (C6)</li> <li>• Outline Scales of measurements. (C2)</li> <li>• Understanding frequency distribution and class intervals. (C2)</li> </ul>	2
<b>Unit 2</b>	Measures of central tendency & measures of dispersion	<ul style="list-style-type: none"> <li>• Explain Measures of central tendency (Mean, median, mode). (C2)</li> <li>• Explain measures of dispersion (standard deviation, variance, quartiles, range, Inter quartile range). (C2)</li> <li>• Solve mathematical problems using datasets. (C3)</li> </ul>	2
<b>Unit 3</b>	Sampling/ Sampling methods	<ul style="list-style-type: none"> <li>• Explain principal concepts in sampling. (C2)</li> </ul>	1



		<ul style="list-style-type: none"> <li>• What is population and sample, parameter, and statistics? (C1)</li> <li>• Compare probability and non-probability sampling techniques? (C2)</li> <li>• What is multistage sampling technique? (C1)</li> <li>• Explain the advantages of various sampling techniques? (C2)</li> </ul>	
<b>Unit 4</b>	Normal distribution	<ul style="list-style-type: none"> <li>• Define normal distributions. (C1)</li> <li>• Properties of normal distributions. (C2)</li> <li>• What is Empirical rule? (C1)</li> <li>• Explain Reference limits. (C2)</li> <li>• What is Standard normal distribution? (C1)</li> <li>• What is Z-score? (C1)</li> <li>• Solve mathematical problem using datasets. (C3)</li> </ul>	1
<b>Unit 5</b>	Representation of data	<ul style="list-style-type: none"> <li>• Explain various methods of representation of data (text, tabulation and graphical). (C2)</li> <li>• Construction of various type of graphs and interpretation. (C6)</li> <li>• Identify the suitable type of graphical representation for a given set of data. (C3)</li> </ul>	1
	Sample size determination	<ul style="list-style-type: none"> <li>• Elaborate on the different approaches used in sample size calculation. (C6)</li> <li>• Analyse dataset and run statistical tests. (C4)</li> </ul>	1
<b>Unit 6</b>	Correlation and regression	<ul style="list-style-type: none"> <li>• Outline correlation and regression methods. (C2)</li> <li>• Classify and compare positive, negative, and neutral correlation. (C2)</li> <li>• Calculate and interpret correlation coefficient. (C5)</li> <li>• Analyse dataset and run binary logistic regression analysis. (C4)</li> </ul>	1



<b>Unit 7</b>	Data management	<ul style="list-style-type: none"> <li>• Make use of MS Excel, SPSS &amp; Epi info for data management. (C3)</li> <li>• Explain data collection, organization, cleaning, storage, and archiving, sharing and security, and quality control. (C2)</li> </ul>	1
<b>Unit 8</b>	Hands on training in MS Office	<ul style="list-style-type: none"> <li>• Summarizing data using MS Excel (C2) <ul style="list-style-type: none"> <li>- fundamentals of MS Excel and spreadsheet</li> <li>- Create and modify charts</li> <li>- Pivot table and pivot charts</li> <li>- Data validation in excel</li> <li>- Making Dashboard</li> <li>- Tabulation</li> </ul> </li> <li>• Demonstrate formatting in MS word (C2) <ul style="list-style-type: none"> <li>- Document formatting, paragraphs, headings, page break, page numbering</li> <li>- Using templates &amp; styles</li> <li>- table of contents, list of figures, templates</li> </ul> </li> <li>• Make use of MS PowerPoint to (C3) <ul style="list-style-type: none"> <li>- Basic tasks</li> <li>- Templates and graphics</li> <li>- Best practices in making a scientific presentation</li> </ul> </li> <li>• Make use of Mendeley reference management software (C3) <ul style="list-style-type: none"> <li>- Desktop version</li> <li>- Web importer</li> <li>- Word plugin</li> </ul> </li> </ul>	1/4=5
<b>Unit 9</b>	Hands on training in SPSS	<ul style="list-style-type: none"> <li>• Outline the fundamentals of using SPSS. (C2)</li> <li>• Understand the basic workings of SPSS and data entry. (C2)</li> <li>• How to compute variables, recode into new variable? (C1)</li> </ul>	1/4= 5





