



**Department of Biochemistry**  
**Kasturba Medical College, Mangalore/Manipal**  
**Manipal Academy of Higher Education, Manipal**

*Outcomes Based Education (OBE) Framework*

**Two Year full time Postgraduate Program**

**M.Sc. Biochemistry (Medical)**

## TABLE OF CONTENTS

<b>SI #</b>	<b>TOPIC/ CONTENT</b>	<b>PAGE NO</b>
<b>1</b>	NATURE AND EXTENT OF THE PROGRAM	<b>3</b>
<b>2</b>	PROGRAM EDUCATION OBJECTIVE	<b>4</b>
<b>3</b>	GRADUATE ATTRIBUTES	<b>5</b>
<b>4</b>	QUALIFICATIONS DESCRIPTORS	<b>6</b>
<b>5</b>	PROGRAM OUTCOMES	<b>7</b>
<b>6</b>	COURSE STRUCTURE, COURSEWISE LEARNING OBJECTIVE, AND COURSE OUTCOMES (COS) <ul style="list-style-type: none"> <li>• COURSE OBJECTIVES</li> <li>• DETAILED COURSE INFORMATION</li> <li>• PRACTICALS/ ASSIGNMENTS</li> <li>• COURSE OUTCOMES</li> </ul>	<b>8-68</b>
<b>7</b>	PROGRAM OUTCOMES AND COURSE LEARNING OUTCOMES MAPPING	<b>69 -70</b>

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

The two year MSc (Medical) Biochemistry program aims to produce a competent Biochemist with sound theoretical and practical knowledge, orientation to research and clinical laboratorian with knowledge of total quality management. It aims at grooming postgraduates for human biochemistry with the basics of immunology, biostatistics and toxicology. It provides first-hand experience in research methodology, clinical laboratory functioning, instrumentation, automation and overall quality management. The course also orients the student to ethical issues related to research and profession.

The program configuration has 4 semesters of 5-6 months each, which culminates in a university examination. Each semester consists of 3-4 courses. M.Sc. in Biochemistry (medical) is open for any graduate with biological science stream/combination having 50% of marks in qualifying examination. Extensive training in theory research methodology, biostatistics, molecular biology techniques, clinical laboratory management and mandatory research project enable the student to choose careers in academics, research and industry or he/she may choose to register for doctoral studies.

## 2. PROGRAM EDUCATION OBJECTIVE (PEO)

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

PEO No	Education Objective
PEO 1	Demonstrate competency in teaching Biochemistry based on theoretical and practical knowledge of the subject gained.
PEO 2	Demonstrate ability to apply the contextual knowledge and modern tools of biochemical research for problem solving
PEO 3	Demonstrate ability to critically analyse scientific data, draw objective conclusions and apply this knowledge for human welfare.
PEO 4	Be a lifelong learner to meet the advances in professional field by keeping abreast of recent advances through participation in continuing education programs and contributing to the same
PEO 5	Exhibit professionalism in the career by following work ethics, interpersonal relationship and cultivating team work

**3. GRADUATE ATTRIBUTES:**

<b>S No.</b>	<b>Attribute</b>	<b>Description</b>
<b>1</b>	<b>Disciplinary Knowledge</b>	Apply the knowledge of the basic sciences and Biochemistry in routine practice
<b>2</b>	<b>Measurable Skills and Industry-ready Professionals</b>	Acquiring and enhancing the skills so that they can confidently provide ethical, legal and other related guidance to others when in profession.
<b>3</b>	<b>Effective and Influencing communication</b>	Well versed in communicating ideas, thoughts and solutions related to the discipline with colleagues and fellow researchers.
<b>4</b>	<b>Leadership readiness/ Qualities</b>	Cultivating leadership attributes so that in future they turn out to be able leaders and visionaries.
<b>5</b>	<b>Critical/ Reflective thinking &amp; language efficiency</b>	Capable of critical and reflective thinking and be able to translate thoughts to paper.
<b>6</b>	<b>Technologically Efficient Professional</b>	Apply knowledge gained in technology to the create teaching learning materials that will help students to easily understand the subject
<b>7</b>	<b>Ethical Awareness</b>	Awareness of the ethics pertaining to the discipline and related fields.
<b>8</b>	<b>Lifelong Learning</b>	Consistently update themselves with the knowledge, skills, materials and technology pertaining to the discipline.
<b>9</b>	<b>Research-related Skills</b>	Apply the knowledge gained to put forth effective research questions and further add to the existing literature.
<b>10</b>	<b>Cooperation/ Team work</b>	Building and working as a team with immense cooperation and utmost efficiency.

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

Typically, holders of the qualification will be able to:

1. Demonstrate comprehensive knowledge of Medical Biochemistry and clinical laboratory processes required by the profession
2. Develop technical expertise, analytical thinking and investigative approach to perform and monitor practical Biochemistry techniques
3. Develop pedagogic skills to effectively teach and practice Biochemistry
4. Demonstrate professionalism and effective teamwork required for a conducive work environment
5. Demonstrate critical thinking, problem-solving skills to identify research gap, plan and conduct meaningful research.
6. Publish the results of the study/work undertaken reliably, with structured and coherent argument.
7. Identify and address their own learning needs to remain relevant in their chosen profession.

**5. PROGRAM OUTCOME: After successful completion of the MSc (Medical) Biochemistry, the students will be able to:**

<b>PO No</b>	<b>Attribute</b>	<b>Competency</b>
<b>PO 1</b>	<b>Knowledge Domain</b>	Exhibit comprehensive knowledge about the basic sciences in general and Biochemistry in particular including current research in the field and effectively teach Biochemistry
<b>PO 2</b>	<b>Skills and Problem analysis</b>	Demonstrate skills to identify, formulate and analyse problems in General and Clinical Biochemistry reaching conclusions based on the principles of the subject.
<b>PO 3</b>	<b>Communication</b>	Communicate effectively with peers, seniors, teachers and students
<b>PO 4</b>	<b>Modern tool usage</b>	Recognise, adopt and apply the relevant techniques/ modalities
<b>PO 5</b>	<b>Environment and sustainability</b>	Recognise the significance and effects of laboratory works on society and environment and explain the impact effectively
<b>PO 6</b>	<b>Ethics and professionalism</b>	Display professional responsibilities and ethical values in the laboratory setting and be able to work respecting the legal framework
<b>PO 7</b>	<b>Individual / Team work</b>	Function effectively as an individual, and as a member of a team
<b>PO 8</b>	<b>Life-long learning</b>	Display skills of lifelong learner and continue professional development



**FIRST YEAR:**

**Semester: 1**

**Semester: 2**

Subject Code	Subject Title	L	T	P	C	Subject Code	Subject Title	L	T	P	C
MCC601	Common Core: Basic sciences	3	1	0	4	MCC602	Common Core: Research methodologies, ethics, statistics, Publishing paper, teaching	2	2	0	4
MBC603	Carbohydrates & Protein –Chemistry & metabolism	3	1	0	4	MBC604	Lipids metabolism, acid base balance & biological oxidation	3	1	0	4
MBC605	General techniques & Enzymes	3	1	0	4	MBC606	Vitamins, minerals, nutrition, Environmental & food pollutants	3	1	0	4
MBC607	Lab 1: Qualitative experiments & chromatography	0	0	8	4	MBC608	Lab 3: Estimation of lipids, vitamins, minerals	0	0	8	4
MBC609	Lab 2: Photometry, Enzyme kinetics, Acids bases & buffers	0	0	8	4	MEL610	<b>Elective* -1</b>	1	1	4	4
	<b>Total</b>	<b>9</b>	<b>3</b>	<b>16</b>	<b>20</b>		<b>Total</b>	<b>9</b>	<b>5</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
MBC701	Endocrinology, Immunology & Heme metabolism	3	1	0	4	MBC 702	Molecular biology & Genetics	3	1	0	4
MBC703	Clinical biochemistry & laboratory management	3	1	0	4	MBC704	Lab 6: Molecular biology techniques	0	0	6	3
MBC705	Lab 4: Electrophoresis, Quantitation by semi automation, POCT & blood gas analysis	0	0	8	4	MBC 706	Lab 7: Clinical lab 2: Organ function Tests	0	0	6	3
MBC707	Lab 5: Clinical lab 1 - ELISA, Clinical enzymology, Automation - QC analysis	0	0	8	4	MBC 798	Project*	0	0	20	10
MEL709	<b>Elective*2</b>	1	1	4	4						
	<b>Total</b>	<b>7</b>	<b>3</b>	<b>20</b>	<b>20</b>		<b>Total</b>	<b>3</b>	<b>1</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 BIOCHEMISTRY

<b>Name of the Program:</b>		<b>MSc Biochemistry (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>	
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 (1hr)</li> <li>Describe the nomenclature, subdivisions, terms and arrangements of anatomical structures (2 hr)</li> <li>Describe different types of skin, fascia and connective tissue, epithelium and cartilage (2 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 (2hr)</li> <li>Classify the joints with structure &amp; examples (1hr)</li> </ul>					32		



	<ul style="list-style-type: none"> <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> <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 (3 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 (5 hr)</li> <li>• Describe the location, parts and function of organs belonging to endocrine system and special senses (3 hrs)</li> </ul>	
<b>Unit 2: Physiology</b>		
Blood and body fluids	<ul style="list-style-type: none"> <li>• Describe the body fluid compartments; composition of body fluids, Transport mechanisms with examples,</li> </ul>	24



<p>Kidney, skin and temperature regulation</p>	<p>composition and functions of blood; Plasma Proteins – functions (1 hr)</p> <ul style="list-style-type: none"> <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 (6 hr)</li> </ul>	
<p>Cardiovascular system</p>	<ul style="list-style-type: none"> <li>• Describe the functions of kidney, Functional anatomy of kidney, renal blood flow (1 hr)</li> <li>• Explain Glomerular filtration rate Tubular functions, Micturition (1 hr)</li> <li>• Describe the functions of skin; body temperature regulation (1 hr)</li> </ul>	
<p>Endocrines</p>	<ul style="list-style-type: none"> <li>• Describe the design of systemic and pulmonary circulation, anatomy of heart and blood vessels, innervation to heart and blood vessels (1 hr)</li> <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>	
<p>Reproductive system</p>	<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</li> </ul>	



<p>Digestion</p>	<p>medullary hormones, Hormones of endocrine pancreas (2 hr)</p> <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>	
<p>Central nervous system</p>	<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>	
<p>Special senses</p>	<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> <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> <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> </ul>	



