



# **Department of Microbiology**

**Manipal Academy of Higher Education, Manipal**

*Outcomes Based Education (OBE) Framework*

**Two Year full time Postgraduate Program**

**M.Sc. Microbiology (Medical)**



# MANIPAL

ACADEMY of HIGHER EDUCATION

*(Deemed to be University under Section 3 of the UGC Act, 1956)*

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## **1. NATURE AND EXTENT OF THE PROGRAM**

Growing medical needs, requires competitive human resources to meet the challenges in technical and non-technical fields including diagnostics, clinical laboratories and therapy since microbiology and medicine are intimately related disciplines. Medical Microbiology contributes to the knowledge of human infectious diseases and provides in-depth knowledge in laboratory diagnosis of diseases and aid in developing strategies to assess and maintain health in general.

M.Sc. in Microbiology (Medical) aims at grooming postgraduates to understand the basics of human infections along with the basics of immunology, biostatistics, and elective subjects. Wide knowledge of principle and application of various instruments and techniques used in the clinical and research field. Provides hands on experience in clinical laboratory functioning, and basics of quality control in clinical laboratory. The present program provides a theoretical and practical exposure to fundamentals of bacteriology, immunology, mycology, parasitology, virology, molecular diagnostics, and quality control along with research methodologies.

M.Sc. in Microbiology (medical) would open for any graduate with biological science stream/combination having 60% of marks in qualifying examination. Extensive training in theory research methodology, biostatistics, molecular biology techniques, and mandatory research project enable the students to choose careers in academics, research, and industry.

## 2. PROGRAM EDUCATION OBJECTIVE (PEO)

The overall objectives of the Learning Outcomes-based Curriculum Framework (LOCF) for **M.Sc. Microbiology (Medical)** program are as follows.

PEO No	Education Objective
PEO 1	Students will be able to apply and integrate the basic knowledge, Students will have an ability to acquire in-depth theoretical and practical knowledge of Microbiology solve problems and widen perspective.
PEO 2	Students will be able to apply the practical aspects of existing techniques that help in addressing the biological and medical challenge whenever required/applicable.
PEO 3	Students will be able to apply the contextual knowledge and modern tools of microbial research for solving problems.
PEO 4	Students will be able to express ideas persuasively and to apply fundamental knowledge for providing innovative solutions to meet the need-based problems for global impact in an interdisciplinary manner.
PEO 5	Students will develop an ability to critically analyse scientific data, draw objective conclusions and apply this knowledge for human welfare.
PEO 6	Students will be able to promote lifelong learning to meet the advances in professional field by developing ethical, interpersonal and team skills.

### Students will be able to

- Utilise suitable methods and bio-statistical/ QC knowledge to evaluate the results of investigations
- Identify the knowledge gaps in microbiology and design and execute appropriate experiments to investigate a relevant problem
- The course will help students to get acquainted with basic instrumentation, principle and procedure and it will enable to implement the use of instruments like MALDI ToF, VITEK, Real Time PCR, MGIT 960, Automated blood culture, Chemiluminescence Analyser, Autoimmune disease diagnosis in biological research.

**3. GRADUATE ATTRIBUTES:**

S No.	Attribute	Description
1	<b>Disciplinary Knowledge</b>	Acquiring the theoretical knowledge and practical strategies to use specific techniques, result analysis, work with instruments and research problems
2	<b>Understanding different subsets of digital marketing</b>	General microbiological and aseptic techniques, microbial identification system and their evaluation, and Quality control
3	<b>Measurable Skills and Industry-ready Professionals</b>	Basic and applicable knowledge of instrumentation, laboratory skills and result analysis
4	<b>Effective and Influencing communication</b>	Effective and Influencing written and speech communications to share ideas, build relationships and to handle challenges
5	<b>Leadership readiness/ Qualities</b>	To maximize efficiency and to achieve organizational goals.
6	<b>Critical/ Reflective thinking &amp; language efficiency</b>	For self-evaluation, corrective actions, and efficient communication
7	<b>Technologically Efficient Professional</b>	To build up and enhance the ability to apply latest techniques and procedures by updating with modern availability and requirements at workplace
8	<b>Ethical Awareness</b>	It is important to know the professional ethics and responsibilities in the field of work
9	<b>Lifelong Learning</b>	Updating with current knowledge of skills, techniques and theoretical knowledge is of prime importance in the competitive & rapidly growing world and is a lifelong process.
10	<b>Research-related Skills</b>	Urge of exploration/ ability to gather information in the relevant, interested field, to review, analyse and interpret the information to get a solution.
11	<b>Cooperation/ Teamwork</b>	A good <i>team</i> can yield a wide range of possible solutions for each specific problem to meet workplace challenges

#### **4. QUALIFICATIONS DESCRIPTORS**

Typically, holders of the qualification will be able to:

1. Demonstrate comprehensive knowledge about the basic sciences in general and Microbiology in particular including current research in the field
2. Demonstrate knowledge of ethics, legal framework, and biomedical waste disposal.
3. Demonstrate laboratory skills in microbiology and techniques required in the field.
4. Demonstrate team work and professionalism and be a role model.
5. Demonstrate critical thinking, identify existing gaps and mitigate them through research.
6. Publish the results of their study/work undertaken accurately and reliably, and with structured and coherent argument.
7. Identify and address their own learning needs to remain relevant in their chosen profession.

**PROGRAM OUTCOMES:** After successful completion of M. Sc. In Microbiology (Medical), Students will be able to:

PO No.	Attribute	Competency
PO 1	Domain knowledge	Apply the theoretical & practical knowledge of microbiological importance in laboratory, industry, and research
PO 2	Problem analysis	Identification, categorization, organising, and scrutinising the problems to draw the conclusion using theoretical/practical knowledge in industry/ laboratory setting/ in work area
PO 3	Design/develop solutions	Design/Develop laboratory equipment, devices, new methods to get efficient results
PO 4	Conduct investigations of complex problems	To develop microbial products and application processes. Identify the biological systems to carry out various analysis, prepare technical report after analysing the data as per the need at/of the time.
PO 5	Modern tool usage	Recognise, develop, adopt, and apply the relevant techniques/ modalities
PO 6	Business and society	Maintain and manage the professional responsibilities such as ethical, legal, and societal issues by applying the contextual knowledge
PO 7	Environment and sustainability	Recognize the significance and effect of new developments on society and environment and explain the impact effectively
PO 8	Ethics	Understanding and obeying the profession ethics and its management on contextual basis/knowledge
PO 9	Individual / Teamwork	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	Communication	Communicate effectively according to the situations comprehensively by written or oral communications to meet the expectations
PO 11	Project management and finance	Demonstrate knowledge and understanding of the financial management principles and apply these to evaluate new and existing projects for effective decision making
PO 12	Life-long learning	Life-long learning capacity to update with current knowledge of skills, techniques and theoretical knowledge is of prime importance in the competitive & rapidly growing world.



**FIRST YEAR:**

**Semester: 1**

**Semester: 2**

Subject Code	Subject Title	L	T	P	C	Subject Code	Subject Title	L	T	P	C
MCC 601	Common Core 1 : Basic sciences	3	1	0	4	MCC 602	Common Core 2 : Introduction to research	2	2	0	4
MIC 603	General Microbiology	1	3	0	4	MIC 604	Systematic Bacteriology -1	2	2	0	4
MIC 605	Immunology	2	2	0	4	MIC 606	Systematic Bacteriology-2	1	3	0	4
MIC 607	Lab 1 (Practical): General Microbiology	0	0	8	4	MIC 608	Lab (Practical): Bacteriology	0	0	8	4
MIC 609	Lab 2 (Practical): Immunology	0	0	8	4	MEL 610	<b>ELECTIVE - 1</b>	1	1	4	4
		<b>6</b>	<b>6</b>	<b>16</b>	<b>20</b>			<b>6</b>	<b>8</b>	<b>12</b>	<b>20</b>

**SECOND YEAR (FINAL YEAR):**

**Semester: 3**

**Semester: 4**

Subject Code	Subject Title	L	T	P	C	Subject Code	Subject Title	L	T	P	C
MIC 701	Virology	2	2	0	4	MIC 702	Mycology + Molecular Techniques	2	2	0	4
MIC 703	Parasitology	2	2	0	4	MIC 704	Lab 1 (Practical): Mycology	0	0	6	3
MIC 705	Lab 1 (Practical): Virology	0	0	8	4	MIC 706	Lab 2 (Practical): Molecular techniques	0	0	6	3
MIC 707	Lab 2 (Practical): Parasitology	0	0	8	4	MIC 798	Project*	0	0	20	10
MEL709	<b>ELECTIVE -2</b>	1	1	4	4	-----	-----	--	--	--	----
		<b>5</b>	<b>5</b>	<b>20</b>	<b>20</b>		Total	<b>2</b>	<b>2</b>	<b>32</b>	<b>20</b>

\*Electives are allotted to the students based on their GPA

\*Students cannot opt for electives offered by their parent department.

\*Additional Electives/Courses would be added to the list of electives from time to time as recommended by MSc Academic review committee.