		<ul style="list-style-type: none"> <li>• Organise data using sort cases and select cases. (C3)</li> <li>• Create simple tables and charts using Chart builder. (C6)</li> <li>• How to export and import SPSS data? (C1)</li> <li>• Perform basic statistical analyses using Descriptive statistics. (C2)</li> <li>• Analyse and perform advanced statistical tests with SPSS (statistical tests, correlation, and regression analysis). (C4)</li> <li>• Demonstrate R statistical software (RStudio and R commander). (C2)</li> </ul>	
<b>Unit 10</b>	Hands on training in Epi Info	<ul style="list-style-type: none"> <li>• Outline the features of Epi Info. (C2)</li> <li>• How to create forms, enter and edit data? (C1)</li> <li>• Create maps using geographical data. (C6)</li> <li>• Utilise Visual dashboard for statistical analyses. (C3)</li> <li>• Compile analysed data and report making. (C6)</li> <li>• Utilize advanced features in Epi Info. (C3)</li> </ul>	1/3=4





**Manipal Institute of Virology**

**CURRICULUM**

<b>Name of the Program</b>	MSc Clinical Virology
<b>Course Title</b>	<b>Intellectual Property rights and patenting</b>
<b>Course Code</b>	MIV608
<b>Academic Year</b>	2021-2023
<b>Semester</b>	IV
<b>Course credits</b>	<b>1</b>
<b>Course Prerequisite</b>	First class/CGPA 6.5 at UG level (BSc Life Sciences/Health Sciences)
<b>Course Synopsis</b>	<ol style="list-style-type: none"> <li>1. This course will sensitize students about the basic information on Intellectual Property Rights, Patent filing process, analysing and drafting patent applications, monetizing research results.</li> <li>2. The course will help students to appreciate the need for various kinds of intellectual property (IP) protection and its impact and association with the growth of organisations.</li> <li>3. The course will teach students to apply intellectual property law principles (including copyright, patents, designs and trademarks) to real problems and analyse the social impact of intellectual property law and policy.</li> <li>4. The course will train students to work in teams, solve problems and manage time.</li> </ol>
<b>Course Outcomes</b>	<p><b>CO 1:</b> Interpret patents, rights conferred on a patentee, copyright and trademarks leading to improvement in teamwork and leadership qualities. (C2)</p> <p><b>CO 2:</b> Identify and analyse patent law, the legislative provisions regulating patents, principles and procedure for obtaining patent. (C4)</p> <p><b>CO 3:</b> Apply technical concepts of IP related technology. (C3)</p> <p><b>CO 4:</b> Demonstrate and develop awareness of relevance and impact of intellectual property law on academic and professional lives. (C3)</p> <p><b>CO 5:</b> Analyse ethical and professional issues which arise in intellectual property law context. (C4)</p>



Mapping of COs to POs														
COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14
CO 1	✓	✓	✓				✓				✓			
CO 2	✓		✓					✓	✓		✓		✓	
CO 3	✓		✓					✓	✓		✓			
CO 4	✓	✓	✓						✓		✓	✓	✓	✓
CO 5	✓	✓						✓	✓		✓	✓		
<b>Learning Strategies, Contact Hours and Student Learning Time (SLT)</b>	<b>LEARNING STRATEGY</b>										<b>CONTACT HOURS</b>		<b>SLT</b>	
	Lecture										-		-	
	Seminar										5		15	
	Small Group Discussion (SGD)										1		3	
	Self-directed learning (SDL)										1		3	
	Problem Based Learning (PBL)										-		-	
	Case Based Learning (CBL)										-		-	
	Clinic										-		-	
	Practical										-		-	
	Revision										-		-	
	Assessment										2		-	
<b>TOTAL</b>										<b>9</b>		<b>21</b>		
<b>Assessment Methods</b>	<b>FORMATIVE</b>										<b>SUMMATIVE</b>			
	Assignment										-			
	Student presentation													
	Group discussion													
	Internal Assessment													

Mapping of assessment with COs					
Nature of assessment	CO 1	CO 2	CO 3	CO 4	CO 5
Assignments	✓				
Student presentations				✓	
Internal assessment	✓	✓	✓	✓	✓
End-semester examination	x	x	x	x	x
Practical examination	x	x	x	x	x