	<ul style="list-style-type: none"> <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>	
<b>Unit 3: Biochemistry</b>		
<p>Amino acids and proteins</p> <p>Enzymes</p> <p>Carbohydrates</p> <p>Blood glucose regulation &amp; diabetes mellitus</p>	<ul style="list-style-type: none"> <li>Classify proteins and amino acids</li> <li>Discuss the structural organization of proteins</li> <li>Discuss the functions of plasma proteins ( 5 hrs)</li> <li>Classify enzymes with one example each</li> <li>Define the terms-Holoenzyme, apoenzyme coenzyme, cofactor, metallo-enzyme, isoenzyme with example</li> <li>Factors affecting enzyme activity</li> <li>List the clinical application of enzymes with examples</li> <li>Differentiate competitive and noncompetitive enzyme inhibition with examples</li> <li>Explain two applications of competitive inhibition. ( 5 hrs)</li> <li>Classification of carbohydrates with suitable examples</li> <li>Explain the structure of starch and glycogen</li> <li>List the heteropolysacchrides/ mucopolysaccharides with their functions (3 hrs)</li> <li>Describe blood glucose regulation- Enumerate the hypoglycemic and hyper glyceemic hormones with their action in regulation of blood glucose</li> </ul>	<p>24</p>



Lipids	<p>and note on diabetes mellitus (2 hrs)</p> <ul style="list-style-type: none"> <li>Classify lipids with suitable examples</li> <li>List the functions of phospholipids</li> <li>Define Essential fatty acids/PUFA with suitable examples</li> <li>Classify lipoproteins and state their functions</li> <li>Name the ring structure present in cholesterol, List the biologically important compounds derived from it.(4 hrs)</li> </ul>	
Molecular Biology	<ul style="list-style-type: none"> <li>Name the purine and pyrimidine nucleotides,</li> <li>List the functions of nucleotides</li> <li>Describe the structure of DNA, rRNA, tRNA , mRNA with their functions</li> <li>List the differences between DNA &amp; RNA (3 hrs)</li> </ul>	
Vitamins & Minerals	<ul style="list-style-type: none"> <li>Discuss the classification, functions and disorders associated of Vitamins &amp; Minerals (5 hrs)</li> </ul>	
Nutrition	<ul style="list-style-type: none"> <li>Discuss the general aspects of nutrition by defining SDA, BMR, nutritional significance of macromolecules and PEM(3hrs)</li> </ul>	

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

<i>Learning strategy</i>	<i>Contact hours</i>	<i>Student learning time (Hrs)</i>
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:**



<b>Formative:</b>		<b>Summative:</b>				
Class tests /Quiz		Sessional examination				
Assignments		End semester examination				
<b>Mapping of assessment with Cos</b>						
Nature of assessment	CO 1					
Sessional Examination 1	X					
Sessional Examination 2	X					
Quiz/ class test	X					
Assignment	X					
End Semester Examination	X					
<b>Feedback Process</b>	✓ Mid-Semester feedback					
<b>Reference Material</b>	<ol style="list-style-type: none"> <li>1. Text book of general anatomy by Vishram Singh</li> <li>2. Manipal manual of physiology</li> <li>3. Essentials of biochemistry by Sathyanarayana</li> </ol>					



Name of the Institution / Department: Department of Biochemistry

<b>Name of the Program:</b>		<b>M.Sc. in Biochemistry(Medical)</b>						
<b>Course Title:</b>		<b>Chemistry &amp;metabolism of Carbohydrates &amp; Proteins</b>						
<b>Course Code:</b> MBC603		<b>Course Instructor:</b> Faculty of Biochemistry						
<b>Academic Year:</b> 2020-2021		<b>Semester:</b> First Year, Semester 1						
<b>No of Credits:</b> 4		<b>Prerequisites:</b>						
<b>Synopsis:</b>		This course will provide knowledge of chemistry, metabolism and biomedical importance of proteins, amino acids and carbohydrates. The course will equip students with requisite knowledge of clinical aspects to understand the disorders associated.						
<b>Course Outcomes (COs):</b>		On successful completion of this course, students will be able to						
CO 1:		Explain the chemistry, metabolic pathways, their significance, special product from amino acids and associated disorders, Structural configuration of proteins, structure-function relationship of haemoglobin, myoglobin and collagen						
CO 2:		Discuss the biomedical significance of carbohydrates, characteristic features, various pathways of glucose metabolism, its regulation and abnormal conditions, metabolism of fructose and galactose						
CO 3:		Apply the theoretical knowledge whenever required to recognise the altered metabolic pathways/conditions						
<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>
CO 1	X	X						
CO 2	X	X						
CO 3	X	X						
<b>Course content and outcomes:</b>								
<i>Content</i>					<i>Competencies</i>			<i>No of Hours</i>
<b>Unit 1: Chemistry &amp;metabolism of proteins</b>								
					<ul style="list-style-type: none"> <li>Discuss the classification, properties and amino acids with suitable examples and biologically important peptide (4 hrs)</li> <li>Describe the structural organisation of Proteins ( 3hrs)</li> <li>Explain the requirements and processes involved in digestion and absorption of proteins including associated disorders (2 hrs)</li> </ul>			40



	<ul style="list-style-type: none"> <li>• Discuss the structure-function relationship of proteins: haemoglobin, myoglobin and collagen. (4 hrs)</li> <li>• Discuss the metabolism of amino acids: Define the term: Transamination, Deamination, Trans-deamination with suitable examples and their significance(3 hrs)</li> <li>• Explain the different sources of ammonia in the body, its transport and detoxification , normal level and its toxicity ( 2hrs)</li> <li>• Discuss the reactions of urea cycle, Associated disorders, normal level and its clinical significance(3 hrs)</li> <li>• Explain the metabolism of individual amino acids -Biologically important products formed with their functions &amp; associated disorders(13 hrs)</li> <li>• Discuss the diagnostic significance of acute phase proteins with suitable examples(2 hrs)</li> <li>• Discuss the process of Protein degradation(2 hrs)</li> <li>• Explain the significance of Cathepsins, proteasomes, Proteomics and metabolomics(2 hrs)</li> </ul>	
<b>Unit 2: Chemistry &amp;metabolism of carbohydrates</b>		
	<ul style="list-style-type: none"> <li>• Discuss the Classification, properties/reactions, derivatives of carbohydrates(4 hrs)</li> <li>• Discuss the chemistry and functions of proteoglycans(3 hrs)</li> <li>• Discuss the chemistry, distribution &amp; functions of Blood group substances(2 hrs)</li> <li>• Discuss different pathways of glucose metabolism: Pathway, inhibitors, Regulation, significance and associated</li> </ul>	40



	<p>disorders: Glycolysis, TCA cycle, HMP shunt, Glycogen metabolism &amp; Gluconeogenesis (25 hrs)</p> <ul style="list-style-type: none"> <li>• Discuss the metabolism of fructose and galactose with associated disorders (2 hrs)</li> <li>• Explain polyol pathway and its significance (2 hrs)</li> <li>• Discuss uronic acid pathway with its significance (1 hr)</li> <li>• Understand the Cori's cycle &amp; Alanine cycle with their significance(1 hr)</li> </ul>					
<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	40	120				
Seminar/ tutorials	10	30				
Small Group Discussion (SGD)	10	30				
Self-directed learning (SDL)	10	10				
Case Based Learning (CBL)	10	30				
Revision	10	10				
Assessment	10	10				
<b>TOTAL</b>	<b>100</b>	<b>240</b>				
<b>Assessment Methods:</b>						
<b>Formative:</b>		<b>Summative:</b>				
Class tests		Sessional examination				
Assignments		End semester examination				
Quiz						
<b>Mapping of assessment with Cos</b>						
Nature of assessment	CO 1	CO 2	CO 3			
Sessional Examination 1	X	X	X			
Sessional Examination 2	X	X	X			
Quiz/ class test	X	X	X			
Assignment	X	X	X			
End Semester Examination	X	X	X			
<b>Feedback Process</b>	✓	Mid-Semester feedback				
	✓	End-Semester Feedback				
<b>Reference Material</b>	<ol style="list-style-type: none"> <li>1. Textbook of Medical Biochemistry- D M Vasudevan</li> <li>2. Lehninger Principles of Biochemistry- David L Nelson and Michael M Cox</li> <li>3. Medical Biochemistry –Kaplan</li> </ol>					



	4. Text book of Biochemistry- ES West and WR Todd 5. Biochemistry- Dr U Sathyanarana
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**Name of the Institution / Department:** Department of Biochemistry

<b>Name of the Program:</b>		<b>M.Sc. in Biochemistry(Medical)</b>						
<b>Course Title:</b>		General techniques & Enzymes						
<b>Course Code:</b> MBC 605		<b>Course Instructor:</b> Faculty of Biochemistry						
<b>Academic Year:</b> 2020-2021		<b>Semester:</b> First Year, Semester 1						
<b>No of Credits:</b> 4		<b>Prerequisites:</b>						
<b>Synopsis:</b>		This course will provide knowledge of general techniques used in a clinical/research laboratory to separate, purify and analyse the components /samples according to the requirements of the work place. The course will also give an insight into enzymology and its applications.						
<b>Course Outcomes (COs):</b>		On successful completion of this course, students will be able to						
CO 1:		Discuss the principle, instrumentation, work flow, applications and advantages of various methodologies pertaining to –various types of spectrophotometers; Immunological techniques(RIA, ELISA, Immunodiffusion, Immunelectrophoresis, ECLIA); pH meters, centrifugation processes; Chromatographic processes, separation, purification analysis and quantitation of proteins and enzymes						
CO 2:		Explain the methods of detection, quantification and use of isotopes						
CO 3:		Discuss the classification, characteristic features, kinetics, types of inhibitions, regulation and applications in the field of diagnostics and research.						
<b>Mapping of COs to POs</b>								
COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO 1	X	x						
CO 2	X							
CO 3	x							
<b>Course content and outcomes:</b>								
<b>Content</b>				<b>Competencies</b>				<b>No of Hours</b>
<ul style="list-style-type: none"> <li><b>Unit 1:</b> General techniques :</li> </ul>								
				<ul style="list-style-type: none"> <li>✓ Explain the Principle, instrumentation and applications of general techniques in research and clinical laboratory(3 hrs)</li> <li>✓ Discuss the various methods of</li> </ul>				36



	<p><b>qualitative analysis</b> of bio molecules:</p> <ul style="list-style-type: none"> <li>✓ <b>Chromatography:</b> Principle, experimental procedure and applications of paper, thin layer, ion exchange, affinity, gel filtration, gas liquid, HPLC(8 hrs)</li> <li>✓ <b>Electrophoresis:</b> Principle, procedures and application of: Paper, polyacrylamide gel, agarose gel and cellulose acetate(8 hrs)</li> <li>✓ <b>Centrifugation techniques:</b> ultracentrifugation, ultrafiltration, isoelectric focussing technique. (5 hrs)</li> <li>✓ Explain the Principle, instrumentation and applications of photometry, spectrophotometry flurometry, flame photometry, nephelometry, osmometry, atomic absorption spectrophotometry, nuclear magnetic resonance spectrometry &amp; mass spectrometry (12 hrs)</li> </ul>	
<p>• <b>Unit 2: Cell biology</b></p>		
	<ul style="list-style-type: none"> <li>✓ Describe the cell structure, macromolecular components of cell and their functions(2 hrs)</li> <li>✓ Discuss the procedures of cell fractionation, biochemical activities of different fractions and marker enzymes. (4 hrs)</li> <li>✓ Explain the methodology involved in the purification of proteins, characterization and criteria for purity &amp; structural elucidation of proteins. ( 4 hrs)</li> </ul>	10
<p><b>Unit 3:</b> Determination of pH/pH meter</p>		
	<ul style="list-style-type: none"> <li>✓ Explain principles and procedure of determination of pH(1 hr)</li> </ul>	4