Name of the Institution / Department: DEPARTMENT OF MICROBIOLOGY

<b>Name of the Program:</b>		<b>MSc Microbiology (Medical)</b>									
<b>Course Title:</b>		<b>Common Core 1 – Basic Sciences</b>									
<b>Course Code: MCC 601</b>		<b>Course Instructor: Faculty Department of Anatomy, Physiology and Biochemistry</b>									
<b>Academic Year: 2020-2021</b>		<b>Semester: First Year, Semester 1</b>									
<b>No of Credits: 4</b>		<b>Prerequisites: Nil</b>									
<b>Synopsis:</b>		This course deals with imparting knowledge of basic science subjects namely, Anatomy, physiology and biochemistry, so that the students acquire sound knowledge of basic subjects that form foundation to all other medical subjects. This course will run during the first 8 weeks in the first semester.									
<b>Course Outcomes (COs):</b>		On successful completion of this course, students will be able to									
CO 1:		Apply the knowledge of basic science subjects and develop understanding of human body structure and functioning.									
<b>Mapping of COs to POs</b>											
<i>COs</i>	<i>PO 1</i>	<i>PO 2</i>	<i>PO 3</i>	<i>PO 4</i>	<i>PO 5</i>	<i>PO 6</i>	<i>PO 7</i>	<i>PO 8</i>	<i>PO 9</i>		
CO 1	X										
<b>Course content and outcomes:</b>											
<i>Content</i>		<i>Competencies</i>								<i>No of Hours</i>	
<b>Unit 1: Anatomy</b>											
<ul style="list-style-type: none"> <li>General anatomy</li> <li>Introduction to systems of the body</li> </ul>		<ul style="list-style-type: none"> <li>Explain the history of anatomy and Subdivision/branches of the anatomy and their functions in brief (1 hr)</li> <li>Describe the nomenclature, subdivisions, terms and arrangements of anatomical structures (1 hr)</li> <li>Describe different types of skin, fascia and connective tissue, epithelium and cartilage (1 hr)</li> <li>Describe the nomenclature, types, parts, attachments and mechanics of muscles (1hr)</li> <li>Describe the types, growth, blood supply, functions and ossification of bones (1 hr)</li> <li>Classify the joints with structure &amp; examples (1hr)</li> <li>Identify major muscles and bones in the body along with their location (4 hrs)</li> <li>Describe the different types of blood vessels, capillaries and sinusoids, components and functions of lymphatic system and structure of lymph node (1 hr)</li> <li>Enumerate the components of cardiovascular system and briefly describe the external features of heart, its blood supply and interior of the chambers (2 hrs)</li> </ul>								32	

	<ul style="list-style-type: none"> <li>• Enumerate the major blood vessels in the body along with its location (2 hr)</li> <li>• Describe the location, parts and function of organs belonging to Respiratory system (3 hrs)</li> <li>• Describe the structure and types of neurons, neuroglia cells, cranial and spinal nerves (2 hr)</li> <li>• Enumerate the parts of brain and brain stem and briefly describe major parts (2 hrs)</li> <li>• Describe the location, parts and function of organs belonging to Gastro intestinal system (4 hr)</li> <li>• Describe the location, parts and function of organs belonging to Renal and reproductive systems (4 hr)</li> <li>• Describe the location, parts and function of organs belonging to endocrine system and special senses (2 hrs)</li> </ul>	
<b>Unit 2: Physiology</b>		
<p>Blood and body fluids</p> <p>Kidney, skin and temperature regulation</p> <p>Cardiovascular system</p>	<ul style="list-style-type: none"> <li>• Describe the body fluid compartments; composition of body fluids, Transport mechanisms with examples, composition and functions of blood; Plasma Proteins – functions (1 hr)</li> <li>• Describe the functions, types, normal values of Haemoglobin and anemia, life span and destruction of RBC and Jaundice (1 hr)</li> <li>• Describe the functions, normal value, variations in Platelets, Hemostasis, blood coagulation, Bleeding disorders, tests for clotting, anticoagulants- actions and uses, WBC Immunity (1 hr)</li> <li>• Determination of RBC, WBC, Hemoglobin count, PCV, ESR Bleeding time, Clotting time (2 hr)</li> <li>• Describe the functions of kidney, Functional anatomy of kidney, renal blood flow, Glomerular filtration rate Tubular functions, Micturition (1 hr)</li> <li>• Describe the functions of skin; body temperature regulation (1 hr)</li> <li>• Describe the design of systemic and pulmonary circulation, anatomy of heart and blood vessels, innervation to heart and blood vessels (1 hr)</li> </ul>	24



	<ul style="list-style-type: none"> <li>• Describe the Cardiac cycle, ECG and heart sounds, Cardiac output: determinants, variations, regulation (2 hr)</li> <li>• Describe the Arterial blood pressure and regulation, shock Coronary circulation (1 hr)</li> </ul>	
Endocrines	<ul style="list-style-type: none"> <li>• Describe the actions and disorders of Anterior pituitary hormones, Posterior pituitary hormones, Thyroid hormones, Adrenal cortical hormones, Adrenal medullary hormones, Hormones of endocrine pancreas (1 hr)</li> </ul>	
Reproductive system	<ul style="list-style-type: none"> <li>• Describe Calcium homeostasis – Functions of calcium, hormones regulating plasma calcium level, parathormone, calcitonin and vitamin D<sub>3</sub> (1 hr)</li> </ul>	
Digestion	<ul style="list-style-type: none"> <li>• Overview of Male reproductive system- Female reproductive system – Menstrual cycle and regulation (1 hr)</li> <li>• Describe the Concept of Pregnancy and parturition, Lactation and family planning (1 hr)</li> </ul>	
Central nervous system	<ul style="list-style-type: none"> <li>• Describe the Composition, function of saliva, gastric juice, pancreatic juice, Bile. (1 hr)</li> <li>• Describe the Deglutition, Gastric emptying, movements of small intestine (1 hr)</li> <li>• Explain the functions of large intestine: movements of colon and defecation (1hr)</li> </ul>	
	<ul style="list-style-type: none"> <li>• Describe Receptors, synapse, reflexes (1 hr)</li> <li>• Explain the Ascending and descending pathways (1 hr)</li> <li>• Describe the Functions and effect of lesions of cerebellum, basal ganglia, Functions of hypothalamus (1 hr)</li> </ul>	
Special senses	<ul style="list-style-type: none"> <li>• Describe the Cerebral cortex, functional area, cerebrospinal fluid, EEG, sleep (1 hr)</li> <li>• Describe the Physiology of taste and smell, Structure and function of external, middle and internal ears (1 hr)</li> <li>• Describe the Structure of eye, functions of different components, accommodation of eye, common errors of refraction, Visual pathway, colour vision (1 hr)</li> </ul>	



Unit 3: Biochemistry						
<ul style="list-style-type: none"> <li>Amino acids and proteins</li> <li>Enzymes</li> <li>Blood glucose regulation &amp; diabetes mellitus</li> <li>Vitamins &amp; Minerals</li> <li>Nutrition</li> </ul>	<ul style="list-style-type: none"> <li>Brief outline of Classification, properties and structural organization and biomedical significance of Proteins, carbohydrates, lipids and nucleic acids.</li> <li>Brief account of general characteristics, kinetics and Inhibition of enzymes</li> <li>Enumerate the hypoglycemic and hyper glyceemic hormones with their action in regulation of blood glucose and note on diabetes mellitus</li> <li>Discuss the classification, functions and associated disorders of Vitamins &amp; Minerals</li> <li>Discuss the general aspects of nutrition by defining SDA, BMR, nutritional significance of macromolecules and PEM</li> </ul>	24				
Learning strategies, contact hours and student learning time						
Learning strategy	Contact hours	Student learning time (Hrs)				
Lecture	60	180				
Tutorial	10	30				
Small Group Discussion (SGD)	10	30				
Revision	10	10				
Assessment	10	10				
<b>TOTAL</b>	<b>100</b>	<b>260</b>				
Assessment Methods:						
Formative:	Summative:					
Class tests /Quiz	Sessional examination					
Assignments	End semester examination					
Mapping of assessment with Cos						
Nature of assessment	CO 1	CO 2	CO 3	CO 4	CO 5	CO 6
Sessional Examination 1	X					
Sessional Examination 2	X					
Quiz/ class test	X					
Assignment	X					
End Semester Examination	X					
Feedback Process	<ul style="list-style-type: none"> <li>Mid-Semester feedback</li> <li>End-Semester Feedback</li> </ul>					
Reference Material	<ol style="list-style-type: none"> <li>Text book of general anatomy by Vishram Singh</li> <li>Manipal manual of physiology</li> <li>Essentials of biochemistry by Sathyanarayana</li> </ol>					



Name of the Institution / Department: DEPARTMENT OF MICROBIOLOGY

<b>Name of the Program:</b>		<b>M.Sc. in Microbiology (Medical)</b>										
<b>Course Title:</b>		<b>Common Core 1, General Microbiology, Immunology, Lab 1 – General Microbiology, Lab 2 – Immunology</b>										
<b>Course Code:</b> MIC 603 MIC 605 MIC 607 MIC 609		<b>Course Instructor:</b> Faculty of the Department of Microbiology										
<b>Academic Year:</b> 2021-2022		<b>Semester:</b> First Year, Semester 1										
<b>No of Credits:</b> 4		<b>Prerequisites:</b> Nil										
<b>Synopsis:</b>		This course would provide basic knowledge required to build up on further in their specific subjects. Under this basic microbiology, students will be exposed to the foundation on fundamentals of General microbiology and Immunology.										
<b>Course Outcomes (COs):</b>		On successful completion of this course, students will be able to										
CO 1:		Understand the principles, functioning and applications of general microbiological techniques										
CO 2:		Comprehend the cell structure, genetics, physiology and virulence attributes of microorganism and microbial virulence factors in infectious diseases.										
CO 3:		Understand the fundamental principles underlying pathological mechanisms, host immune defences in health and diseases and their diagnostic modalities										
CO 4:		Apply the principles of aseptic methods and perform bacterial characterization and drug susceptibility testing.										
CO 5:		Perform and interpret immunoserological tests for common infectious diseases										
<b>Mapping of COs to POs</b>												
<i>COs</i>	<i>PO 1</i>	<i>PO 2</i>	<i>PO 3</i>	<i>PO 4</i>	<i>PO 5</i>	<i>PO 6</i>	<i>PO 7</i>	<i>PO 8</i>	<i>PO 9</i>	<i>PO 10</i>	<i>PO 11</i>	<i>PO 12</i>
CO 1	X	X		X								X
CO 2	X	X		X								X
CO 3	X	X		X								X
CO 4	X	X	X	X	X			X	X	X		X
CO 5	X	X	X	X	X			X	X	X		X
<b>Course content and outcomes:</b>												
<i>Content</i>		<i>Competencies</i>									<i>No of Hours</i>	
<b>Unit 2: MIC 603 - General Microbiology</b>										<b>80</b>		
Introduction		Define Microbiology, List the Branches in medical microbiology, Morphological forms of bacteria, Classification, Identification and typing of micro-organisms, The role of microorganisms in infection, Host microbe interactions									1	