<b>Feedback Methods</b>	Student feedback on Course and Course master
<b>Reference Materials</b>	<ul style="list-style-type: none"> <li>Intellectual Property Rights, Deborah. E. Bouchoux, Cengage Learning.</li> <li>Intellectual Property Rights– Unleashmy The Knowledge Economy, Prabuddha Ganguli, Tate Mc Graw Hill Publishing Company Ltd.</li> </ul>

<b>Course learning outcomes</b>			
<b>Content</b>	<b>Topics</b>	<b>Learning Outcomes</b>	<b>Hours (Tutorials)</b>
<b>Unit 1</b>	Overview of Intellectual Property	<ul style="list-style-type: none"> <li>Explain intellectual property and its importance. (C2)</li> <li>Classify the various types of intellectual property. (C2)</li> <li>List the various international organizations associated with IPR. (C2)</li> <li>List the various agencies and treaties associated with IPR. (C2)</li> <li>Explain the importance of intellectual property rights. (C2)</li> </ul>	1
<b>Unit 2</b>	Patents	<ul style="list-style-type: none"> <li>Explain the definition, basics of patents. (C2)</li> <li>Outline the patent searching process. (C2)</li> <li>Reading and interpreting patent documents. (C2)</li> <li>Summarize in detail the ownership rights and transfer. (C2)</li> <li>Explain the new developments in Patent law. (C2)</li> <li>Outline the International Patent Law. (C2)</li> <li>Discuss important case laws. (C3)</li> </ul>	2
<b>Unit 3</b>	Copyrights	<ul style="list-style-type: none"> <li>Explain Fundamental of Copy Right Law. (C2)</li> <li>Explain the importance of originality of material in Law of copy rights. (C2)</li> <li>Explain the rules of rights of reproduction. (C2)</li> </ul>	4



		<ul style="list-style-type: none"> <li>• Explain the rights to perform the work publicly. (C2)</li> <li>• Explain the issues of copyrighted owner. (C2)</li> <li>• Explain the copyright law globally. (C2)</li> <li>• Discuss important case laws. (C3)</li> </ul>	
<b>Unit 4</b>	Trademarks	<ul style="list-style-type: none"> <li>• Define trademarks and explain their purpose and function. (C2)</li> <li>• Illustrate importance of acquisition of trademark rights. (C2)</li> <li>• Explain the trademark protectable matter topics. (C2)</li> <li>• Explain the selection and evaluation of a trademark. (C2)</li> <li>• Explain the trademark registration process. (C2)</li> <li>• Discuss important case laws. (C3)</li> </ul>	4





Manipal Institute of Virology

**CURRICULUM**

<b>Name of the Program</b>	MSc Clinical Virology													
<b>Course Title</b>	Disaster management													
<b>Course Code</b>	MIV610													
<b>Academic Year</b>	2021-2023													
<b>Semester</b>	IV													
<b>Course credits</b>	1													
<b>Course Prerequisite</b>	First class/CGPA 6.5 at UG level (BSc Life Sciences/Health Sciences)													
<b>Course Synopsis</b>	<ol style="list-style-type: none"> <li>1. To sensitize students regarding potential emergencies and disasters that could affect the clinical laboratory.</li> <li>2. To identify elements of an emergency management plan and methods to implement it.</li> <li>3. To acquire necessary skills for handling emergencies.</li> </ol>													
<b>Course Outcomes</b>	<p><b>CO 1:</b> Explain different disaster types and develop a reactive approach for management. (C2)</p> <p><b>CO 2:</b> Outline policies and procedures for management of natural and man-made emergencies. (C2)</p> <p><b>CO 3:</b> Explain mitigation and management of laboratory emergencies. (C2)</p> <p><b>CO 4:</b> Develop skills for handling emergencies. (C2)</p>													
<b>Mapping of COs to POs</b>														
<b>COs</b>	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>	<b>PO 9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>	<b>PO 13</b>	<b>PO 14</b>
CO 1	✓	✓	✓					✓	✓		✓	✓		✓
CO 2	✓	✓	✓				✓		✓		✓			
CO 3	✓	✓	✓	✓		✓		✓	✓		✓			
CO 4	✓							✓	✓		✓		✓	
<b>Learning Strategies, Contact Hours and Student Learning Time (SLT)</b>	<b>LEARNING STRATEGY</b>						<b>CONTACT HOURS</b>						<b>SLT</b>	
	Lecture						-						-	
	Seminar						7						21	
	Small Group Discussion (SGD)						3						9	