	✓ Understand the significance/ importance of standard hydrogen electrode, reference electrode, glass electrode, & ion selective electrodes. (3 hrs)	
<b>Unit 4:</b>		
• Isotopes	✓ Write the definition, types and examples of isotopes and their applications.	4
<b>Unit 5:</b>		
• Immunochemical techniques	✓ Describe the principle, procedure and applications of immunochemical techniques: Radioimmuno assays (RIA), Enzyme linked immunosorbent assay (ELISA), immunodiffusion, immune electrophoresis & ECLIA	10
<b>Unit 6:</b>		
✓ Enzymes	<ul style="list-style-type: none"> <li>✓ Discuss the classification with suitable examples, mechanism of action, Kinetics, characteristic properties and enzyme specificity (4 hrs)</li> <li>✓ Explain the terms: coenzyme, cofactor, Isoenzyme, proenzyme, tandem enzyme and multienzyme complex with suitable examples and their significance in an enzymatic reaction(4 hrs)</li> <li>✓ Categorise different types of enzyme inhibitions – Competitive, non-competitive, allosteric and suicide inhibition with kinetics, examples and their significance/ applications(4 hrs)</li> <li>✓ Explain the mechanisms involved in the regulation of enzyme action (4 hrs)</li> </ul>	16
<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	40	120
Seminar/ tutorials	10	30
Small Group Discussion (SGD)	10	30



Self-directed learning (SDL)	10	10				
Case Based Learning (CBL)	10	30				
Revision	10	10				
Assessment	10	10				
<b>TOTAL</b>	<b>100</b>	<b>240</b>				
<b>Assessment Methods:</b>						
<b>Formative:</b>		<b>Summative:</b>				
Class tests		Sessional examination				
Assignments		End semester examination				
Quiz						
<b>Mapping of assessment with Cos</b>						
Nature of assessment	CO 1	CO 2	CO3			
Sessional Examination 1	X	X	X			
Sessional Examination 2	X	X	X			
Quiz/ class test	X	X	X			
Assignment	X	X	X			
End Semester Examination	X	X	X			
<b>Feedback Process</b>	✓	Mid-Semester feedback				
	✓	End-Semester Feedback				
<b>Reference Material</b>	<ol style="list-style-type: none"> <li>1. Fundamentals of Clinical Chemistry- Tietz</li> <li>2. Practical Clinical Biochemistry- Varley</li> <li>3. Biophysical Chemistry (Principles and Techniques)- Upadhyay, Kakoli Upadhyay, and Nirmalendu Nath</li> <li>4. Textbook of Medical Biochemistry- DM Vasudevan</li> <li>5. Principles and Techniques of Biochemistry and Molecular Biology- Wilson and Walker</li> <li>6. Lehninger Principles of Biochemistry- David L Nelson and Michael M Cox</li> <li>7. Text book of Biochemistry- ES West and WR Todd</li> </ol>					



Name of the Institution / Department: Department of Biochemistry

<b>Name of the Program:</b>		<b>M.Sc. in Biochemistry(Medical)</b>						
<b>Course Title:</b>		Lab1: Qualitative experiments, Chromatography						
<b>Course Code:</b> MBC 607		<b>Course Instructor:</b> Faculty of Biochemistry						
<b>Academic Year:</b> 2020-2021		<b>Semester:</b> First Year, Semester 1						
<b>No of Credits:</b> 4		<b>Prerequisites:</b>						
<b>Synopsis:</b>		The course will provide skill to perform various techniques required for identification and separation of carbohydrates and amino acids.						
<b>Course Outcomes (COs):</b>		On successful completion of this course, students will be able to						
CO 1:		Perform suitable tests to identify and interpret the class of carbohydrates, type of proteins, amino acids and NPN substances.						
CO 2:		Separate and identify the carbohydrate/amino acids from a given specimen using paper/Thin Layer Chromatography						
<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>
CO 1	X	x	x		X		X	
CO 2	x	x	x	x	X		X	X
<b>Content</b>					<b>Competencies</b>			<b>No of Hours</b>
<b>Unit 1:</b> Qualitative experiments								
					<ul style="list-style-type: none"> <li>Perform, identify and interpret the reactions of proteins: General reactions and precipitation reactions of proteins, specific colour reactions of amino acids,</li> <li>Identification of the proteins (Gelatin, peptone, albumin, Casein)/amino acid components in a solution performing above reactions</li> <li>General reactions of monosaccharides, disaccharides, polysaccharides and identification of carbohydrates in a given solution</li> <li>Identification of NPN substances</li> <li>Identification of components from a mixture of unknowns based on the above mentioned principles (proteins/aminoacid/carbohydrates/NPN).</li> </ul>			80
<b>Unit 2:</b> Chromatography								





	<ul style="list-style-type: none"> <li>Perform various chromatographic techniques to separate carbohydrates/amino acids with guidance.</li> <li>Perform the techniques independently and identify the components from a mixture of unknown substances.</li> <li>Observe the use of these techniques in the detection of metabolites in the urine sample of new born.</li> </ul>	80
<b>Learning strategies, contact hours and student learning time</b>		
<i>Learning strategy</i>	<i>Contact hours</i>	<i>Student learning time (Hrs)</i>
Practical	120	240
Small Group Discussion (SGD)	---	---
Self-directed learning (SDL)	40	40
Revision	10	10
Assessment	10	10
<b>TOTAL</b>	<b>180</b>	<b>300</b>
<b>Assessment Methods:</b>		
<b>Formative:</b>		<b>Summative:</b>
Class tests		Sessional examination
Assignments		End semester examination
Quiz		
<b>Mapping of assessment with Cos</b>		
Nature of assessment	CO 1	CO 2
Sessional Examination 1	X	X
Sessional Examination 2	X	X
Quiz/ class test	X	X
Assignment	X	X
End Semester Examination	X	X
<b>Feedback Process</b>	✓ Mid-Semester feedback ✓ End-Semester Feedback	
<b>Reference Material</b>	<ol style="list-style-type: none"> <li>Biochemistry Laboratory Manual KMC Mangalore/Manipal</li> <li>Fundamentals of Clinical Chemistry- Tietz</li> <li>Practical Clinical Biochemistry- Varley</li> <li>Biophysical Chemistry (Principles and Techniques)- Upadhyay, Kakoli Upadhyay, and Nirmalendu Nath</li> <li>Laboratory Manual in Biochemistry- J Jayaraman</li> </ol>	

Name of the Institution / Department: Department of Biochemistry

<b>Name of the Program:</b>		<b>M.Sc. in Biochemistry(Medical)</b>						
<b>Course Title:</b>		Lab 2: Photometry & Enzyme kinetics						
<b>Course Code:</b> MBC 609		<b>Course Instructor:</b> Faculty of Biochemistry						
<b>Academic Year:</b> 2020-2021		<b>Semester:</b> First Year, Semester 1						
<b>No of Credits:</b> 4		<b>Prerequisites:</b>						
<b>Synopsis:</b>		This course will help to acquire the knowledge of preparation of appropriate buffer solutions, skills for the operation of colorimeter/spectrophotometers independently. It provides skills to perform the reactions involved in enzyme kinetics. It also provides skills to estimate clinically important parameters like blood glucose, total protein, albumin, urea & creatinine and interpret the results obtained.						
<b>Course Outcomes (COs):</b>		On successful completion of this course, students will be able to						
CO 1:		Understand the basic concepts involved in the preparation of appropriate buffer solutions and know the use under various conditions.						
CO 2:		Operate the colorimeter/spectrophotometer independently for analysis and detection of various components under standard conditions or in a given patient sample.						
CO 3:		Perform various experiments to determine the kinetics of an enzyme catalysed reaction.						
CO 4:		Estimate and interpret various clinically significant analytes using colorimetric/spectrophotometric techniques.						
<b>Mapping of COs to POs</b>								
COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO 1	X	x	x	x	X		X	
CO 2	x	X	x	x	X		X	
CO 3	X	X	X		X		X	
CO 4	X	X	X	X	X		X	X
<b>Content</b>			<b>Competencies</b>					<b>No of Hours</b>
<b>Unit 1: Photometry</b>								
			<ul style="list-style-type: none"> <li>Determine the components required for the preparation of buffer solutions of varied concentration and combinations</li> <li>Measure the buffering capacity and compare the various buffers</li> <li>Understand the concept behind buffering action and strength of buffers</li> <li>Solve problems related to buffer preparation</li> <li>State, Perform and apply Beers law</li> <li>Choose and operate colorimeter and spectrophotometers independently as per the experimental requirement</li> </ul>					110



	<ul style="list-style-type: none"> <li>Identify various amino acids based on their absorption spectra</li> <li>Estimate the following analytes using the standard curve and interpret the results obtained               <ul style="list-style-type: none"> <li>Plasma glucose</li> <li>Serum total protein, albumin, calculate globulin &amp; A/G ratio</li> <li>Serum Urea</li> <li>Serum creatinine with creatinine clearance</li> </ul> </li> </ul>	
<b>Unit 2:</b> Enzyme kinetics		
	<ul style="list-style-type: none"> <li>Determine the enzyme Kinetics of trypsin – optimum pH, Temperature, effect of Enzyme concentration, Substrate concentration &amp; Km value.</li> </ul>	50

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

<i>Learning strategy</i>	Contact hours	Student Learning time
Practical	120	240
Small Group Discussion (SGD)	----	----
Self-directed learning (SDL)	40	40
Case Based Learning (CBL)	----	----
Revision	10	10
Assessment	10	10
<b>TOTAL</b>	<b>180</b>	<b>300</b>

**Assessment Methods:**

<b>Formative:</b>	<b>Summative:</b>
Class tests	Sessional examination
Assignments	End semester examination
Quiz	

**Mapping of assessment with Cos**

Nature of assessment	CO 1	CO 2	CO 3	CO 4		
Sessional Examination 1	X	X	X	X		
Sessional Examination 2	X	X	X	X		
Quiz/ class test	X	X	X	X		
Assignment	X	X	X	X		
End Semester Examination	X	X	X	X		