History	Describe the contributions of various scientists to medical, microbiology, Antony Van Leuwenhoek – discovery of bacteria-, Theory of spontaneous generation. Contributions of Louis Pasteur, Discovery of vaccines, solid media, Contributions of Robert Koch, Koch’s postulates, and its short comings, Koch’s Molecular postulates, Discovery of disinfectant – father of antiseptic surgery – Lord Lister	1
Bacterial cell structure	Describe the various parts of bacterial cell: Cell wall, cytoplasmic membrane, cytoplasm, Extracellular structures, Endospores	10
Bacterial growth & nutrition, Bacterial physiology, Bacterial metabolism	Binary fission, generation time and growth requirements of bacteria, Classification of bacteria according to oxygen requirements, temperature and pH requirement, physiological mechanisms, definitions of auxotrophs, chemotrophs, Capnophilic, Halophilic and Bacterial growth curve in detail with diagram	10
Culture media, culture methods, Cultural characteristics	Enumerate different types of culture media, techniques employed in bacterial cultivation, colony morphologies, pigment production, biochemical tests in the identification of bacteria	10
Antimicrobial sensitivity tests	Types of antibiotic sensitivity methods- Diffusion and dilution methods. Diffusion methods- Kirby Bauer method and their uses. Dilution methods-Broth and Agar dilution and their uses and Interpretation of antibiotic sensitivity tests	8
Genetics	Basic principles of genetics, chromosome and extra-chromosomal DNA Mutation: Definition, types, mutagens and effects Plasmids-Definition, classification, properties, functions and uses Transposons- Definition, structure and functions Gene transfer in bacteria- Methods, mechanism and functions of transformation, Transduction, conjugation and transposition. Drug resistance- Definition, mechanisms, types with examples and clinical implications of Drug resistance	10
Sterilization & Disinfection	Definition of sterilization, disinfection and antiseptis. Differences between sterilization and disinfection, Classification of sterilization, Heat-types of heat, factors affecting sterilization by heat, dry heat-mode of action, Principle, description and uses of flaming, red heat incineration, hot air oven (in detail), sterilization control , Moist heat- Classification, Principle, procedure and uses of Pasteurization, inspissation, Tyndallisation	20



	<p>Definition, principle, types, procedure, advantages, disadvantages and uses of laboratory autoclave with a note on sterilization control, filtration- principle of filtration, types, uses, advantages and disadvantages of different types of bacterial filters (Candle filter, Asbestos filter, sintered glass filter and membrane filter), Radiation- types (ionizing, nonionizing), principle and uses</p> <p>Chemicals used for sterilization, Disinfection-Chemical agents used, modes of actions and uses, a note on factors affecting disinfection and testing of disinfectants,</p>	
Bacteriology of water, food and milk	<p>Describe the infections and the causative agents of infections transmitted by food and water</p> <p>Describe the methods used to detect the presence of microbial contamination of food and water</p>	10
Unit 3: MIC 605 – Immunology		80
Infection	<p>Types of infections, sources of infection, methods of transmission of infection</p> <p>Microbial pathogenicity: Bacterial virulence factors- Transmission, adherence, invasion, intracellular survival. Toxin production- Types of bacterial toxins, comparison of endotoxin and exotoxins. Bacterial enzymes related to virulence.</p> <p>Definition of attenuation and exaltation</p>	10
Antigens and adjuvants	<p>Antigens, Immunogens, Haptens and Antigenic determinants, Properties and factors affecting immunogenicity of a substance. Explanation of types of antigens (Autoantigens, Isoantigens, Heterophile antigens, T cell dependent/independent antigens)</p> <p>Adjuvants: Definition, properties and types</p>	4
Immunoglobulins	<p>Definitions of Immunoglobulins/antibodies. Explanation of the structure of an Immunoglobulin molecule. The different classes of Immunoglobulins (IgM, IgG, IgA, IgE, IgD), their properties, functions. Note on significance of detection of different classes of Immunoglobulins. Note on Monoclonal antibodies.</p>	4
Structure and functions of the Immune system	<p>Introduction to the components of the immune system, Classification of lymphoid organs, Structure and functions of the thymus, Bursa and Bursa equivalent (Bone Marrow), Structure and functions of the lymph node, spleen and MALT</p> <p>T Cells- Definition, development of T cells, Classification (subtypes) of T cells, features of T cells, Activation, functions, Comparison of T cells and B cells</p>	10



	B Cells- Definition, development, features, Activation and Functions, Properties and functions of Natural Killer cells- Dendritic cells - Polymorphonuclear leukocytes, Eosinophils	
Immunity	<p>Definitions, Classification of types of Immunity, Comparison of Innate &amp; Acquired immunities. Explanation of the innate defense mechanisms of the body. Factors affecting innate immunity. Innate defense mechanisms at the Species, Racial levels</p> <p>Acquired Immunity – Explanation of Active acquired immunity &amp; Passive acquired immunity with examples. Comparison of active &amp; passive immunity. Explanation of Local immunity &amp; Herd Immunity. Vaccines – Principle of vaccination &amp; types of vaccines with examples</p>	6
Complement system	<p>Introduction to the complement system, explanation of the complement components. The explanation of the mechanisms of activation of the alternate / classic cascade / lectin pathways. The consequences of activation of complement system. Regulation &amp; control of the complement system. The role of complement in health &amp; disease (deficiencies of complement fractions, anaphylatoxic effects of complement fractions, role of complement in hypersensitivities &amp; autoimmune disorders.</p>	2
Antigen – Antibody reactions	<p>Classification and general features of antigen antibody reaction and Zone phenomenon</p> <p>Principle, types with examples and uses of precipitation reaction</p> <p>Principle, types with examples and uses of agglutination and complement fixation test</p> <p>Principle, types with examples and uses of neutralization test, Immunofluorescence, Enzyme Immuno assay, and RIA</p>	22
Immune responses	<p>Definition and types of immune response, Humoral Immune Response-Steps in the production of antibodies, primary and secondary immune response</p> <p>Factors affecting antibody production, mechanisms of antibody mediated immunity</p> <p>Cell mediated immune response- mechanism, classification of cytokines with examples, functions of cytokines, functions of CMI and evaluation of CMI</p>	4
Hypersensitivity	<p>Definitions, Classification and comparison of hypersensitivity</p> <p>Type I hypersensitivity (IgE dependent) - Anaphylaxis and Atopy</p>	10





	<p>Anaphylaxis – Definition, mechanism with description of primary and secondary mediators, types and clinical aspects, treatment and prevention</p> <p>Atopy – definition, mechanism examples</p> <p>Type II hypersensitivity – mechanisms and examples</p> <p>Type III hypersensitivity – description of Arthus reaction and serum sickness, immune complex diseases</p> <p>Type IV hypersensitivity – description of contact dermatitis and tuberculin type hypersensitivity , Intradermal skin test</p>	
Autoimmunity	<p>Definition and induction of tolerance, B and T cell tolerance.</p> <p>Definition and mechanism of autoimmunity, classification of autoimmune diseases with examples, their treatment and diagnosis</p>	2
Vaccines and immunisation	Principles of immunization, National Immunisation schedule	2
Immunodeficiency	Classification, congenital immunodeficiencies – B cell deficiencies, T cell deficiencies, combined immunodeficiencies, complement deficiencies, phagocyte deficiencies and Acquired immunodeficiencies	2
Transplantation immunology Immunology of Malignancy	<p>Types of transplants, Graft versus host reactions,</p> <p>Tumor- associated antigens, Mechanisms of tumor immunity, Carcinoembryonic antigen, alpha fetoprotein</p> <p>Immune response in malignancy, Immunotherapy of cancer</p> <p>Immunological Surveillance</p>	2
Unit 4: MIC 607 Lab 1 – General Microbiology		160
Microscopy	Understand the various parts, types, and application of microscopy	10
Staining methods	Perform different type of staining methods employed in diagnostic microbiology	30
Sterilization & Disinfection methods	Application of sterilization & disinfection methods in microbiology laboratory	20
Culture media – Preparation, QC	Prepare various culture media and perform QC	20
Biochemical tests/reagents	Perform identification of bacteria using various common biochemical tests	30
Quantitation – Bacterial counts	Enumerate bacterial growth and quantitation of bacteria	30



Antibiotic susceptibility testing	Perform antibiotic susceptibility testing by disk diffusion and dilution methods	20				
<b>Unit 5: MIC 609 Lab 2 – Immunology</b>		<b>160</b>				
Concepts of Immunopathology & immunodiagnostic tests, their principles/uses, Specimen collection, preparation/preservation	Describe the storage and preservation of serum samples	10				
Immunodiagnostic tests	Perform and interpret various serological tests for common infectious diseases	150				
<b>Learning strategies, contact hours and student learning time</b>						
<i>Learning strategy</i>	<i>Contact hours</i>	<i>Student learning time (Hrs)</i>				
Lectures	50	150				
Seminars	35	105				
SDL	30	30				
Practical	320	960				
Revision	20	20				
Assessment	25	25				
<b>TOTAL</b>	<b>480</b>	<b>1290</b>				
<b>Assessment Methods:</b>						
<b>Formative:</b>		<b>Summative:</b>				
Class tests		Sessional examination				
Assignments/presentations		End semester examination				
<b>Mapping of assessment with Cos</b>						
Nature of assessment	CO 1	CO 2	CO 3	CO 4	CO 5	CO 6
Sessional Examination 1	X		X		X	X
Sessional Examination 2		X		X	X	X
Assignment/Presentation	X	X	X	X	X	X
End Semester Examination	X	X	X	X	X	X
Laboratory examination					X	X
<b>Feedback Process</b>	<ul style="list-style-type: none"> <li>• Mid-Semester feedback</li> <li>• End-Semester Feedback</li> </ul>					
<b>Reference Material</b>	<ol style="list-style-type: none"> <li>1. Mackie &amp; McCartney Practical Medical Microbiology</li> <li>2. Prescott's Microbiology</li> </ol>					



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|--|---|
|  | <ol style="list-style-type: none"><li>3. Koneman's Color Atlas and Textbook of Diagnostic Microbiology</li><li>4. Medical Immunology by Daniel P. Stites</li><li>5. Kuby immunology</li></ol> |
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Name of the Institution / Department: DEPARTMENT OF MICROBIOLOGY

<b>Name of the Program:</b>	<b>MSc Microbiology (Medical)</b>
<b>Course Title:</b>	Common core: Introduction to research
<b>Course Code: MCC 602</b>	<b>Course Instructor: Faculty Department of Community Medicine</b>
<b>Academic Year: 2020-2021</b>	<b>Semester: First Year, Semester 2</b>
<b>No of Credits: 4</b>	<b>Prerequisites: Nil</b>

<b>Synopsis:</b>	This course sensitises students towards research and help them to acquire knowledge in the basic aspects of biostatistics and research methodology. Also helps to gain knowledge to use computer application for searching scientific database.
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<b>Course Outcomes (COs):</b>	On successful completion of this course, students will be able to
CO 1:	Explain the processes involved in basic research
CO 2:	Explain the importance of ethics in research & misconduct in research