	Self-directed learning (SDL)	2	6
	Problem Based Learning (PBL)	1	3
	Case Based Learning (CBL)	-	-
	Clinic	-	-
	Practical	-	-
	Revision	-	-
	Assessment	2	
	<b>TOTAL</b>	<b>15</b>	<b>39</b>
<b>Assessment Methods</b>	<b>FORMATIVE</b>	<b>SUMMATIVE</b>	
	Assignment	-	
	Student presentation		
	Group discussion		
	Internal assessment		

<b>Mapping of assessment with COs</b>				
<i>Nature of assessment</i>	<b>CO 1</b>	<b>CO 2</b>	<b>CO 3</b>	<b>CO 4</b>
Assignments	✓			✓
Student presentations		✓	✓	
Internal assessment	✓	✓	✓	✓
End-semester examination	✗	✗	✗	✗
Practical examination	✗	✗	✗	✗

<b>Feedback Methods</b>	Student feedback on Course and Course master
<b>Reference Materials</b>	<ul style="list-style-type: none"> <li><a href="https://www.who.int/hac/techguidance/preparedness/en/">https://www.who.int/hac/techguidance/preparedness/en/</a></li> </ul>

<b>Course learning outcomes</b>			
<b>Content</b>	<b>Topics</b>	<b>Learning Outcomes</b>	<b>Hours (Tutorials)</b>
<b>Unit 1</b>	Definition and types of disaster management	<ul style="list-style-type: none"> <li>Define disaster and classify types of disaster. (C2)</li> <li>Explain disaster management. (C2)</li> </ul>	4
<b>Unit 2</b>	Study of Important disasters (External and Internal emergencies)	<ul style="list-style-type: none"> <li>Explain emergency management plan for natural and man-made emergencies. (C2)</li> </ul>	4
<b>Unit 3</b>	Mitigation and Management of laboratory emergencies	<ul style="list-style-type: none"> <li>Explain risk assessment and mitigation plan for management of</li> </ul>	4



		laboratory emergencies. (C2)	
<b>Unit 4</b>	Training, awareness program and preparedness on disaster management	<ul style="list-style-type: none"> <li>Develop skills for emergency (fire, spills) response. (C2)</li> </ul>	3

MANIPAL INSTITUTE OF VIROLOGY, MAHE







Manipal Institute of Virology

**CURRICULUM**

<b>Name of Program</b>	MSc Clinical Virology
<b>Course Title</b>	<b>Research Project</b>
<b>Course Code</b>	MIV699
<b>Academic Year</b>	2021-2023
<b>Semester</b>	IV
<b>No. of credits</b>	<b>12</b>
<b>Course Prerequisite</b>	First class/CGPA 6.5 at UG level (BSc Life Sciences/Health Sciences)
<b>Course Synopsis</b>	<ol style="list-style-type: none"> <li>1. Students of M.Sc. Clinical Virology shall carry out a Project Work for a minimum of 24 weeks.</li> <li>2. The project may be carried out in the institution/ industry/ research laboratory or any other institution where facilities exist with approval of the parent institute.</li> <li>3. The research project will be both assessed and credited.</li> </ol>
<b>Course Outcome</b>	<p><b>CO1:</b> Formulate a research question. (C5)</p> <p><b>CO2:</b> Conduct extensive literature review. (C4)</p> <p><b>CO3:</b> Delineate aims and objectives of the study. (C3)</p> <p><b>CO4:</b> Procure required materials for the work. (C4)</p> <p><b>CO5:</b> Devise the methodology and execute the experiments. (C5, P3)</p> <p><b>CO6:</b> Analyse and document the outcome. (C4, P3)</p> <p><b>CO7:</b> Present research findings to the panel of examiners. (C5, P6, A5)</p> <p><b>CO8:</b> Translate the scientific findings into a manuscript. (C5, P5)</p>

**Mapping of COs to POs**

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14
CO 1	✓		✓					✓						
CO 2	✓									✓	✓		✓	
CO 3			✓		✓	✓		✓			✓			
CO 4		✓											✓	
CO 5			✓	✓	✓	✓	✓	✓	✓			✓	✓	
CO 6			✓	✓	✓			✓		✓	✓	✓		