<b>Feedback Process</b>	✓ Mid-Semester feedback ✓ End-Semester Feedback
<b>Reference Material</b>	1. Fundamentals of Clinical Chemistry- Tietz 2. Practical Clinical Biochemistry- Varley 3. Laboratory Manual in Biochemistry- J Jayaraman 4. Medical Biochemistry-Kaplan

Name of the Institution / Department: DEPARTMENT OF BIOCHEMISTRY

<b>Name of the Program:</b>		<b>MSc Biochemistry (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.						
<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						
<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>
CO 1	X	X						
CO 2	X				X			
<b>Course content and outcomes:</b>								
<i>Content</i>		<i>Competencies</i>					<i>No of Hours</i>	
<b>Unit 1: Introduction to research</b>								
		<ul style="list-style-type: none"> <li>• Interpret a journal article</li> <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	
<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

ACADEMY of HIGHER EDUCATION

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

Lecture	40	120				
Seminar	-----	-----				
Small Group Discussion (SGD)	30	90				
Self-directed learning (SDL)	10	10				
Case Based Learning (CBL)	---	---				
Assessment	10	10				
Revision	10	10				
<b>TOTAL</b>	<b>100</b>	<b>240</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 Biochemistry

<b>Name of the Program:</b>		<b>M.Sc. in Biochemistry(Medical)</b>						
<b>Course Title:</b>		Lipid metabolism, Acid base balance & Biological oxidation						
<b>Course Code:</b> MBC 604		<b>Course Instructor:</b> Faculty of Biochemistry						
<b>Academic Year:</b> 2020-2021		<b>Semester:</b> First Year, Semester 2						
<b>No of Credits:</b> 4		<b>Prerequisites:</b>						
<b>Synopsis:</b>		<p>This course provides theoretical knowledge of chemistry, metabolism and the biomedical significance of lipids.</p> <p>It also helps understand the details of energy production in the body by integration of metabolism and biological oxidation.</p> <p>It gives an insight into the homeostasis of acid base balance in the living systems and its clinical implications.</p>						
<b>Course Outcomes (COs):</b>		On successful completion of this course, students will be able to						
CO 1:		Discuss the chemistry, metabolism and disorders related to lipids with Mention of membranes						
CO 2:		Comprehend the integration of various metabolisms and the concept of energy production						
CO 3:		Understand the acid base, electrolyte balance and related disorders						
<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>
CO 1	X							
CO 2	X							
CO 3	X	X						
<b>Course content and outcomes:</b>								
<i>Content</i>				<i>Competencies</i>				<i>No of Hours</i>
<b>Unit 1:</b>								
<b>Chemistry of Lipids</b>				<ul style="list-style-type: none"> <li>✓ Discuss Classification, chemistry of lipids with suitable examples.(2hrs)</li> <li>✓ Explain the types of fatty acids and their significance(2hrs)</li> <li>✓ Discuss the functions of phospholipids (1 hr)</li> </ul>				5
<b>Unit 2:</b>								
Metabolism of Lipids				<ul style="list-style-type: none"> <li>✓ Discuss the process of digestion, absorption and associated disorder(3hrs)</li> <li>✓ Explain the requirements, process, unsaturation and mode of regulation of fatty acid biosynthesis. (4 hrs)</li> </ul>				51



	<ul style="list-style-type: none"> <li>✓ Describe the pathway, regulation, energetics and associated disorders of oxidation of saturated &amp; unsaturated fatty acids – Alpha oxidation, Beta oxidation &amp; omega oxidation (6 hrs)</li> <li>✓ Discuss the metabolism of ketone bodies, explain the term ketoacidosis and role of insulin in ketone body metabolism. (4 hrs)</li> <li>✓ Explain the metabolism of eicosanoids with clinical significance. (4 hrs)</li> <li>✓ Discuss the synthesis of cholesterol, major steps involved in the formation of biologically important products formed from it, normal serum cholesterol level and its regulation. (7 hrs)</li> <li>✓ Classify lipoproteins, Discuss the metabolism, functions and clinical significance- lipoproteinemias. (9 hrs)</li> <li>✓ Role of adipose tissue and liver in lipid metabolism. Hormonal regulation of lipid metabolism. Fatty liver and lipotropic factors. (6 hrs)</li> <li>✓ Explain the synthesis and degradation of TG and its regulation (4 hrs)</li> <li>✓ Discuss the Biochemical basis of Lipid storage disorders (4 hrs)</li> </ul>	
<b>Unit 3:</b>		
Membranes	<ul style="list-style-type: none"> <li>● Describe the chemical composition, structure, biological properties, functions, membrane transport systems and defects.</li> </ul>	3
<b>Unit 4:</b>		
Integration of metabolism	<ul style="list-style-type: none"> <li>✓ Integrate/Correlate the significance of different metabolic pathways during fed/fasting conditions</li> </ul>	4





<b>Unit 5:</b>		
Bioenergetics and biological oxidation	<ul style="list-style-type: none"> <li>✓ Categorise the high energy compounds in the body(2hrs)</li> <li>✓ Explain the components, energy synthesising sites , their inhibitors and the basis of electron transport chain(2hrs)</li> <li>✓ Describe/illustrate the process of synthesis of ATP (2hrs)</li> <li>✓ Discuss the terms and the significance of shuttle pathways, ionophores &amp; uncouplers in connection with ETC(2hrs)</li> </ul>	8
<b>Unit 6:</b>		
Acid base balance	<ul style="list-style-type: none"> <li>✓ Understand the concept of pH and buffers(1 hr)</li> <li>✓ Write the derivation and use of Henderson-Hasselbalch equation (2hrs)</li> <li>✓ Describe the body mechanisms of acid base balance – the buffer systems, renal and respiratory mechanisms</li> <li>✓ Categorise the disorders of acid base balance and the mechanism of compensation (2hrs)</li> <li>✓ Discuss electrolyte, understand the term and significance of anion gap related disorders(2hrs)</li> </ul>	9
<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	40	120
Seminar/ tutorials	10	30
Small Group Discussion (SGD)	10	30
Self-directed learning (SDL)	10	10
Case Based Learning (CBL)	10	10
Revision	10	10
Assessment	10	10
<b>TOTAL</b>	<b>100</b>	<b>220</b>
<b>Assessment Methods:</b>		



<b>Formative:</b>		<b>Summative:</b>				
Class tests		Sessional examination				
Assignments		End semester examination				
Quiz						
<b>Mapping of assessment with Cos</b>						
Nature of assessment	CO 1	CO 2	CO 3			
Sessional Examination 1	X	X	X			
Sessional Examination 2	X	X	X			
Quiz/ class test	X	X	X			
Assignment	X	X	X			
End Semester Examination	X	X	X			
<b>Feedback Process</b>	✓	Mid-Semester feedback				
	✓	End-Semester Feedback				
<b>Reference Material</b>	<ol style="list-style-type: none"> <li>1. Textbook of Medical Biochemistry- D M Vasudevan</li> <li>2. Lehninger Principles of Biochemistry- David L Nelson and Michael M Cox</li> <li>3. Medical Biochemistry –Kaplan</li> <li>4. Text book of Biochemistry- ES West and WR Todd</li> <li>5. Biochemistry- Dr U Sathyanarana</li> </ol>					

Name of the Institution / Department: Department of Biochemistry

<b>Name of the Program:</b>		<b>M.Sc. in Biochemistry(Medical)</b>						
<b>Course Title:</b>		Vitamins, Minerals, Nutrition, Environmental & Food pollutants						
<b>Course Code:</b> MBC 606		<b>Course Instructor:</b> Faculty of Biochemistry						
<b>Academic Year:</b> 2020-2021		<b>Semester:</b> First Year, Semester 2						
<b>No of Credits:</b> 4		<b>Prerequisites:</b>						
<b>Synopsis:</b>		<p>This course emphasises on classification, metabolism and associated disorders of vitamins and minerals.</p> <p>It also describes in detail the nutritional requirements to maintain the health status.</p> <p>It gives a brief idea on environmental and food pollutants</p>						
<b>Course Outcomes (COs):</b>		On successful completion of this course, students will be able to						
CO 1:		Classify and discuss the chemistry, metabolism, biological functions, requirements and associated disorders of vitamins and minerals.						
CO 2:		Discuss the energy requirements, various indices to calculate the same, with stress on importance of diet in health and disease under different conditions.						
CO 3:		Identify the environmental and food pollutants with emphasis on free radicals and antioxidants and their effects on health and disease.						
<b>Mapping of COs to POs</b>								
COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO 1	X							
CO 2	X	X	X					
CO 3	X							
<b>Course content and outcomes:</b>								
<i>Content</i>				<i>Competencies</i>				<i>No of Hours</i>
<b>Unit 1:</b>								
Vitamins				<ul style="list-style-type: none"> <li>✓ Classification of vitamins and their general characteristic features (1 hr)</li> <li>✓ Discuss the sources, requirements, chemistry, mechanism of absorption, metabolic/physiological significance and associated disorders of : <ul style="list-style-type: none"> <li>✓ Fat soluble- Vitamin A,D,E &amp; K (8 hrs)</li> <li>✓ Members of B complex ( 11 hrs)</li> <li>✓ Vitamin C( 2 hr)</li> </ul> </li> </ul>				22
<b>Unit 2:</b>								
Free radicals and antioxidants				<ul style="list-style-type: none"> <li>✓ Describe the term Reactive oxygen species, mechanisms/reactions of their formation, their significance in health and disease conditions (5 hrs)</li> </ul>				10



	<ul style="list-style-type: none"> <li>✓ Discuss the defence mechanisms against reactive species- the antioxidants including enzyme systems (5 hrs)</li> </ul>	
<b>Unit 3:</b>		
<ul style="list-style-type: none"> <li>• Mineral Metabolism:</li> </ul>	<ul style="list-style-type: none"> <li>• Classification of minerals - Macro &amp; micro/trace minerals with definition (1hr)</li> <li>• Explain the absorption, maintenance of blood levels, functions, associated disorders, sources and requirements of :           <ul style="list-style-type: none"> <li>✓ Macrominerals- sodium, potassium, chloride, magnesium, calcium, phosphorus (8 hrs)</li> <li>✓ Trace elements: iron, copper, manganese, zinc, cobalt, molybdenum, selenium, iodine and fluoride (6 hrs)</li> </ul> </li> </ul>	15
<b>Unit 4:</b>		
<ul style="list-style-type: none"> <li>• Nutrition:</li> </ul>	<ul style="list-style-type: none"> <li>• Define and Explain the significance of the terms calorific value, BMR, SDA, RQ in nutrition (2 hr)</li> <li>• Justify dietary significance of different food components:           <ul style="list-style-type: none"> <li>✓ carbohydrates with dietary fibres (1 hr)</li> <li>✓ Types of lipids and their dietary significance- PUFA/EFA (1 hr)</li> <li>✓ Proteins- Nitrogen balance, nutritive value, biological value, chemical score, Protein quality, limiting amino acids, protein sparing effect, mutual supplementation of proteins (4 hrs)</li> </ul> </li> <li>• Discuss the concept proximate of diet and their relative proportions (2 hrs)</li> <li>• calculate energy requirements for different age &amp; functional groups (1 hr)</li> <li>• Sketch balanced diet – with different food groups.</li> <li>• Explain/ Discuss Nutritional disorders: obesity, starvation, binge eating disorders, protein energy malnutrition and diet formulations in health &amp; disease. (3 hrs)</li> <li>• Understand the term Glycemic index(1 hr)</li> <li>• Discuss on total parental nutrition and its complications(2 hrs)</li> <li>• Differentiate nutritional anaemias (2 hrs)</li> </ul>	19