Mapping of COs to POs										
COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	
CO 1	X	X								
CO 2	X				X					

Course content and outcomes:		
Content	Competencies	No of Hours

Unit 1: Introduction to research		
	<ul style="list-style-type: none"> <li>Describe Selection of a research topic, framing of hypothesis, research objectives and their outcomes</li> <li>Familiarize with Literature survey and write a research protocol</li> <li>Describe the steps of designing study involving both humans and animal models</li> <li>Understand the Importance of statistics in research and introduction to basic statistics and usage of statistical software</li> <li>Describe the format of Thesis and scientific articles for publication</li> <li>Explain Ethics &amp; responsible conduct in research</li> <li>Describe the Process of publication of scientific papers</li> <li>Familiarize with indexing sources, impact factors and citations of journal articles</li> </ul>	80

**Learning strategies, contact hours and student learning time**

Learning strategy	Contact hours	Student learning time (Hrs)
Lecture	40	120
Seminar	-----	-----
Small Group Discussion (SGD)	30	90
Self-directed learning (SDL)	10	10
Case Based Learning (CBL)	10	30
Revision	10	10
Assessment	10	10



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<b>TOTAL</b>	<b>110</b>	<b>270</b>
<b>Assessment Methods:</b>		
<b>Formative:</b>	<b>Summative:</b>	
Class tests	Sessional examination	
Assignments	End semester examination	
<b>Mapping of assessment with Cos</b>		
Nature of assessment	CO 1	CO 2
Sessional Examination 1	X	
Sessional Examination 2	X	X
class test	X	X
Assignment	X	
End Semester Examination	X	X
<b>Feedback Process</b>	<ul style="list-style-type: none"> <li>• Mid-Semester feedback</li> <li>• End-Semester Feedback</li> </ul>	
<b>Reference Material</b>	Parks Text book of Community medicine	



Name of the Institution / Department: DEPARTMENT OF MICROBIOLOGY

<b>Name of the Program:</b>		<b>M.Sc. in Microbiology (Medical)</b>										
<b>Course Title:</b>		<b>Systematic Bacteriology-1, Systematic Bacteriology-2, Lab (Practical): Bacteriology, Elective-1</b>										
<b>Course Code:</b> MIC 604 MIC 606 MIC 608 MEL 610		<b>Course Instructor:</b> Faculty of the Department of Microbiology										
<b>Academic Year: 2020-2021</b>		<b>Semester: Second Year, Semester 2</b>										
<b>No of Credits: 20</b>		<b>Prerequisites: Nil</b>										
<b>Synopsis:</b>		This course would provide the postgraduate student with sound knowledge in medically important bacteria, their pathogenesis and diseases caused by them, laboratory diagnosis of bacterial infections including the most recent diagnostic tests, antibiotic susceptibility pattern of the isolates, drug resistance mechanisms and prophylaxis. Further, the students will also acquire knowledge regarding processing of clinical specimens to isolate and identify bacteria perform and interpret antibiotic sensitivity tests.										
<b>Course Outcomes (COs):</b>		On successful completion of this course, students will be able to										
CO 1:		Describe the classification, morphology, cultural characteristics, and virulence factors of bacteria of medical importance.										
CO 2:		Describe the pathogenesis, clinical features, lab diagnosis and prophylaxis of important bacterial infections.										
CO 3:		Be able to identify bacteria by performing the appropriate techniques of culture and sensitivity.										
CO 4:		Be able to isolate and identify the pathogen from a clinical specimen, perform antibiotic sensitivity test and interpret the results.										
CO 5:		Describe the important bacterial infections affecting different organ systems in the body, list the etiological agents causing such infections, explain the laboratory diagnosis, prophylaxis and recent advances in the evaluation of such infections.										
CO 6:		Describe Laboratory organization and Safety measures to be followed in the laboratory, Quality Control in Microbiology and Biomedical waste management.										
<b>Mapping of COs to POs</b>												
<i>Cos</i>	<i>PO 1</i>	<i>PO 2</i>	<i>PO 3</i>	<i>PO 4</i>	<i>PO 5</i>	<i>PO 6</i>	<i>PO 7</i>	<i>PO 8</i>	<i>PO 9</i>	<i>PO 10</i>	<i>PO 11</i>	<i>PO 12</i>
CO 1	X	X		X								X
CO 2	X	X	X	X	X	X	X	X				X
CO 3	X	X	X	X	X	X	X	X	X	X	X	X
CO 4	X	X		X	X	X	X	X	X	X	X	X
CO 5	X	X	X	X	X	X	X	X				X
CO 6	X	X	X	X	X	X	X	X	X	X	X	X



COURSE STRUCTURE, COURSEWISE LEARNING OBJECTIVE, AND COURSE OUTCOMES (COS)		
Content	Competencies	No of Hours
<b>Unit 2: MIC 604: Systematic Bacteriology-1 (80 Hours)</b>		
<ul style="list-style-type: none"> <li>Gram positive cocci</li> </ul>	<ul style="list-style-type: none"> <li>Explain the morphology, cultural characteristics, virulence factors, pathogenesis, clinical features, laboratory diagnosis, Resistance mechanisms and treatment of infections caused by Staphylococcus and Streptococcus</li> </ul>	20
<ul style="list-style-type: none"> <li>Gram negative cocci</li> </ul>	<ul style="list-style-type: none"> <li>Explain the morphology, cultural characteristics, virulence factors, pathogenesis, clinical features, laboratory diagnosis, Resistance mechanisms and treatment of infections due to Neisseria spp.</li> </ul>	02
<ul style="list-style-type: none"> <li>Gram positive bacilli</li> </ul>	<ul style="list-style-type: none"> <li>Explain the morphology, cultural characteristics, virulence factors, pathogenesis, clinical features, Laboratory diagnosis, Resistance mechanisms and treatment of infections due to Corynebacterium, Listeria, Erysipelothrix, Bacillus, Clostridium and Mycobacteria</li> </ul>	20
<ul style="list-style-type: none"> <li>Gram negative bacilli Enterobacteriaceae</li> </ul>	<ul style="list-style-type: none"> <li>Explain the morphology, cultural characteristics, virulence factors, pathogenesis, clinical features, Laboratory diagnosis, Resistance mechanisms and treatment of infections due to Enterobacteriaceae</li> </ul>	38
<b>Unit 3: MIC 606: Systematic Bacteriology-2 (80 Hours)</b>		
<ul style="list-style-type: none"> <li>Gram negative Bacilli (Continued)</li> </ul>	<ul style="list-style-type: none"> <li>Explain the classification, morphology, cultural characteristics, virulence factors, pathogenesis, clinical features, laboratory diagnosis, Resistance mechanisms and treatment of infections due to Vibrio, nonfermenters, Brucella, Haemophilus, Bordetella, Mycoplasma, Chlamydia, Rickettsia, and other miscellaneous bacteria (Campylobacter, Helicobacter, Pasteurella, Francisella, HACEK, Ureaplasma, Legionella)</li> </ul>	45
<ul style="list-style-type: none"> <li>Non sporing anaerobes</li> </ul>	<ul style="list-style-type: none"> <li>Explain the classification, morphology, cultural characteristics, virulence factors and pathogenesis, clinical features, laboratory diagnosis and treatment of infections due to nonsporing anaerobes</li> </ul>	05
<ul style="list-style-type: none"> <li>Spirochaetes</li> </ul>	<ul style="list-style-type: none"> <li>Explain the classification, morphology, cultural characteristics, virulence factors, pathogenesis, clinical features, laboratory diagnosis and treatment of infections due to Treponema, Leptospira, Borrelia</li> <li>Explain the classification, morphology, cultural characteristics, virulence factors and pathogenesis,</li> </ul>	25



<ul style="list-style-type: none"> <li>Actinomycetes, Nocardia</li> </ul>	clinical features, laboratory diagnosis, treatment of infections due to Actinomycetes, Nocardia	05
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**Unit 4: MIC 608: Lab (Practical): Bacteriology 160 Hours**

<ul style="list-style-type: none"> <li>Introduction</li> </ul>	<ul style="list-style-type: none"> <li>Laboratory organization, Safety, Quality Control, Biomedical waste management, Methods of identification &amp; typing of Bacteria based on morphological, cultural &amp; biochemical properties; rapid &amp; automated methods</li> </ul>	05
<ul style="list-style-type: none"> <li>Identification of pure cultures of Bacteria</li> </ul>	<ul style="list-style-type: none"> <li>Identification of pure cultures of bacteria based on morphological, cultural &amp; biochemical properties demonstration of additional properties and antibiotic sensitivity testing by standard methods</li> </ul>	50
<ul style="list-style-type: none"> <li>Isolation and identification of bacteria from clinical specimens</li> </ul>	<ul style="list-style-type: none"> <li>Isolation and identification of bacteria from clinical cases with suspected Respiratory tract infections, Gastrointestinal tract infections, Urinary tract infections, Skin, Soft tissue &amp; eye infection, Central Nervous system infections, Sexually transmitted infections, Obstetric &amp; Perinatal infections and opportunistic infections</li> </ul>	90
<ul style="list-style-type: none"> <li>Interpretation of serological tests</li> </ul>	<ul style="list-style-type: none"> <li>Interpretation of the serological tests used for the diagnosis of zoonotic &amp; vector borne infections and Fever of unknown origin</li> </ul>	15

**Learning strategies, contact hours and student learning time**

<i>Learning strategy</i>	<i>Contact hours</i>	<i>Student learning time (Hrs)</i>
Lectures	50	150
Seminars	50	150
Journal Club	20	60
Practical	200	600
Revision	40	40
Assessment	10	10
<b>TOTAL</b>	<b>370</b>	<b>1010</b>

**Assessment Methods:**

<b>Formative:</b>	<b>Summative:</b>
Assignments/presentations	End semester examination
Sessional Examinations	

**Mapping of assessment with Cos**

Nature of assessment	CO 1	CO 2	CO 3	CO 4	CO 5	CO 6
Sessional Examination 1	X	X			X	X