CO 7	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	
CO 8	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	
<b>Assessment Methods</b>				<ul style="list-style-type: none"> <li>• Interim presentation by the student, three months from the commencement of the project, to discuss the work progress</li> <li>• Final evaluation after the completion of the project work and submission of the dissertation through viva-voce/open defence.</li> </ul>										

MANIPAL INSTITUTE OF VIROLOGY, MAHE



## 8. PROGRAM OUTCOMES & COURSE OUTCOMES MAPPING

S. No.	Course Code	Course Name	Credits	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14
1.	MIV501	Cell Biology	1	CO1 CO2 CO3 CO4 CO5 CO6 CO7							CO1 CO5 CO6	CO5 CO7		CO1 CO2 CO3 CO4 CO5 CO6 CO7			
2.	MIV503	Basic Virology	3	CO1 CO2 CO3 CO4 CO5 CO6 CO7		CO4 CO5		CO6 CO7	CO6 CO7			CO4		CO1 CO2 CO3 CO4 CO5 CO6 CO7			
3.	MIV505	Biosafety and Biosecurity	2	CO1 CO2 CO3 CO4 CO5 CO6	CO3 CO4 CO5	CO1 CO2 CO4 CO5 CO6	CO4 CO6		CO2 CO3 CO4 CO6		CO1	CO1		CO1 CO2 CO3 CO4 CO5 CO6			
4.	MIV507	Tissue/Cell culture	2	CO1 CO2 CO3 CO4 CO5		CO3 CO4		CO4	CO2 CO3		CO1	CO2		CO1 CO2 CO3 CO4 CO5		CO3	
5.	MIV509	Systematic Virology-I	4	CO1 CO2 CO3 CO4	CO1 CO3	CO1 CO3 CO4		CO1			CO3 CO4			CO1 CO2 CO3 CO4			
6.	MIV511	Systematic Virology-II	4	CO1 CO2 CO3 CO4	CO1 CO3	CO1 CO3 CO4		CO1			CO3 CO4			CO1 CO2 CO3 CO4			



7.	MIV513	Immunology of Viral diseases	3	CO1 CO2 CO3 CO4 CO5 CO6 CO7 CO8 CO9 CO10		CO2 CO3 CO6 CO9 CO10					CO3 CO5 CO9 CO10	CO10		CO1 CO2 CO3 CO4 CO5 CO6 CO7 CO8 CO9 CO10			
8.	MIV515	Practical I	1	CO1 CO2 CO3		CO2			CO1 CO2			CO1		CO1 CO2 CO3		CO2	
9.	MIV517	Microbiology postings	2	CO1 CO2 CO3		CO2			CO1 CO2			CO1		CO1 CO2 CO3		CO2	
10.	MIV502	Epidemiology	3	CO1 CO2 CO3 CO4 CO5 CO6 CO7	CO3 CO4 CO5	CO1 CO2 CO4 CO6	CO4 CO5 CO6	CO6		CO4 CO5	CO2	CO4 CO7	CO5 CO6	CO1 CO2 CO3 CO4 CO5 CO6 CO7	CO4 CO5		CO4 CO5
11.	MIV504	Molecular Virology and Bioinformatics	3	CO1 CO2 CO3 CO4	CO2	CO2 CO3	CO2 CO4	CO2 CO3	CO3 CO4			CO2	CO2 CO3 CO4	CO1 CO2 CO3 CO4			
12.	MIV506	Virological Techniques	3	CO1 CO2 CO3 CO4 CO5 CO6		CO3	CO6 CO6	CO1 CO2 CO3 CO4 CO5 CO6		CO1	CO5		CO1 CO2 CO3 CO4 CO5 CO6		CO1 CO3		
13.	MIV508	Insect vectors of Viral diseases	3	CO1 CO2 CO3 CO4 CO5 CO6 CO7		CO3 CO6 CO7			CO3 CO4 CO6		CO3 CO7		CO1 CO2 CO3 CO4 CO5 CO6 CO7				
14.	MIV510	Disease related risk communication	2	CO1 CO2 CO3 CO4 CO5	CO1 CO3 CO4 CO5	CO3 CO4 CO5					CO3	CO2 CO5		CO1 CO2 CO3 CO4 CO5	CO3 CO5	CO3 CO5	