<b>Unit 5:</b>						
Environmental & food pollutants:	<ul style="list-style-type: none"> <li>• Discuss:               <ul style="list-style-type: none"> <li>✓ hazards of Heavy metal poisons, pesticides &amp; insecticides (3 hrs)</li> <li>✓ occupational, radiation &amp; industrial hazards(3 hrs)</li> <li>✓ the pollutants,- air, water &amp; food additives(8 hrs)</li> </ul> </li> </ul>					14
<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	40			120		
Seminar/ tutorials	10			30		
Small Group Discussion (SGD)	10			30		
Self-directed learning (SDL)	10			10		
Case Based Learning (CBL)	10			10		
Revision	10			10		
Assessment	10			10		
<b>TOTAL</b>	<b>100</b>			<b>220</b>		
<b>Assessment Methods:</b>						
<b>Formative:</b>				<b>Summative:</b>		
Class tests				Sessional examination		
Assignments				End semester examination		
Quiz						
<b>Mapping of assessment with Cos</b>						
Nature of assessment	CO 1	CO 2	CO 3			
Sessional Examination 1	X	X	X			
Sessional Examination 2	X	X	X			
Quiz/ class test	X	X	X			
Assignment	X	X	X			
End Semester Examination	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. Textbook of Medical Biochemistry- D M Vasudevan</li> <li>2. Lehninger Principles of Biochemistry- David L Nelson and Michael M Cox</li> <li>3. Medical Biochemistry –Kaplan</li> <li>4. Text book of Biochemistry- ES West and WR Todd</li> <li>5. Biochemistry- Dr U Sathyanarana</li> </ol>					



Name of the Institution / Department: Department of Biochemistry

<b>Name of the Program:</b>		<b>M.Sc. in Biochemistry(Medical)</b>						
<b>Course Title:</b>		Lab 1: Estimation of lipids, vitamins, minerals						
<b>Course Code:</b> MBC 608		<b>Course Instructor:</b>						
<b>Academic Year:</b> 2020-2021		<b>Semester:</b> First Year, Semester 2						
<b>No of Credits:</b>		<b>Prerequisites:</b>						
<b>Synopsis:</b>	This course provides opportunity to cultivate skills related to estimation of various analytes associated with lipid profile, nutritional status and oxidative stress.							
<b>Course Outcomes (COs):</b>		On successful completion of this course, students will be able to						
CO 1:	Estimate and calculate levels of lipid profile components and interpret the values of a given sample							
CO 2:	Estimate vitamin C levels and study select antioxidant enzyme activities and products of lipid peroxidation							
CO 3:	Perform estimations and interpret the values of minerals in serum namely, Calcium, Phosphorus, Chloride, Copper, iron and indicators of mineral status such as ceruloplasmin, iron binding capacity.							
<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>
CO 1	X	X	X		X	X	X	X
CO 2	X	X	X		X		X	X
CO 3	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 1:</b>								
<b>Lipid profile analysis:</b>					<ul style="list-style-type: none"> <li>Estimate the following analytes using the standard curve and interpret the results obtained - Total cholesterol, Triglycerides, HDL-C</li> <li>Calculate the values using Freidewald's formula</li> </ul>			50
<b>Unit 2:</b>								
<b>Vitamins</b>					<ul style="list-style-type: none"> <li>Estimate the levels of Vitamins</li> </ul>			50
<b>Unit 3:</b>								
<b>Minerals</b>					<ul style="list-style-type: none"> <li>Analyse serum: Calcium, chloride, Phosphorus, Iron, Iron binding capacity Ceruloplasmin &amp; Copper</li> </ul>			60
<b>Learning strategies, contact hours and student learning time</b>								
<i>Learning strategy</i>					<i>Contact hours</i>			<i>Student learning time (Hrs)</i>



Seminar/ tutorials	-----	----				
Small Group Discussion (SGD)	----	----				
Self-directed learning (SDL)	40	40				
Practical	120	240				
Revision	10	10				
Assessment	10	10				
<b>TOTAL</b>	<b>180</b>	<b>300</b>				
<b>Assessment Methods:</b>						
<b>Formative:</b>		<b>Summative:</b>				
Class tests		Sessional examination				
Assignments		End semester examination				
Quiz						
<b>Mapping of assessment with Cos</b>						
Nature of assessment	CO 1	CO 2	CO 3			
Sessional Examination 1	X	X	X			
Sessional Examination 2	X	X	X			
Quiz/ class test	X	X	X			
Assignment	X	X	X			
End Semester Examination	X	X	X			
<b>Feedback Process</b>	✓	Mid-Semester feedback				
	✓	End-Semester Feedback				
<b>Reference Material</b>	<ol style="list-style-type: none"> <li>1. Fundamentals of Clinical Chemistry- Tietz</li> <li>2. Practical Clinical Biochemistry- Varley</li> <li>3. Biochemistry- Kaplan</li> </ol>					

**Name of the Institution / Department:** DEPARTMENT OF BIOCHEMISTRY

<b>Name of the Program:</b>		<b>MSc Biochemistry (Medical)</b>										
<b>Course Title:</b>		Elective 1*										
<b>Course Code: MEL 610</b>		<b>Course Instructor: Faculty Department of Biochemistry</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 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 and a maximum of 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										
<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>				
CO 1	X	X	X	X								
<b>Course content and outcomes:</b>												
<i>Content</i>		<i>Competencies</i>								<i>No of Hours</i>		
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>To understand the aims and effects of tissue fixation</li> <li>To know the precautions to be taken during tissue fixation</li> <li>To name the commonly used fixatives and to explain their merits and demerits</li> <li>To name the different types of embedding methods available and to give their applications</li> <li>To know the detailed procedure involved in paraffin embedding method</li> <li>To get hands on experience in paraffin embedding method for variety of tissues</li> <li>To name the different types of microtomes and to explain their applications</li> <li>To know the detailed procedure of section cutting using rotary microtome</li> <li>To get hands on experience in using rotary microtome for section cutting</li> <li>To know the water bath method of flattening and mounting of sections</li> </ul>	120
<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> </ul>	120



	<ul style="list-style-type: none"> <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>	
<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>	<ol 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> </ol>	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> </ul>	120



	<ul style="list-style-type: none"> <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>	
<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>	<p>Learning objectives:</p> <p>Basics of Andrology techniques, Code: MEL 610.9:</p> <p>Basic andrology requirements          Patient instruction for semen collection          Macroscopic examination of human ejaculate          Microscopic examination of human ejaculate          Structure of human spermatozoa          Reference values for normal semen profile          Sperm processing for insemination</p>	120



<ul style="list-style-type: none"> <li>MEL 610.10- Forensic toxicology</li> </ul>	<p>To have knowledge and able to classify the poisons.</p> <ul style="list-style-type: none"> <li>- Describe and understand the factors modifying the actions of poisons.</li> <li>- Understanding the principles behind detection of the different types of poisons and quantification of the same from the biological samples.</li> <li>- Understand the characteristic features and the detection techniques of the following poisons:           <ul style="list-style-type: none"> <li>· Features of Corrosive acids / alkalies, and its medicolegal importance.</li> <li>· Appearances of phosphorus and insecticides, and its detection techniques.</li> <li>· Identification of the common compounds containing heavy metals like arsenic, lead, mercury, copper, its characteristic features and detection techniques.</li> <li>· Identifying the common vegetable and animal irritants, differentiating the features of each poisoning.</li> <li>· To understand the various preparations of Somniferous and inebriant poisons, its usage, characteristic features and detection techniques.</li> <li>· Identify the various plants containing deliriant, cardiac and spinal poisons and its detection techniques.</li> <li>· Identification and mechanism of action of the various compounds containing Asphyxiants substances.</li> <li>· To have knowledge on food poisoning, drug abuse and deaths associated with it</li> </ul> </li> </ul>	<p>120</p>
<p><b>Learning strategies, contact hours and student learning time</b></p>		
<p><i>Learning strategy</i></p>	<p><i>Contact hours</i></p>	<p><i>Student learning time (Hrs)</i></p>
<p>Lecture</p>	<p>20</p>	<p>60</p>



# MANIPAL

ACADEMY of HIGHER EDUCATION

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

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>	✓ End elective Feedback	
<b>Reference Material</b>	Based on elective- departments will specify	



**Name of the Institution / Department:** Department of Biochemistry

<b>Name of the Program:</b>		<b>M.Sc. in Biochemistry(Medical)</b>										
<b>Course Title:</b>		Endocrinology, Immunology & Heme metabolism										
<b>Course Code:</b> MBC 701		<b>Course Instructor:</b> Faculty of Biochemistry										
<b>Academic Year:</b> 2020-2021		<b>Semester:</b> Second Year, Semester 3										
<b>No of Credits:</b> 4		<b>Prerequisites:</b>										
<b>Synopsis:</b>		This subject aids the post- graduate student to acquire knowledge and understanding of the classes, mechanism of action, synthesis and tests to evaluate the levels of various hormones in the body.										
<b>Course Outcomes (COs):</b>		On successful completion of this course, students will be able to										
CO 1:		Discuss the mechanism of action and laboratory evaluation of all hormones in general with special emphasis on adrenal and thyroid hormones										
CO 2:		Describe the types, clinical features, investigations in the diagnosis and management of Diabetes mellitus and its complications										
CO 3:		Discuss the structure, metabolism and associated disorders of heme metabolism										
CO 4:		Explain the mechanisms involved in the process of detoxification										
<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>				
CO 1	X											
CO 2	x											
CO 3	X											
CO 4	X											

<b>Course content and outcomes:</b>		
<i>Content</i>	<i>Competencies</i>	<i>No of Hours</i>
<b>Unit 1:</b>		
Endocrinology:	<ul style="list-style-type: none"> <li>Classify &amp; describe the mechanism of action of hormones, hormone receptors(3hrs)</li> <li>Signal transduction, G-protein (4hrs)</li> <li>Secondary messengers: cyclic AMP, cyclic GMP, Inositol triphosphate, diacylglycerol, nitric oxide (4hrs)</li> <li>Hormonal regulation of gene expression (4hrs)</li> </ul>	40