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Sessional Examination 2	X	X	X	X	X	X
Assignment/Presentation	X	X	X	X	X	X
End Semester Examination	X	X	X	X	X	X
Laboratory examination	X	X	X	X	X	X
<b>Feedback Process</b>	<ul style="list-style-type: none"> <li>• Mid-Semester feedback</li> <li>• End-Semester Feedback</li> </ul>					
<b>Reference Material</b>	<ol style="list-style-type: none"> <li>1. <b>Books Recommended</b></li> <li>1. Textbook of Microbiology. Ananthanarayan: Orient Langman, 7<sup>th</sup> Edition</li> <li>2. Jawetz Medical Microbiology. Brooks et al, Lange publication, 24<sup>th</sup>ed</li> <li>3. Mackie &amp; Mac Cartney Practical Medical Microbiology</li> <li>5. Medical Microbiology by Greenwood and Slack, 17<sup>th</sup> edition, Churchill Livingstone</li> </ol> <p><b>REFERENCE BOOKS</b></p> <ol style="list-style-type: none"> <li>1. Mim's Medical Microbiology by Cedric Mims, Mosby Elsevier</li> <li>2. Diagnostic Microbiology by Bailey and Scott, Mosby &amp; Co St. Louis</li> <li>3. Review of Medical Microbiology and Immunology by Warren Levinson, McGraw Hill book co, New York</li> <li>4. Textbook of Diagnostic Microbiology by Connie R Mahon, Saunders Co. London</li> <li>5. Microbiology and Microbial Infections – Bacteriology Vol 1 by Topley and Wilson, Hodder and ELBS</li> <li>6. Microbiology and Microbial Infections – Bacteriology Vol 2 by Topley and Wilson, Hodder and ELBS</li> <li>7. Color Atlas and Textbook of Diagnostic Microbiology by Konemann Lippincott, Williams &amp; Wilkins</li> </ol>					



Name of the Institution / Department: DEPARTMENT OF MICROBIOLOGY

<b>Name of the Program:</b>		<b>MSc Microbiology (Medical)</b>									
<b>Course Title:</b>		Elective 1*									
<b>Course Code: MEL 610</b>		<b>Course Instructor: course coordinator of elective</b>									
<b>Academic Year: 2021-2023</b>		<b>Semester: First Year, Semester 2</b>									
<b>No of Credits: 4</b>		<b>Prerequisites: Nil</b>									
<b>Synopsis:</b>		This exposure to multidisciplinary courses will help them develop interests and abilities that will help them further their career skills. Students can choose any one of the electives, listed below in the respective campuses. There should be a minimum of 3 students opting for a particular elective for it to be offered. The electives will be assigned depending on the number of slots available based on previous semester CGPA. Each elective runs for a period of 4 weeks. 75% attendance is mandatory and at the end of each elective there is assessment, the scores will help boost CGPA.									
<b>Course Outcomes (COs):</b>		On successful completion of this course, students will be able to									
CO 1:		Explore their interests and develop desirable career skills and abilities that will help professional development									
COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9		
CO 1	X	X	X	X					X		
<b>Course content and outcomes:</b>											
<b>Content</b>		<b>Competencies</b>								<b>No of Hours</b>	
MEL 610.1	Tissue Processing	ANATOMY					Both campuses				
MEL 610.2	Basic cardiovascular Examination	PHYSIOLOGY					Both campuses				
MEL 610.3	Photometric Techniques	BIOCHEMISTRY					Both campuses				
MEL 610.4	BA/BE studies	PHARMACOLOGY					Not offered in both campus since May 2017				
MEL 610.5	Serological diagnosis of infectious diseases	MICROBIOLOGY					At Mangalore campus only				
MEL 610.6	Microbiological analysis of water	MICROBIOLOGY					At Manipal campus only				
MEL 610.7	Drug development	PHARMACOLOGY					Both campuses				
MEL 610.8	IEM screening	Biochemistry					At Manipal campus only				
MEL 610.9	Basics of andrology techniques	Clinical embryology					At Manipal campus only				
MEL 610.10	Forensic toxicology	Forensic medicine					At Manipal campus only				
<ul style="list-style-type: none"> <li>MEL 610.1-Tissue Processing</li> </ul>		<ul style="list-style-type: none"> <li>Explain the aims and effects of tissue fixation</li> <li>Enumerate the precautions to be taken during tissue fixation</li> <li>Name the commonly used fixatives and to explain their merits and demerits</li> </ul>								120	



	<ul style="list-style-type: none"> <li>Name the different types of embedding methods available and to give their applications</li> <li>Describe the detailed procedure involved in paraffin embedding method</li> <li>Demonstrate the paraffin embedding method for variety of tissues</li> <li>Name the different types of microtomes and to explain their applications</li> <li>Describe the detailed procedure of section cutting using rotary microtome</li> <li>Demonstrate the experience in using rotary microtome for section cutting</li> <li>Explain the water bath method of flattening and mounting of sections</li> </ul>	
<ul style="list-style-type: none"> <li>MEL 610.2-Basic cardiovascular Examination</li> </ul>	<ul style="list-style-type: none"> <li>Demonstrate the basic use of stethoscope</li> <li>Demonstrate how to measure the pulse</li> <li>Demonstrate the recording of blood pressure using sphygmomanometer</li> <li>Describe the basic approach to the Physical examination of cardiovascular system including inspection, palpation, percussion and auscultation</li> <li>Explain the basic heart sounds</li> <li>Record ECG</li> <li>Understand the basic principle and record heart rate variability</li> <li>Perform the basic cardiovascular examination independently</li> </ul>	120
<ul style="list-style-type: none"> <li>MEL 610.3-Photometric Techniques</li> </ul>	<ul style="list-style-type: none"> <li>To know the principle, instrumentation and functioning of colorimeter &amp; spectrophotometer</li> <li>Understand the Beer's law, on which the photometric techniques are based for measuring the concentration of a substance in solution.</li> <li>Describe the operation and component parts of the colorimeter/ spectrophotometer</li> <li>Operate the colorimeter /spectrophotometer and measure the concentration of an analyte</li> <li>To know the principle and clinical applications of atomic absorption spectrophotometer, flame photometer, fluorometer, nephelometer</li> <li>To understand the principle of ELISA and its use</li> <li>To know the working of a semiautoanalyzer</li> <li>To select an appropriate technique for measuring an analyte based on the requirements</li> </ul>	120



<ul style="list-style-type: none"> <li>MEL 610.5- Serological diagnosis of infectious diseases</li> </ul>	<ul style="list-style-type: none"> <li>List the different types of serological tests used in diagnosis of infectious diseases and principles of the routine serological procedures performed in the clinical laboratory ·</li> <li>Acquire knowledge about the applications of different serological tests ·</li> <li>Understand and analyse the various concepts involved in serological diagnosis of infectious diseases</li> </ul>	120
<ul style="list-style-type: none"> <li>MEL 610.6- Microbiological analysis of water</li> </ul>	<ul style="list-style-type: none"> <li>Enumerate different Water borne infectious diseases</li> <li>Describe the source and reservoirs of the water borne pathogens in the community and healthcare facilities</li> <li>Narrate different strategies for Controlling Waterborne Microbial Contamination</li> <li>Describe and demonstrate collection, transportation, and various methods of bacteriological analysis of water with respect to community and hospital settings (dialysis water, RO) and interpretation of results</li> <li>Investigate waterborne outbreak in the community and hospital</li> </ul>	120
<ul style="list-style-type: none"> <li>MEL 610.7- Drug development</li> </ul>	<ul style="list-style-type: none"> <li>To explain pre-clinical phases of drug development</li> <li>To explain the clinical phases of drug development</li> <li>To understand the basic concepts of Ethical Guidelines for Biomedical Research and Ethical Issues in Clinical Research</li> <li>To learn Roles &amp; responsibilities of the investigator / sponsor / CRO / Site coordinator / Site manager and Auditor</li> <li>To explain the process of Informed consent and submission dossier to IEC</li> <li>To understand the Role of regulatory bodies: FDA/ DCGI and IRB/IEC and Updates in the regulatory requirements in India</li> <li>To be aware and understand the Good Clinical Practice Guidelines</li> <li>To understand and demonstrate Adverse event reporting: ADR reporting Form and Serious adverse events and reporting and Collection of ADRs from hospital</li> </ul>	120
<ul style="list-style-type: none"> <li>MEL 610.8- IEM screening</li> </ul>	<ul style="list-style-type: none"> <li>To know the biochemical basis of different disorders of inborn errors of metabolism</li> <li>To be able to prepare chemical solutions required to perform the qualitative tests in IEM lab</li> <li>To be able to perform and interpret the basic screening tests of IEM.</li> <li>To be able to perform and interpret thin layer chromatography (TLC) of organic acids</li> <li>To know the principle and application of HPLC</li> <li>To observe the new born screening tests done in DBS samples</li> </ul>	120



<ul style="list-style-type: none"> <li>MEL 610.9- Basics of andrology techniques</li> </ul>	<ul style="list-style-type: none"> <li>Identify the basic instruments in Andrology laboratory</li> <li>Communicate instructions to the patient about semen collection</li> <li>Analyse semen - macroscopic and microscopic evaluations</li> <li>Demonstrate sperm preparation methods for therapeutic insemination</li> <li>Assess sperm DNA damage</li> </ul>	120
<ul style="list-style-type: none"> <li>MEL 610.10- Forensic toxicology</li> </ul>	<ul style="list-style-type: none"> <li>To be able to identify the poisons</li> <li>To identify the poisons based on their physical forms</li> <li>To classify poisons based on systems on which they act</li> <li>To know various poisons based on classification</li> <li>To know general management of the poisons</li> <li>To know and identify the common household poisons and their management</li> <li>To be aware of medico-legal aspects of poisoning</li> <li>To have knowledge about substances that may affect a person's performance or behaviour and ability to make rational judgement; and</li> <li>To have knowledge about substances that are not compliant with employment regulations or classified as substances of abuse.</li> <li>To have knowledge about evidentiary materials.</li> </ul>	120
<b>Learning strategies, contact hours and student learning time</b>		
<i>Learning strategy</i>	<i>Contact hours</i>	<i>Student learning time (Hrs)</i>
Lecture	20	60
Tutorial- SGT	10	30
SDL	10	10
Practical	80	160
Assessment	10	10
<b>TOTAL</b>	<b>130</b>	<b>270</b>
<b>Assessment Methods:</b>		
<b>Formative:</b>		<b>Summative:</b>
Practical assessment		End of elective examination
<b>Mapping of assessment with Cos</b>		
Nature of assessment	CO 1	
Practical assessment	X	
End of elective examination	X	
<b>Feedback Process</b>	<ul style="list-style-type: none"> <li>End elective Feedback</li> </ul>	
<b>Reference Material</b>	Based on elective- departments will specify	