15.	MIV512	Emerging Viral Diseases and Public health response	3	C01 C02 C03 C04 C05		C02	C02				C01 C02 C04	C02 C04		C01 C02 C03 C04 C05	C04	C04	C04
16.	MIV514	Practical II	3	C01 C02 C03 C04 C05 C06 C07	C02	C02 C03	C02 C07	C02 C03 C07	C03 C04 C05 C06 C07		C04	C02 C06	C02 C03	C01 C02 C03 C04 C05 C06 C07		C04	
17.	MIV516	Laboratory Rotation - I	2	C01 C02					C01 C02			C01		C01 C02		C02	
18.	MIV601	Clinical & Diagnostic Virology-I	3	C01 C02 C03 C04 C05 C06 C07		C02 C04 C05 C06 C07	C05 C06 C07		C06		C02 C04 C05 C07	C02 C04 C05 C06 C07	C01 C02 C03 C04 C05 C06 C07		C06		
19.	MIV603	Clinical & Diagnostic Virology-II	3	C01 C02 C03 C04 C05 C06 C07		C02 C04 C05 C06 C07	C05 C06 C07		C06		C02 C04 C05 C07	C02 C04 C05 C06 C07	C01 C02 C03 C04 C05 C06 C07		C06		
20.	MIV605	Viral Vaccines & Antiviral Pharmacotherapy	4	C01 C02 C03 C04 C05 C06 C07 C08	C04 C05 C06 C07 C08	C02 C03		C07	C02 C03 C07 C08	C07 C08	C02 C03 C04 C07 C08	C02 C04 C05 C06 C07 C08		C01 C02 C03 C04 C05 C06 C07 C08		C03 C07	
21.	MIV607	Application of GIS in viral disease epidemiology	2	C01 C02 C03 C04 C05		C02 C03 C05	C02 C04		C03 C05			C03 C04 C05	C01 C02 C03 C04 C05	C01 C02 C03 C04 C05		C01	
22.	MIV609	Virology lab design and management	2	C01 C02 C03		C01 C02 C03	C01	C01 C03	C02	C01	C01 C02	C02 C03		C01 C02 C03			



23.	MIV611	Comprehensive Practical	4	C01 C02 C03 C04 C05 C06 C07		C01 C02 C04 C05 C06 C07	C01 C02 C05 C06 C07		C01 C02 C06		C04 C05 C07	C01 C02 C04 C05 C06 C07		C01 C02 C03 C04 C05 C06 C07		C01 C02 C06	
24.	MIV602	Bioethics	1	C01 C02 C03 C04 C05 C06	C05	C05 C06		C05	C03 C04 C05	C05	C03 C04 C05	C04 C05 C06	C06	C01 C02 C03 C04 C05 C06	C01 C02 C03 C04 C05 C06		C01
25.	MIV604	Analytical methods	1	C01 C02 C03 C04 C05 C06 C07		C01 C02 C03 C04 C05 C06 C07	C01 C02 C03 C04 C05 C06 C07	C01 C02 C03 C04 C05 C06 C07			C01 C02 C03 C04 C05 C06 C07		C01 C02 C03 C04 C05 C06 C07	C01 C02 C03 C04 C05 C06 C07			
26.	MIV606	Biostatistics	2	C01 C02 C03 C04 C05 C06 C07		C04 C06 C07	C02 C03 C04 C05 C06 C07	C03 C04 C05 C06 C07			C03	C03 C04 C06 C07	C02 C03 C04 C05 C06 C07	C01 C02 C03 C04 C05 C06 C07			
27.	MIV608	Intellectual Property rights and patenting	1	C01 C02 C03 C04 C05	C01 C04 C05	C01 C02 C03 C04				C01	C02 C03 C05	C02 C03 C04 C05		C01 C02 C03 C04 C05	C04 C05	C02 C05	C04
28.	MIV610	Disaster management	1	C01 C02 C03 C04	C01 C02 C03	C01 C02 C03	C03		C03	C02	C01 C03 C04	C01 C02 C03 C04		C01 C02 C03 C04	C01 C04	C04	C01
29.	MIV699	Research Project	12	C01 C02 C07 C08	C04 C08	C01 C03 C05 C06 C07 C08	C05 C06 C07 C08	C03 C05 C06 C07 C08	C03 C05 C07 C08	C05	C01 C03 C05 C06 C07 C08	C05 C07 C08	C02 C06 C07 C08	C02 C03 C05 C06 C07 C08	C04 C05 C07 C08	C02	



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