	<ul style="list-style-type: none"> <li>• Biosynthesis and degradation of adrenal medullary hormones and thyroid hormones(5hrs)</li> <li>• Biological functions and disorders of hypothalamus, pituitary, thyroid, parathyroid, adrenal, gonads and pancreas(7hrs)</li> <li>• Biochemical evaluation of endocrine disorders (thyroid, parathyroid, adrenal and gonadal function tests). (6hrs)</li> <li>• Discuss the hormones in carbohydrate utilization and Blood glucose homeostasis (2hrs)</li> <li>• Describe the types, clinical features, investigations in the diagnosis and management of Diabetes mellitus and its complications ( significance of Blood glucose, glucose tolerance test· Glycated haemoglobin, fructosamino albumin) (5hrs)</li> </ul>	
<b>Unit 2:</b>		
Basic concepts of immunology:	<ul style="list-style-type: none"> <li>• Describe the Chemistry and structure, classification function of immunoglobulins(4hrs)</li> <li>• Discuss the primary and secondary immune responses, autoimmune phenomenon , anaphylaxis, clonal selection( 8hrs)</li> <li>• Explain the role of B cells, T cells, NK cells, macrophages and HLA antigens (8hrs)</li> <li>• Describe autoimmunity and its clinical effects</li> </ul>	20
<b>Unit 3:</b>		
Hemoglobin metabolism and disorders:	<ul style="list-style-type: none"> <li>• Understand the structure of heme and list the heme containing components (1hr).</li> <li>• Discuss the synthesis of Heme and its regulation (3hrs)</li> <li>• Classify porphyrias and describe in detail each one of them (2hrs)</li> </ul>	15



	<ul style="list-style-type: none"> <li>Describe bilirubin metabolism(2hrs)</li> <li>Know the hemoglobin derivatives, with physiological and pathological relevance (2hrs)</li> <li>Explain Hemoglobin electrophoresis(2hrs)</li> <li>Discuss the hemoglobinopathies (3hrs)</li> </ul>	
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**Unit 4**

Biotransformation & Detoxification	<ul style="list-style-type: none"> <li>Discuss the mechanisms involved in Biotransformation/ detoxification: Phase-I &amp; II reactions with suitable examples</li> </ul>	5
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**Learning strategies, contact hours and student learning time**

Learning strategy	Contact hours	Student learning time (Hrs)
Lecture	40	120
Seminar/ tutorials	10	30
Small Group Discussion (SGD)	10	30
Self-directed learning (SDL)	10	10
Case Based Learning (CBL)	10	10
Revision	10	10
Assessment	10	10
<b>TOTAL</b>	<b>100</b>	<b>220</b>

**Assessment Methods:**

Formative:	Summative:
Class tests	Sessional examination
Assignments	End semester examination
Quiz	

**Mapping of assessment with Cos**

Nature of assessment	CO 1	CO 2	CO 3	CO 4		
Sessional Examination 1	X	X	X	X		
Sessional Examination 2	X	X	X	X		
Quiz/ class test	X	X	X	X		
Assignment	X	X	X	X		
End Semester Examination	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>
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<b>Reference Material</b>	<ol style="list-style-type: none"> <li>Textbook of Medical Biochemistry- D M Vasudevan</li> <li>Lehninger Principles of Biochemistry- David L Nelson and Michael M Cox</li> <li>Medical Biochemistry –Kaplan</li> <li>Text book of Biochemistry- ES West and WR Todd</li> <li>Biochemistry- Dr U Sathyanarana</li> </ol>
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Name of the Institution / Department: Department of Biochemistry

<b>Name of the Program:</b>		<b>M.Sc. in Biochemistry(Medical)</b>						
<b>Course Title:</b>		<b>Clinical biochemistry &amp; laboratory management</b>						
<b>Course Code:</b> MBC 703		<b>Course Instructor:</b> Faculty of Biochemistry						
<b>Academic Year:</b> 2020-2021		<b>Semester:</b> Second Year, Semester 3						
<b>No of Credits:</b> 4		<b>Prerequisites:</b>						
<b>Synopsis:</b>	This course provides knowledge of composition of blood and various body fluids in health and disease with emphasis of their role as diagnostic tool. The course also provides knowledge of total laboratory management.							
<b>Course Outcomes (COs):</b>		On successful completion of this course, students will be able to						
CO 1:	Describe the composition of blood and various body fluids indicating the analytes investigated to detect the derangement of major organ functions or inherited metabolic disorders.							
CO 2:	Discuss in detail the basic principle and concepts involved in the functioning of a clinical laboratory with importance of automation and total quality management.							
<b>Mapping of COs to POs</b>								
COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO 1	X	X	X			X	X	X
CO 2	X	X	X			X	X	X
<b>Course content and outcomes:</b>								
<b>Content</b>					<b>Competencies</b>			<b>No of Hours</b>
<b>Unit 1:</b>								
Composition of blood & body fluids					<p>To know the composition of blood plasma and other body fluids in health and the changes associated in diseases.</p> <ul style="list-style-type: none"> <li>• Analysis of components of CSF, ascitic fluid, pleural fluid.(4 hr)</li> <li>• Principle, procedure and interpretation of the results of blood gas analysis. (6 hrs)</li> <li>• Analyse urine sample to study the various disorders Inherited/ acquired metabolic disorders and screening tests. (10 hrs)</li> <li>• Describe the importance parameters estimated in the clinical biochemistry lab as a routine investigation or special investigations for detection and monitoring of various organ functions and systemic diseases. These include electrolytes,</li> </ul>			40



	vitamins, minerals, biomarkers, organ profiles, enzymes and the like. (20hrs)	
<b>Unit 2:</b>		
Laboratory Management	<ul style="list-style-type: none"> <li>• Discuss the basic principles and concepts of biostatistics as applied to health sciences: precision, accuracy, specificity, sensitivity, percentage error. (10hrs)</li> <li>• Practice the precautions in handling hazardous materials, biomedical waste management. (4 hrs)</li> <li>• Observe and study the pre-analytical techniques, sample collection, automation in clinical laboratory (10 hrs)</li> <li>• Describe the quality control processes involved in the total quality management of clinical laboratory. (16 hrs)</li> </ul>	40

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

<i>Learning strategy</i>	<i>Contact hours</i>	<i>Student learning time (Hrs)</i>
Lecture	40	120
Seminar/ tutorials	10	30
Small Group Discussion (SGD)	10	30
Case Based Learning (CBL)	10	10
Self-directed learning (SDL)	10	10
Revision	10	10
Assessment	10	10
<b>TOTAL</b>	<b>100</b>	<b>220</b>

**Assessment Methods:**

<b>Formative:</b>	<b>Summative:</b>
Class tests	Sessional examination
Assignments	End semester examination
Quiz	

**Mapping of assessment with Cos**

Nature of assessment	CO 1	CO 2				
Sessional Examination 1	X	X				
Sessional Examination 2	X	X				
Quiz/ class test	X	X				

Assignment	X	X				
End Semester Examination	X	X				
<b>Feedback Process</b>	✓	Mid-Semester feedback				
	✓	End-Semester Feedback				
<b>Reference Material</b>	6. 1. Textbook of Medical Biochemistry- D M Vasudevan 7. Lehninger Principles of Biochemistry- David L Nelson and Michael M Cox 8. Medical Biochemistry –Kaplan 9. Text book of Biochemistry- ES West and WR Todd 10. Biochemistry- Dr U Sathyanarana					



Name of the Institution / Department: Department OF Biochemistry

<b>Name of the Program:</b>		<b>M.Sc. in Biochemistry(Medical)</b>						
<b>Course Title:</b>		Lab 4: Electrophoresis, Hb and its degradation product, POCT, Body fluid & stone analysis						
<b>Course Code:</b> MBC705		<b>Course Instructor:</b> Faculty of Biochemistry						
<b>Academic Year:</b> 2020-2021		<b>Semester:</b> Second Year, Semester 3						
<b>No of Credits:</b> 3		<b>Prerequisites:</b>						
<b>Synopsis:</b>	This course provides skill of usage of various point of care testing devices. The course also imparts skills pertaining to the analysis and interpretation of protein Electrophoresis, Hemoglobin & its degradation products. The course will also provide skills of analysis and interpretation of urinary and gall stones.							
<b>Course Outcomes (COs):</b>		On successful completion of this course, students will be able to						
CO 1:	Analyse and interpret normal and abnormal urine samples by routine method and using point of care testing devices							
CO 2:	Perform and Interpret the tests related to protein Electrophoresis, Hemoglobin & its degradation products, urinary and gall stones							
<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>
CO 1	X	x	x	x	x	X	X	X
CO 2	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>
				Perform and interpret the results of estimation of:				160
				<ul style="list-style-type: none"> <li>• Haemoglobin</li> <li>• Blood glucose(by glucometer)</li> <li>• Serum bilirubin</li> <li>• Serum Protein Electrophoresis</li> <li>• Analysis of urinary and gall stones</li> <li>• Urine sample for normal &amp; abnormal components</li> </ul>				
<b>Learning strategies, contact hours and student learning time</b>								
<i>Learning strategy</i>				<i>Contact hours</i>			<i>Student learning time (Hrs)</i>	
Case based learning				---			----	
Small Group Discussion (SGD)				----			----	



Self-directed learning (SDL)	40	40
Practicals	120	240
Revision	10	10
Assessment	10	10
<b>TOTAL</b>	<b>180</b>	<b>300</b>
<b>Assessment Methods:</b>		
<b>Formative:</b>		<b>Summative:</b>
Class tests		Sessional examination
Assignments		End semester examination
Quiz		
<b>Mapping of assessment with Cos</b>		
Nature of assessment	CO 1	CO 2
Sessional Examination 1	X	X
Sessional Examination 2	X	X
Quiz/ class test	X	X
Assignment	X	X
End Semester Examination	X	X
<b>Feedback Process</b>	✓	Mid-Semester feedback
	✓	End-Semester Feedback
<b>Reference Material</b>	<ol style="list-style-type: none"> <li>1. Fundamentals of Clinical Chemistry- Tietz</li> <li>2. Practical Clinical Biochemistry- Varley</li> <li>3. Biochemistry- Kaplan</li> <li>4. Biophysical Chemistry (Principles and Techniques)- Upadhyay, Kakoli Upadhyay, and Nirmalendu Nath</li> <li>5. Laboratory Manual in Biochemistry- J Jayaraman</li> </ol>	