Name of the Institution / Department: DEPARTMENT OF MICROBIOLOGY

<b>Name of the Program:</b>		<b>M.Sc. in Microbiology (Medical)</b>										
<b>Course Title:</b>		<b>Virology, Parasitology, Lab 1 (Practical): Virology and Lab 2 (Practical): Parasitology, Elective 2</b>										
<b>Course Code:</b> MIC 701 MIC 703 MIC 705 MIC 707 MEL 709		<b>Course Instructor:</b> Faculty of the Department of Microbiology										
<b>Academic Year:</b> 2021-2022		<b>Semester:</b> Second Year, Semester 3										
<b>No of Credits:</b> 20		<b>Prerequisites:</b> Nil										
<b>Synopsis:</b>		This course would provide the postgraduate student with sound knowledge in medically important viruses, the diseases caused by them, the laboratory diagnosis of such infections including the most recent serological techniques and also undergo basic training in the virology laboratory regarding viral cultivation. Further, the students will also acquire knowledge regarding the medically important parasites, their life cycles, the diseases caused by them and the laboratory diagnosis of such infections.										
<b>Course Outcomes (COs):</b>		On successful completion of this course, students will be able to										
CO 1:		Describe the structure, replication, classification and diseases caused by viruses										
CO 2:		Describe the pathogenesis, clinical features and lab diagnosis of important viral infections										
CO 3:		Be able to conduct serological testing of various viral infections										
CO 4:		Describe the morphology, classification and diseases caused by parasites										
CO 5:		Describe the life cycles, pathogenesis, lab diagnosis and prophylaxis of important parasitic infections										
CO 6:		Be able to conduct various laboratory techniques used in the diagnosis of parasitic infections and be able to identify important parasites in clinical specimen										
<b>Mapping of COs to POs</b>												
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
CO 1	X	X		X								X
CO 2	X	X		X								X
CO 3	X	X	X	X	X			X	X	X		X
CO 4	X	X		X								X
CO 5	X	X		X								X
CO 6	X	X	X	X	X			X	X	X		X
<b>COURSE STRUCTURE, COURSEWISE LEARNING OBJECTIVE, AND COURSE OUTCOMES (COS)</b>												
<b>Content</b>				<b>Competencies</b>						<b>No of Hours</b>		
<b>Unit 1: MIC 701: Virology (80 Hours)</b>												



<ul style="list-style-type: none"> <li>• Introduction to Virology</li> <li>• DNA viruses</li> <li>• RNA viruses</li> <li>• Miscellaneous topics in virology</li> </ul>	<ul style="list-style-type: none"> <li>• Historical aspects, structure, replication &amp; classification of viruses, viral cultivation, viral genetics, pathogenesis of viral infections, antiviral agents and principles of vaccination against viral diseases</li> <li>• Pathogenesis, clinical features, lab diagnosis &amp; prevention of Pox viruses, Adenoviruses Herpesviruses and Hepatitis B virus infections</li> <li>• Pathogenesis, clinical features, lab diagnosis &amp; prophylaxis of Picornavirus, Ortho and Paramyxoviruses, Arboviruses, Hepatitis viruses, Rabies virus, Retroviruses and emerging viral infections (SARS/Covid 19)</li> <li>• Oncogenic viruses, Prion diseases, Congenital viral infections, Viral gastroenteritis; principles of bio-safety and precautions to be taken in the virology lab</li> </ul>	<p>10</p> <p>20</p> <p>40</p> <p>10</p>
<p><b>Unit 2: MIC 703: Parasitology (80 Hours)</b></p>		
<ul style="list-style-type: none"> <li>• Introduction to Parasitology</li> <li>• Protozoology</li> <li>• Helminthology 1 (Cestodes)</li> <li>• Helminthology 2 (Trematodes)</li> </ul>	<ul style="list-style-type: none"> <li>• Classification of Parasites, terminology, their morphology, life cycles of important parasites and the diseases caused by them, and the principles of diagnosis of parasitic infections</li> <li>• Classification, geographical distribution, habitat, morphology, life cycle, pathogenicity (mode of infection, pathogenesis and pathology), laboratory diagnosis and prevention &amp; control of important Protozoal parasites such as <i>E.histolytica</i>, Free living amebae, <i>G.lambliia</i>, <i>T.vaginalis</i>, Leishmania, Plasmodia &amp; opportunistic protozoal parasites (Toxoplasma, Cryptosporidia, Isospora and Microsporidia)</li> <li>• Classification, geographical distribution, habitat, morphology, life cycle, pathogenicity (mode of infection, pathogenesis and pathology), laboratory diagnosis and prevention &amp; control of important tapeworms such as <i>T.saginata/solium</i>, <i>E.granulosus</i> and <i>H.nana</i></li> <li>• Classification, geographical distribution, habitat, morphology, life cycle, pathogenicity (mode of infection, pathogenesis and pathology), laboratory diagnosis and prevention &amp; control of important flukes such as <i>S.hematobium</i>, Liver flukes, Intestinal fluke and the Lung fluke</li> </ul>	<p>4</p> <p>30</p> <p>8</p> <p>8</p>



<ul style="list-style-type: none"> <li>• Helminthology 3 (Nematodes)</li> </ul>	<ul style="list-style-type: none"> <li>• Classification, geographical distribution, habitat, morphology, life cycle, pathogenicity (mode of infection, pathogenesis and pathology), laboratory diagnosis and prevention &amp; control of important nematodes such as <i>A.lumbricoides</i>, <i>A.duodenale/Necator</i>, <i>S.stercoralis</i>, <i>T.trichura</i>, <i>E.vermicularis</i>, <i>T.spiralis</i>, <i>W.bancrofti</i>, <i>L.loa</i>, <i>B.malayi</i>, <i>D.medinensis</i></li> </ul>	30
<b>Unit 3: MIC 705: Lab 1 (Practical): Virology 160 Hours</b>		
<ul style="list-style-type: none"> <li>• Virology lab posting</li> <li>• Viral serology</li> <li>• Viral gene detection</li> </ul>	<ul style="list-style-type: none"> <li>• Propagation of viruses; Tissue culture and egg inoculation technique for the isolation of common medically important viruses; Routes of inoculations in embryonated eggs; Preparation of virus stocks; plaque assay and determination of TCID50; Preparation of high titre of bacteriophage stocks and Electron microscopy</li> <li>• Diagnosis of viral infections such as Herpesviruses, Rubella, CMV, VZV, Hepatitis viruses, HIV and Coronavirus 2 by detection of viral antigens / antiviral antibodies using techniques such as ELISA, ELFA, ECLIA, Mini Vidas, Immunochromatography and Immunofluorescence</li> <li>• Use of molecular techniques such as PCR, RT-PCR, GeneXpert for diagnosis of important viral infections such as HIV1 &amp; 2, Hepatitis B, Herpesvirus and Coronavirus 2</li> </ul>	48  90  22
<b>Unit 4: MIC 707: Lab 2 (Practical): Parasitology (160 Hours)</b>		
<ul style="list-style-type: none"> <li>• Blood examination</li> <li>• Examination of Stool</li> </ul>	<ul style="list-style-type: none"> <li>• Laboratory diagnosis of blood and tissue parasites- preparation of thick and thin smear of blood sample, staining and detection of blood and tissue parasites such as the Plasmodia, Leishmania, Toxoplasma, Wuchereria.</li> <li>• Laboratory diagnosis of Intestinal parasites such as macroscopy / microscopy of fecal specimen using various techniques such as wet mount, staining; Concentration techniques used in stool examination</li> </ul>	60  100
<b>Learning strategies, contact hours and student learning time</b>		
<i>Learning strategy</i>	<i>Contact hours</i>	<i>Student learning time (Hrs)</i>





# MANIPAL

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Lectures	60	180
Seminars	30	90
Journal Club	20	60
Practical	320	960
Revision	20	20
Assessment	30	30
<b>TOTAL</b>	<b>480</b>	<b>1340</b>

### Assessment Methods:

#### Formative:

Class tests

Assignments/presentations

#### Summative:

Sessional examination

End semester examination

### Mapping of assessment with Cos

Nature of assessment	CO 1	CO 2	CO 3	CO 4	CO 5	CO 6
Sessional Examination 1	X	X		X	X	
Sessional Examination 2	X	X	X	X	X	X
Assignment/Presentation	X	X		X	X	
End Semester Examination	X	X	X	X	X	X
Laboratory examination			X			X

#### Feedback Process

- Mid-Semester feedback
- End-Semester Feedback

#### Reference Material

1. Textbook of Microbiology. Ananthanarayan: Orient Langman
2. Medical Microbiology by Jawetz, McGraw Hill book co. NY
3. Fundamentals of Diagnostic Mycology by Fran Fisher, Saunders
4. Mackie & McCartney's Practical Medical Microbiology
5. Paniker's Textbook of Medical Parasitology, 8th Edition



# MANIPAL

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Name of the Institution / Department: DEPARTMENT OF MICROBIOLOGY

<b>Name of the Program:</b>		<b>MSc Microbiology (Medical)</b>									
<b>Course Title:</b>		Elective 2*									
<b>Course Code: MEL 709</b>		<b>Course Instructor: Faculty of Elective department</b>									
<b>Academic Year: 2020-2021</b>		<b>Semester: Final Year, Semester 3</b>									
<b>No of Credits: 4</b>		<b>Prerequisites: Nil</b>									
<b>Synopsis:</b>		This exposure to multidisciplinary courses will help them develop interests and abilities that will help them further their career skills. Students can choose any one of the electives, listed below in the respective campuses. There should be a minimum of 3 students opting for a particular elective for it to be offered. The electives will be assigned depending on the number of slots available based on previous semester CGPA. Each elective runs for a period of 4 weeks. 75% attendance is mandatory and at the end of each elective there is assessment, the scores will help boost CGPA.									
<b>Course Outcomes (COs):</b>		On successful completion of this course, students will be able to									
CO 1:		Explore their interests and develop desirable career skills and abilities that will help professional development									
<b>Mapping of COs to POs</b>											
COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9		
CO 1	X	X	X	X	X				X		
<b>Course content and outcomes:</b>											
<b>Content</b>		<b>Competencies</b>								<b>No of Hours</b>	
MEL 709.1	Staining Techniques	ANATOMY						Both campuses			
MEL 709.2	Basic genetic techniques and tissue culture	ANATOMY						At Manipal campus only- <b>Not offered since MAY 2017</b>			
MEL 709.3	Neurophysiology tests	PHYSIOLOGY						Both campuses			
MEL 709.4	Orientation to Clinical Biochemistry	BIOCHEMISTRY						Both campuses			
MEL 709.5	Preclinical Drug Screening	PHARMACOLOGY						Both campuses- <b>not offered since MAY 2017</b>			
MEL 709.6	Isolation, identification and antimicrobial sensitivity testing-conventional & automated methods	MICROBIOLOGY						At Mangalore campus only			
MEL 709.7	Detection of food borne pathogens	MICROBIOLOGY						At Manipal campus only- <b>not offered since NOV 2019</b>			
MEL 709.8	Basics of animal research	PHARMACOLOGY						Both campuses			
MEL 709.9	Analytical toxicology	BIOCHEMISTRY						At Manipal campus only			



MEL 709.10	SEMEN CRYOPRESERVATION	CLINICAL EMBRYOLOGY	At Manipal campus only
MEL 709.11	Fungi in health and disease	MICROBIOLOGY	At Manipal campus only
MEL 709.12	Clinical Forensic medicine	FORENSIC MEDICINE	At Manipal campus only
<b>MEL 709. 1 - staining techniques</b>	<ul style="list-style-type: none"> <li>To name variety of staining techniques with their applications</li> <li>To explain the principle and procedure of Hematoxylin &amp; Eosin (H&amp;E) staining technique in detail</li> <li>To demonstrate the Hematoxylin &amp; Eosin staining procedure</li> <li>To explain some special staining techniques with their principles and procedures (e.g. Van Giessen's stain, Masson's Trichrome stain &amp; Mallory's stain)</li> </ul>		120
<b>MEL 709. 3- Neurophysiology tests</b>	<ul style="list-style-type: none"> <li>Demonstrate the sensory function test</li> <li>Demonstrate the motor function test</li> <li>Demonstrate the clinical examination of cranial nerves</li> <li>Basic techniques used in neurophysiological research using animal models</li> <li>Perform the basic clinical examination of the central nervous system and to perform techniques used in neurophysiology studies independently</li> </ul>		120
<b>MEL 709. 4 - Orientation to Clinical Biochemistry</b>	<ul style="list-style-type: none"> <li>Understand the basic workflow in a clinical/ medical testing laboratory: Sample collection &amp; transport, Sample acceptance &amp; rejection criteria</li> <li>Understand the use of automation</li> <li>Rationale for selection of test panels/organ specific tests – LFT, RFT, TFT, Diabetes, Lipid profile, MI and tumour markers</li> <li>Know the preanalytical, analytical and post-analytical phases and their significance; A typical lab report format; instrument flags and their corrective actions, the significance of auto verification</li> <li>Understand the total quality management of the lab: Use of IQC, EQAS, ILQC, handling of feedback, complaints, errors in laboratory reports</li> <li>Appreciate the significance of laboratory accreditation as per the regulatory bodies</li> </ul>		120
<b>MEL 709. 6- Isolation, identification and antimicrobial sensitivity testing-conventional &amp; automated methods</b>	<ul style="list-style-type: none"> <li>Acquire knowledge regarding the basic concepts of isolation and identification of Infectious agents from clinical specimen</li> <li>Describe the process to determine antimicrobial susceptibility of pathogenic bacteria</li> </ul>		120



	<ul style="list-style-type: none"> <li>Acquire knowledge on the automated methods employed for isolation, identification &amp; antimicrobial susceptibility testing of pathogenic bacteria</li> <li>Understand the basic concepts of Serological techniques used in the diagnosis of Infectious diseases</li> </ul>	
<b>MEL 709. 8-</b> Basics of animal Research	<ul style="list-style-type: none"> <li>Demonstrate animal handling &amp; drug administration techniques</li> <li>Explain Preclinical toxicity studies</li> <li>Understand and observe the spontaneous behavior in laboratory animals</li> <li>Explain the principles and demonstrate the screening of analgesics using hot plate and tail flick method</li> <li>Explain the principles and demonstrate the screening of antiepileptics in MES and PTZ models</li> <li>Explain the principles and demonstrate the test for screening of anti-inflammatory activity</li> <li>Explain the principles and demonstrate the screening of antidepressants using tail suspension methods and forced swim test</li> <li>Explain the principles and demonstrate the screening of anxiolytics using elevated plus maze and light &amp; dark box</li> </ul>	120
<b>MEL 709. 9-</b> Analytical toxicology	<ul style="list-style-type: none"> <li>Description and demonstration of various tests related to the panels: drug abuse panel; pesticide panel; alcohol panel; narcotic panel and heavy metal panel</li> <li>Identification and quantification of unknown chemical/poisons assessment by using a GC-MS (Gas chromatography- mass spectrometry)</li> <li>Description and demonstration of conducting systematic studies regarding use and hazards of various chemicals, used in agriculture.</li> <li>Developing information leaflets regarding guidelines and hazards of pesticide use to all needy farmers across all districts of our state</li> </ul>	120
<b>MEL 709. 10-</b> SEMEN CRYOPRESERVATION	<ul style="list-style-type: none"> <li>Discussions on basics of semen analysis</li> <li>Demonstration of semen cryopreservation and thawing</li> <li>Assessing the post-thaw competence of spermatozoa - motility and viability assessment</li> <li>Preparation of frozen-thawed spermatozoa for therapeutic insemination</li> </ul>	120
<b>MEL 709. 11-</b> Fungi in health and disease	<ul style="list-style-type: none"> <li>Understand the diverse pathogenic fungi involved in disease.</li> <li>Familiarize the laboratory skills for diagnosis of fungal infections.</li> <li>Comprehend the beneficial role of fungi and their applications.</li> </ul>	120



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<b>MEL 709. 12-</b> Clinical Forensic medicine	<ul style="list-style-type: none"> <li>Description on to handle medico-legal cases in the hospital</li> <li>Procedure to make a case medico-legal</li> <li>Documentation in a medico-legal cases</li> <li>Procedure on legal protocol that includes police intimation, collection of evidentiary material, preparation of certificates</li> <li>Examination of sexual assault &amp; drunkenness cases</li> <li>About medico-legal consultation</li> <li>Recording of dying declaration</li> </ul>	120
<b>Learning strategies, contact hours and student learning time</b>		
<i>Learning strategy</i>	<i>Contact hours</i>	<i>Student learning time (Hrs)</i>
Lecture	20	60
Tutorial- SGT	10	30
SDL	10	10
Practical	80	160
Assessment	10	10
<b>TOTAL</b>	<b>130</b>	<b>270</b>
<b>Assessment Methods:</b>		
<b>Formative:</b>		<b>Summative:</b>
Practical assessments		End elective examination
<b>Mapping of assessment with Cos</b>		
Nature of assessment	CO 1	
Practical Assessment	X	
End Elective Examination	X	
<b>Feedback Process</b>	<ul style="list-style-type: none"> <li>End-Elective Feedback</li> </ul>	
<b>Reference Material</b>	Depending on the elective, departments will specify the reference books	

Name of the Institution / Department: DEPARTMENT OF Microbiology

<b>Name of the Program:</b>		<b>M.Sc. in Microbiology (Medical)</b>										
<b>Course Title:</b>		Mycology and Molecular Techniques, Lab1: Mycology, Lab 2- Molecular techniques, Project work										
<b>Course Code: MIC 702 MIC 704 MIC706 MIC 798</b>		<b>Course Instructor: Faculty of the Department of Microbiology</b>										
<b>Academic Year: 2020-2021</b>		<b>Semester: Second Year, Semester 4</b>										
<b>No of Credits: 20</b>		<b>Prerequisites: Nil</b>										
<b>Synopsis:</b>		This course would provide the postgraduate student with sound knowledge of Medically important fungi & the diseases caused by them. Further, Molecular techniques will orient them towards the application of the knowledge acquired in the laboratory diagnosis of infectious diseases at molecular level. Research projects undertaken will give an insight of literature search, data collection, statistical analysis, interpretation, writing skills, publication in scientific journals.										
<b>Course Outcomes (COs):</b>		On successful completion of this course, students will be able to										
CO 1:		Describe the morphology, classification pathogenicity, clinical features, Lab diagnosis of fungal infections										
CO 2:		Describe the methods of specimen collection, processing of clinical specimens, prevention and control of fungal infections										
CO 3:		To perform various fungal culture techniques used in the diagnosis of Fungal infections										
CO 4:		Describe the principles, methods and applications of various Molecular techniques										
CO 5:		To Perform nucleic acid extraction & detection of medically important pathogens by PCR										
CO 6:		Design, perform and analyse a research problem										
<b>Mapping of COs to POs</b>												
<i>COs</i>	<i>PO 1</i>	<i>PO 2</i>	<i>PO 3</i>	<i>PO 4</i>	<i>PO 5</i>	<i>PO 6</i>	<i>PO 7</i>	<i>PO 8</i>	<i>PO 9</i>	<i>PO 10</i>	<i>PO 11</i>	<i>PO 12</i>
CO 1	x	x										x
CO 2	x	x	x					x				x
CO 3	x		X		X				X		X	x
CO 4	x	X										x
CO 5	X		X		X				X		X	x
CO 6		X	x		X			X	X	X		x