Name of the Institution / Department: Department OF Biochemistry

<b>Name of the Program:</b>		<b>M.Sc. in Biochemistry(Medical)</b>						
<b>Course Title:</b>		Lab 5: ELISA, QC Analysis, Clinical enzymology						
<b>Course Code: MBC707</b>		<b>Course Instructor: Faculty of Biochemistry</b>						
<b>Academic Year:2020-2021</b>		<b>Semester: Second Year, Semester 3</b>						
<b>No of Credits: 4</b>		<b>Prerequisites:</b>						
<b>Synopsis:</b>		The course provide the skills to perform and interpret ELISA, enzymes of diagnostic importance. It also enables the student to analyse the LJ chart.						
<b>Course Outcomes (COs):</b>		On successful completion of this course, students will be able to						
CO 1:		Perform and interpret ELISA						
CO 2:		Estimate the enzymes of diagnostic importance and interpret the results						
CO 3:		Analyse the LJ chart for pre analytical, analytical & post analytical analysis of clinical laboratory results						
<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>
CO 1		x		x	x		X	X
CO 2		X		X	X		X	X
CO3		X		X	X		X	X
<b>Course content and outcomes:</b>								
<i>Content</i>			<i>Competencies</i>				<i>No of Hours</i>	
			To perform and interpret: <ul style="list-style-type: none"> <li>• Insulin/TSH by ELISA</li> <li>• Enzymes of diagnostic significance AST, ALT ,ALP ,GGT ,Amylase</li> <li>• the results for pre analytical, analytical &amp; post analytical errors using LJ chart and QC</li> </ul>				160	
<b>Learning strategies, contact hours and student learning time</b>								
<i>Learning strategy</i>			<i>Contact hours</i>			<i>Student learning time (Hrs)</i>		
Case based learning			---			----		
Small Group Discussion (SGD)			----			----		
Self-directed learning (SDL)			40			40		
Practicals			120			240		
Revision			10			10		
Assessment			10			10		
<b>TOTAL</b>			<b>180</b>			<b>300</b>		
<b>Assessment Methods:</b>								
<b>Formative:</b>					<b>Summative:</b>			



# MANIPAL

ACADEMY of HIGHER EDUCATION

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

Class tests		Sessional examination				
Assignments		End semester examination				
Quiz						
<b>Mapping of assessment with Cos</b>						
Nature of assessment	CO 1	CO 2	CO3			
Sessional Examination 1	X	X	X			
Sessional Examination 2	X	X	X			
Quiz/ class test	X	X	X			
Assignment	X	X	X			
End Semester Examination	X	X	X			
<b>Feedback Process</b>	✓	Mid-Semester feedback				
	✓	End-Semester Feedback				
<b>Reference Material</b>	<ol style="list-style-type: none"> <li>1. Fundamentals of Clinical Chemistry- Tietz</li> <li>2. Practical Clinical Biochemistry- Varley</li> <li>3. Biochemistry- Kaplan</li> <li>4. Biophysical Chemistry (Principles and Techniques)- Upadhyay, Kakoli Upadhyay, and Nirmalendu Nath</li> <li>5. Laboratory Manual in Biochemistry- J Jayaraman</li> </ol>					

Name of the Institution / Department: DEPARTMENT of BIOCHEMISTRY

<b>Name of the Program:</b>		<b>MSc Biochemistry (Medical)</b>											
<b>Course Title:</b>		Elective 2*											
<b>Course Code: MEL 709</b>		<b>Course Instructor: Faculty Department of Biochemistry</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>													
<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>					
CO 1	X	X	X	X	X								
<b>Course content and outcomes:</b>													
<i>Content</i>		<i>Competencies</i>										<i>No of Hours</i>	
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 get hands on experience in 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> </ul>	120	



	<ul style="list-style-type: none"> <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>	
<p><b>MEL 709. 6-</b> Isolation, identification and antimicrobial sensitivity testing- conventional &amp; automated methods</p>	<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> <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>	120
<p><b>MEL 709. 8-</b> Basics of animal Research</p>	<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



<p><b>MEL 709. 9-</b> Analytical toxicology</p>	<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>	<p>120</p>
<p><b>MEL 709. 10-</b> SEMEN CRYOPRESERVATION</p>	<p>Semen Cryopreservation, Code: MEL 709.10:</p> <ul style="list-style-type: none"> <li>• Principles of cryopreservation</li> <li>• Requirements for semen cryopreservation</li> <li>• Preparation of semen cryopreservation medium</li> <li>• Various methods of semen cryopreservation</li> <li>• Freezing and thawing of human ejaculate</li> <li>• Assessing post-thaw quality of spermatozoa</li> <li>• Sperm processing for insemination</li> </ul>	<p>120</p>
<p><b>MEL 709. 11-</b> Fungi in health and disease</p>	<ul style="list-style-type: none"> <li>• To 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>	<p>120</p>
<p><b>MEL 709. 12-</b> Clinical Forensic medicine</p>	<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> </ul>	<p>120</p>



	<ul style="list-style-type: none"> <li>Recording of dying declaration</li> </ul>		
<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>	✓	End-Elective Feedback	
<b>Reference Material</b>	Depending on the elective, departments will specify the reference books		

Name of the Institution / Department: Department of Biochemistry

<b>Name of the Program:</b>		<b>M.Sc. in Biochemistry(Medical)</b>						
<b>Course Title:</b>		Molecular Biology and genetics						
<b>Course Code: MBC702</b>		<b>Course Instructor: Faculty of Biochemistry</b>						
<b>Academic Year: 2020-2021</b>		<b>Semester: Second Year, Semester 4</b>						
<b>No of Credits: 4</b>		<b>Prerequisites:</b>						
<b>Synopsis:</b>	This course provides knowledge on chemistry and metabolism of nucleic acids and their associated disorders. The course also gives a detailed insight into the various molecular diagnostic techniques and their applications. It also provides information related to the recent advances in the field of molecular diagnostics and disorders.							
<b>Course Outcomes (COs):</b>		On successful completion of this course, students will be able to						
CO 1:	Describe the chemistry, metabolism and disorders associated with purines and pyrimidines and nucleic acids.							
CO 2:	Discuss the principle, process and applications of various molecular diagnostic techniques.							
CO 3:	Describe the role of molecular mechanisms involved in the development, detection and treatment of cancer, AIDS and Alzheimer's disease.							
<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>
CO 1	X							
CO 2	X							X
CO 3	X							X
<b>Course content and outcomes:</b>								
<i>Content</i>				<i>Competencies</i>				<i>No of Hours</i>
<b>Unit 1: Chemistry and metabolism of Nucleic acids</b>								
<ul style="list-style-type: none"> <li>Chemistry &amp; metabolism of purines and pyrimidines</li> </ul>				<ul style="list-style-type: none"> <li>Describe the Chemistry and structure and properties of bases, nucleosides, nucleotides, RNA and DNA.</li> <li>Discuss the functions of different types of RNAs and DNA.</li> <li>Describe the property of Watson crick model of DNA.</li> <li>Discuss the synthesis (de novo and salvage pathways) and degradation of purine and pyrimidine bases, regulation, and inhibitors.</li> <li>Describe the clinical features and biochemical changes in Gout, Lesch-Nyhan syndrome and other disorders associated with the metabolism of nitrogenous bases.</li> </ul>				20



<b>Unit 2:</b>		
<ul style="list-style-type: none"> <li>Replication, transcription, translation</li> </ul>	<ul style="list-style-type: none"> <li>Describe the cell cycle, its check points and the regulation,</li> <li>Discuss the role of DNA &amp; RNA as genetic material.</li> <li>Explain in detail DNA replication, DNA damage and repair processes, telomeres and inhibitors of replication.</li> <li>Define Mutations, Mutagens, carcinogens (Biological and chemical) and their effect on health and disease.</li> <li>Explain the process of transcription, factors affecting the process and post-transcriptional modification of RNA (exons, splicing) and inhibitors of transcription.</li> <li>Explain the regulation of gene expression, Operon concept, promoters, enhancers, silencers, hormone responsive elements</li> <li>Describe the Genetic code and explain in detail the pre requisites and process of translation , post-translational modifications , inhibitors of translation, Protein targeting</li> </ul>	25
<b>Unit 3:</b>		
<ul style="list-style-type: none"> <li>Molecular biology Techniques:</li> </ul>	<ul style="list-style-type: none"> <li>Explain in detail the principle, requirements, procedure and applications of the following techniques.</li> <li>Recombinant DNA technique, Cloning procedures, vectors, plasmids, cosmids, restriction map</li> <li>PCR technique.</li> <li>Southern, Northern and Western blotting procedures.</li> <li>Restriction fragment length polymorphism (RFLP), VNTRs</li> <li>monoclonal antibodies, Hybridoma technology,</li> </ul>	25



	<ul style="list-style-type: none"> <li>• Gene therapy, antisense therapy</li> <li>• DNA sequence determination,</li> <li>• microarray technique, Fluorescent in situ hybridisation (FISH) techniques.</li> </ul>	
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**Unit 4:**

Miscellaneous	<ul style="list-style-type: none"> <li>• Understand the role of caspases. Oncogenes, tumor suppressor genes, tumor markers in maintaining normalcy.</li> <li>• Understand the principles of transgenic animals and microinjection technique, DNA chips, Genomic library and cDNA library and Human genome project (HGP).</li> <li>• AIDS: HIV, genes and gene products, diagnosis, precautions.</li> <li>• Alzheimer's disease, prions, beta amyloid</li> </ul>	10
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**Learning strategies, contact hours and student learning time**

Learning strategy	Contact hours	Student learning time (Hrs)
Lecture	40	120
Seminar/ tutorials	10	30
Small Group Discussion (SGD)	10	30
Self-directed learning (SDL)	10	10
Case Based Learning (CBL)	10	10
Revision	10	10
Assessment	10	10
<b>TOTAL</b>	<b>100</b>	<b>220</b>

**Assessment Methods:**

Formative:	Summative:
Class tests	Sessional examination
Assignments	End semester examination
Quiz	

**Mapping of assessment with Cos**

Nature of assessment	CO 1	CO 2	CO 3			
Sessional Examination 1	X	X	X			
Sessional Examination 2	X	X	X			
Quiz/ class test	X	X	X			
Assignment	X	X	X			
End Semester Examination	X	X	X			

<b>Feedback Process</b>	✓ Mid-Semester feedback ✓ End-Semester Feedback
<b>Reference Material</b>	<ol style="list-style-type: none"> <li>1. Textbook of Medical Biochemistry- D M Vasudevan</li> <li>2. Lehninger Principles of Biochemistry- David L Nelson and Michael M Cox</li> <li>3. Medical Biochemistry –Kaplan</li> <li>4. Text book of Biochemistry- ES West and WR Todd</li> <li>5. Biochemistry- Dr U Sathyanarana</li> <li>6. Cell-Geoffrey Cooper and Robert Hausman-</li> </ol>