**COURSE STRUCTURE, COURSEWISE LEARNING OBJECTIVE, AND COURSE OUTCOMES (COS)**

<i>Content</i>	<i>Competencies</i>	<i>No of Hours</i>
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Unit 1: MIC 702 Mycology & Molecular Techniques (Theory)		80
<p><b>Mycology</b></p> <ul style="list-style-type: none"> <li>Introduction to Medical Mycology</li> <li>Superficial and Dermatomycosis</li> <li>Subcutaneous mycosis</li> <li>Systemic Mycosis</li> <li>Opportunistic Mycosis</li> <li>Laboratory diagnosis of fungal disease:</li> <li>Fungal toxin and allergies,</li> <li>Antifungal drugs &amp; antifungal susceptibility</li> </ul> <p><b>Molecular Techniques</b></p> <ul style="list-style-type: none"> <li>Polymerase chain reaction</li> <li>Blotting techniques</li> <li>Gel electrophoresis</li> </ul>	<ul style="list-style-type: none"> <li>Classification, structure, physiology, pathogenesis and medical importance of fungi               <ul style="list-style-type: none"> <li>List of fungi causing superficial &amp; cutaneous mycosis, their pathogenesis laboratory diagnosis, treatment &amp; prevention</li> <li>List of fungi causing subcutaneous infections their pathogenesis laboratory diagnosis, treatment &amp; prevention</li> <li>List of fungi causing systemic infections, their pathogenesis laboratory diagnosis, treatment &amp; prevention</li> <li>Fungi Causing opportunistic infections their pathogenesis laboratory diagnosis, treatment &amp; prevention</li> </ul> </li> <li>Specimen collection, &amp; transport to the laboratory,</li> <li>Different fungal staining methods used &amp; microscopic examinations of clinical samples</li> <li>Different culture media used for growing fungi causing cutaneous, sub cutaneous, systemic &amp; opportunistic infections</li> <li>Identification of fungal growth</li> <li>Rapid methods/ serological test / Molecular tests used</li> <li>Different mycotoxins, their harmful effects &amp; diagnosis</li> <li>List of different antifungal agents used for treatment</li> <li>Antifungal testing as per CLSI method</li> <li>History of PCR</li> <li>Definition of PCR</li> <li>Steps in PCR:</li> <li>Types of DNA polymerases</li> <li>Thermocyclers &amp; their functioning</li> <li>Listing of different types of PCR reactions (uniplex, multiplex, nested, Real-time)</li> <li>Merits &amp; demerits of PCR</li> <li>Applications</li> <li>Different types of Blotting techniques</li> <li>Applications of Southern blotting, Northern blotting, western blotting techniques</li> <li>Principle of agarose Gel electrophoresis</li> <li>How to read &amp; interpret the results</li> <li>List of different molecular typing methods their principles, methodology, &amp; applications</li> </ul>	<p><b>40</b></p>



<ul style="list-style-type: none"> <li>Molecular typing methods</li> </ul>		<b>40</b>
<b>Unit 2: MIC 704 Lab 1 (Mycology)</b>		<b>120</b>
<ul style="list-style-type: none"> <li>Mycology Practical</li> </ul>	<ul style="list-style-type: none"> <li>Preparation of fungal stains and staining techniques</li> <li>Fungal culture techniques</li> <li>Isolation and Characterization of medically important fungi from clinical specimens</li> <li>Isolation and characterization of dimorphic fungi</li> <li>Identification of fungi</li> </ul>	<b>120</b>
<b>Unit 3: MIC 706 Lab 2 (Molecular Techniques)</b>		<b>120</b>
<ul style="list-style-type: none"> <li>Molecular Technique practical</li> <li>Extraction and purification of Nucleic acids</li> <li>PCR's for diagnosis of infectious diseases:</li> <li>Identification of organisms using probes</li> <li>Molecular Typing methods for epidemiological purposes</li> </ul>	<ul style="list-style-type: none"> <li>Performance of Nucleic acid extraction by boiling method / Phenol- Chloroform</li> <li>Determination of DNA quality and concentration using Spectrophotometer / NanoDrop</li> <li>Preparation Master mix</li> <li>Amplification of DNA and RNA by conventional PCR</li> <li>Preparation of agarose Gel, Electrophoresis technique, Staining of Gel, amplicon visualization by Gel documentation</li> <li>Interpretation of results of PCR</li> <li>Different probes used in Real time PCR, interpretation of real time PCR results</li> <li>Demonstration and interpretation of Random amplification of Polymorphic DNA</li> </ul>	<b>120</b>
<b>Unit 4: MIC 798 Project work</b>		<b>400</b>
<ul style="list-style-type: none"> <li>Research project: Each student will be given a research problem by the mentor assigned to them</li> </ul>	<p>Student will be trained in</p> <ul style="list-style-type: none"> <li>Literature survey</li> <li>Designing the experiments</li> <li>Conducting experiments</li> <li>Data collection</li> <li>Tabulation</li> <li>Analysis and interpretation of results</li> <li>Discussion and possible publication.</li> <li>Writing a brief project report</li> </ul>	<b>400</b>

**Learning strategies, contact hours and student learning time**

Learning strategy	Contact hours	Student learning time (Hrs)
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Lecture	25	75				
Seminars	6	18				
Tutorial - SDL	45	45				
Practical	200	600				
Revision	20	20				
Assessment	20	20				
Project	400	800				
<b>TOTAL</b>	<b>720</b>	<b>1578</b>				
<b>Assessment Methods:</b>						
<b>Formative:</b>		<b>Summative:</b>				
Class tests		Sessional examination				
Assignments/presentations		End semester examination				
Quiz						
<b>Mapping of assessment with COs</b>						
Nature of assessment	CO 1	CO 2	CO 3	CO 4	CO 5	CO 6
Sessional Examination 1	x	x		x		
Sessional Examination 2	x	x	x	x	x	
Quiz						
Assignment/Presentation						
End Semester Examination	x	x	x	x	x	x
Laboratory examination			x		x	
Research project						x
<b>Feedback Process</b>	<ul style="list-style-type: none"> <li>• Mid-Semester feedback</li> <li>• End-Semester Feedback</li> </ul>					
<b>Reference Material</b>	<ol style="list-style-type: none"> <li>1. Textbook of Microbiology. Ananthanarayan: Orient Langman</li> <li>2. Medical Microbiology by Jawetz, McGraw Hill book co. NY</li> <li>3. Fundamentals of Diagnostic Mycology by Fran Fisher, Saunders</li> <li>4. Mackie &amp; McCartney's Practical Medical Microbiology</li> <li>5. Brock biology of Microorganisms 15<sup>th</sup> Edn. Michel Madigan</li> <li>6. PCR for clinical Microbiology Editors: Margret Schuller, Sloots TP, James GS, Halliday CL, Carter I J</li> <li>7. Principles &amp; Technical Aspects of PCR Amplification by Pelt Verkuil E, Belkum AV &amp; Hays J.P.</li> <li>8. Molecular cloning: A Laboratory Manual E. F. Fritsch, Joseph Sambrook, and Tom Maniatis</li> </ol>					



S.No.	Course Code	Course Name	Credits	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	MCC 601	Common Core 1 : Basic sciences	4	CO1											
2	MIC 603	General Microbiology	4	CO1 CO2 CO3 CO4 CO5 CO6	CO2 CO3 CO4 CO5 CO6		CO2 CO3 CO4 CO5 CO6								
3	MIC 605	Immunology	4	CO1 CO2 CO3 CO4 CO5 CO6	CO2 CO3 CO4 CO5 CO6		CO2 CO3 CO4 CO5 CO6								
4	MIC 607	Lab 1 – General Microbiology	4	CO1 CO2 CO3 CO4 CO5 CO6	CO2 CO3 CO4 CO5 CO6	CO5 CO6	CO2 CO3 CO4 CO5 CO6				CO5 CO6	CO5 CO6	CO5 CO6		CO5 CO6
5	MIC 609	Lab 2 - Immunology	4	CO1 CO2 CO3 CO4 CO5 CO6	CO2 CO3 CO4 CO5 CO6	CO5 CO6	CO2 CO3 CO4 CO5 CO6				CO5 CO6	CO5 CO6	CO5 CO6		CO5 CO6
6	MCC 602	Common Core 2 : Introduction to research	4	CO1											
7	MIC 604	Bacteriology Paper-1	4	CO1 CO2 CO5 CO6	CO1 CO2 CO5 CO6	CO2 CO5 CO6	CO1 CO2 CO5 CO6	CO2 CO5 CO6	CO2 CO5 CO6	CO5 CO6	CO2 CO5 CO6	CO6	CO6	CO3 CO4 CO6	CO1 CO2 CO5 CO6
8	MIC 606	Bacteriology Paper-2	4	CO1 CO2 CO5 CO6	CO1 CO2 CO5 CO6	CO2 CO5 CO6	CO1 CO2 CO5 CO6	CO2 CO5 CO6	CO2 CO5 CO6	CO5 CO6	CO2 CO5 CO6	CO6	CO6	CO3 CO4 CO6	CO1 CO2 CO5 CO6
9	MIC 608	Lab (Practical): Bacteriology	4	CO1 CO2 CO3 CO4	CO1 CO2 CO3 CO4 CO5	CO2 CO3 CO5 CO6	CO1 CO2 CO3 CO4 CO5	CO2 CO3 CO4 CO5 CO6	CO2 CO3 CO4 CO5 CO6	CO3 CO4 CO5 CO6	CO2 CO4 CO5 CO6	CO3 CO4 CO6	CO3 CO4 CO6	CO3 CO4 CO6	CO1 CO2 CO3 CO4 CO5



S.No.	Course Code	Course Name	Credits	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
				CO5 CO6	CO6		CO6								CO6
10	MEL 610	Elective – 1*	4	CO1	CO1	CO1	CO1						CO1		
11	MIC 701	Virology	4	CO1 CO2	CO1 CO2 CO3		CO1 CO2 CO3	CO3							CO1 CO2 CO3
12	MIC 703	Parasitology	4	CO4 CO5	CO4 CO5 CO6		CO4 CO5 CO6	CO6							CO4 CO5 CO6
13	MIC 705	Lab 1 (Practical): Virology	4	CO3	CO1 CO2 CO3	CO3	CO3	CO3			CO3	CO3	CO3		CO3
14	MIC 707	Lab 2 (Practical): Parasitology	4	CO6	CO4 CO5 CO6	CO6	CO6	CO6			CO6	CO6	CO6		CO6
15	MEL 709	Elective - 2	4	CO3 CO6	CO1 CO2 CO4 CO5		CO3 CO6	CO3 CO6			CO3 CO6	CO3 CO6	CO3 CO6		CO3 CO6
16	MIC702	Mycology and Molecular techniques	4	CO1 CO2 CO4	CO1 CO2 CO4	CO 2	-	-	-	-	CO2	-	-	-	CO 1 CO 2 CO 4
17	MIC 704	Lab1 Mycology	3	CO3	-	CO3	-	CO3	-	-	-	CO3	-	CO3	CO3
18	MIC706	Lab 2 Molecular Techniques	3	CO5	-	CO5	-	CO5	-	-	-	CO5	-	CO5	CO5
19	MIC 798	Project work	10	-	CO6	CO6	-	CO6	-	-	CO6	CO6	CO6	-	CO6