Name of the Institution / Department: Department of Biochemistry

<b>Name of the Program:</b>		<b>M.Sc. in Biochemistry(Medical)</b>							
<b>Course Title:</b>		Lab:Molecular Biology Techniques							
<b>Course Code: MBC 704</b>		<b>Course Instructor: Faculty of Biochemistry</b>							
<b>Academic Year: 2020-2021</b>		<b>Semester: Second Year, Semester 4</b>							
<b>No of Credits: 3</b>		<b>Prerequisites:</b>							
<b>Synopsis:</b>		This course aids the post graduate student to acquire knowledge and understand basics of molecular biology techniques involving the nucleic acids. It also gives information on clinically significant analyte of nucleic acid metabolism.							
<b>Course Outcomes (COs):</b>		On successful completion of this course, students will be able to							
CO 1:		Perform estimation of nucleic acid and the byproduct of its metabolism.							
<b>Mapping of COs to POs</b>									
COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	
CO 1		X							
<b>Course content and outcomes:</b>									
<i>Content</i>					<i>Competencies</i>				<i>No of Hours</i>
<b>Unit 1:</b>									
					<ul style="list-style-type: none"> <li>Perform the techniques of isolation of DNA from various sources</li> <li>With the help of a standard curve, quantitate the amount of DNA from one of sources using spectrophotometric techniques.</li> <li>Isolate DNA from an unknown sample and quantitate the same with the help of</li> <li>Quantitate the amount of RNA from one of sources using spectrophotometric techniques.</li> <li>Estimate the amount of uric acid in the given patient sample using the standard graph</li> <li>Interpret the values and discuss the clinical significance of the same</li> </ul>				160
<b>Learning strategies, contact hours and student learning time</b>									
<i>Learning strategy</i>					<i>Contact hours</i>			<i>Student learning time (Hrs)</i>	
Practical					120			240	
Small Group Discussion (SGD)					40			40	
Self-directed learning (SDL)					---			---	
Case Based Learning (CBL)					---			---	



Revision	10	10
Assessment	10	10
<b>TOTAL</b>	<b>180</b>	<b>300</b>
<b>Assessment Methods:</b>		
<b>Formative:</b>	<b>Summative:</b>	
Class tests	Sessional examination	
Assignments	End semester examination	
Quiz		
<b>Mapping of assessment with Cos</b>		
Nature of assessment	CO 1	
Sessional Examination 1	X	
Sessional Examination 2	X	
Quiz/ class test	X	
Assignment	X	
End Semester Examination	X	
<b>Feedback Process</b>	✓ Mid-Semester feedback ✓ End-Semester Feedback	
<b>Reference Material</b>	1. Fundamentals of Clinical Chemistry- Tietz 2. Practical Clinical Biochemistry- Varley 3. Biochemistry- Kaplan 4. Biophysical Chemistry (Principles and Techniques)- Upadhyay, Kakoli Upadhyay, and Nirmalendu Nath 5. Laboratory Manual in Biochemistry- J Jayaraman	



Name of the Institution / Department: Department of Biochemistry

<b>Name of the Program:</b>		<b>M.Sc. in Biochemistry(Medical)</b>						
<b>Course Title:</b>		<b>Lab: Organ function Tests</b>						
<b>Course Code: MBC 706</b>		<b>Course Instructor: Faculty of Biochemistry</b>						
<b>Academic Year: 2020-2021</b>		<b>Semester: Second Year, Semester 4</b>						
<b>No of Credits: 3</b>		<b>Prerequisites:</b>						
<b>Synopsis:</b>		The course provide the skills to perform and interpret the lab reports related to various organ function tests and specific conditions						
<b>Course Outcomes (COs):</b>		On successful completion of this course, students will be able to						
CO 1:		Perform and interpret the results of organ function tests of kidney, liver, pancreas and thyroid						
CO2:		Interpret the investigations related to tumour markers						
<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>
CO 1		X		X	X		X	X
CO2		X			X		X	X
<b>Course content and outcomes:</b>								
<i>Content</i>				<i>Competencies</i>				<i>No of Hours</i>
				<p>To perform various markers/ enzymes of diagnostic significance related to organ function and interpret the results stating the clinical significance</p> <ul style="list-style-type: none"> <li>• Amylase</li> <li>• Urea, Creatinine, Microalbumin</li> <li>• Total protein, albumin, A:G ratio</li> <li>• Bilirubin, ALT,AST, ALP</li> </ul> <p>Given a cased based problem/lab report, choose the relevant diagnostic parameters required to assess</p> <ul style="list-style-type: none"> <li>• Endocrine functions <ul style="list-style-type: none"> <li>• Tumors of thyroid, ovary, liver, prostate, Pancreas, Breast, GI tract etc</li> </ul> </li> </ul>				160
<b>Learning strategies, contact hours and student learning time</b>								
<i>Learning strategy</i>				<i>Contact hours</i>			<i>Student learning time (Hrs)</i>	



Practical	120	240				
Small Group Discussion (SGD)	--	---				
Self-directed learning (SDL)	40	40				
Case Based Learning (CBL)	---	---				
Revision	10	10				
Assessment	10	10				
<b>TOTAL</b>	<b>180</b>	<b>300</b>				
<b>Assessment Methods:</b>						
<b>Formative:</b>	<b>Summative:</b>					
Class tests	Sessional examination					
Assignments	End semester examination					
Quiz						
<b>Mapping of assessment with Cos</b>						
Nature of assessment	CO 1	CO2				
Sessional Examination 1	X	X				
Sessional Examination 2	X	X				
Quiz/ class test	X	X				
Assignment	X	X				
End Semester Examination	X	X				
<b>Feedback Process</b>	✓	Mid-Semester feedback				
	✓	End-Semester Feedback				
<b>Reference Material</b>	6. Fundamentals of Clinical Chemistry- Tietz 7. Practical Clinical Biochemistry- Varley 8. Biochemistry- Kaplan 9. Biophysical Chemistry (Principles and Techniques)- Upadhyay, Kakoli Upadhyay, and Nirmalendu Nath 10. Laboratory Manual in Biochemistry- J Jayaraman					

Name of the Institution / Department: DEPARTMENT OF BIOCHEMISTRY

<b>Name of the Program:</b>		<b>MSc Biochemistry (Medical)</b>											
<b>Course Title:</b>		Project*											
<b>Course Code: MBC 798</b>		<b>Course Instructor: Faculty Department of Biochemistry</b>											
<b>Academic Year: 2020-2021</b>		<b>Semester: Final Year, Semester 4</b>											
<b>No of Credits: 10</b>		<b>Prerequisites: Nil</b>											
<b>Synopsis:</b>		In course students, under guidance will conduct independent literature review, designing the experiments, conducting experiments, Data collection, tabulation, analysis and interpretation, Discussion and possible publication.											
<b>Course Outcomes (COs):</b>		On successful completion of this course, students will be able to											
CO 1:		Conduct independent relevant research, under guidance and develop skills to prepare project report, present the findings in conference and prepare manuscript in publishable format following research ethics											
<b>Mapping of COs to POs</b>													
COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8					
CO 1	X	X	X	X	X	X	X	X					
<b>Course content and outcomes:</b>													
<b>Content</b>		<b>Competencies</b>										<b>No of Hours</b>	
<b>Unit 1: Project</b>													
•		<ul style="list-style-type: none"> <li>Identify the field of interest to conduct the research</li> <li>Identify a topic on which research will be conducted</li> <li>Conduct literature review and determine the relevance of the topic and discuss with guide and finalize</li> <li>Frame a research question</li> <li>Design the materials and methods of the experiment to be conducted</li> <li>Develop skills to use the instruments and process involved in research</li> <li>Determine the statistical analysis that needs to be applied in consultation with the statistician</li> <li>Prepare protocol and standardize the intervention tools/ dosage of drugs or process of estimations, consent forms if any etc</li> <li>Prepare a protocol and seek clearance from scientific and ethics committee, animal ethics committee, biomedical research committee</li> <li>Conduct the experiment</li> </ul>										400 hrs	



	<ul style="list-style-type: none"> <li>• Collate the findings, apply statistical tests and formulate the results</li> <li>• Discuss the results citing evidence from earlier reports and your new findings (both positive and negative)</li> <li>• Prepare project report and pass it through plagiarism check software (acceptable level - Similarity index less than 10%)</li> <li>• Submit to university with relevant approval of guide, HOD and HOI</li> <li>• Present the research findings in conference if possible</li> <li>• Prepare a research manuscript in publishable format following ethical guidelines and send for publication preferably.</li> </ul>	
<b>Learning strategies, contact hours and student learning time</b>		
<i>Learning strategy</i>	<i>Contact hours</i>	<i>Student learning time (Hrs)</i>
SDL	100	100
Project work	300	600
Assessment	10	10
<b>TOTAL</b>	<b>410</b>	<b>710</b>
<b>Assessment Methods:</b>		
<b>Formative:</b>		<b>Summative:</b>
Monthly updates to guide		End semester examination
<b>Mapping of assessment with Cos</b>		
Nature of assessment	CO 1	
Regular Updates to guide	X	
End Semester Examination	X	
<b>Feedback Process</b>	<ul style="list-style-type: none"> <li>✓ Monthly feedback from guide</li> <li>✓ End-Semester Feedback</li> </ul>	
<b>Reference Material</b>	Journals indexed in reputed indexing agencies.	



2. PROGRAM OUTCOMES (POS) AND COURSE OUTCOMES (COS) MAPPING												
S.No.	Course Code	Course Name	Credits	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
1	MCC 601	Common Core 1 : Basic sciences	4	CO1								
2	MBC603	Carbohydrates & Protein –Chemistry & metabolism	4	CO1 CO2 CO3	CO1 CO2 CO3							
3	MBC605	General techniques & Enzymes	4	CO1 CO2 CO3	CO1							
4	MBC607	Lab 1: Qualitative experiments & chromatography	4	CO1 CO2	CO1 CO2	CO1 CO2	CO2	CO1 CO2		CO1 CO2	CO2	
5	MBC609	Lab 2: Photometry, Enzyme kinetics, Acids bases & buffers	4	CO1 CO2 CO3 CO4	CO1 CO2 CO3 CO4	CO1 CO2 CO3 CO4	CO1 CO2 CO3 CO4	CO1 CO2 CO3 CO4		CO1 CO2 CO3 CO4	CO4	
6	MCC602	Common Core: Research methodologies, ethics, statistics, Publishing paper, teaching methodologies etc	4	CO1 CO2	CO1			CO2				
7	MBC604	Lipids metabolism, acid base balance & biological oxidation	4	CO1 CO2 CO3	CO3							
8	MBC606	Vitamins, minerals, nutrition, Environmental & food pollutants	4	CO1 CO2 CO3	CO2	CO2						



9	MBC608	Lab 3: Estimation of lipids, vitamins, minerals	4	CO1 CO2 CO3	CO1 CO2 CO3	CO1 CO2 CO3	CO3	CO1 CO2 CO3	CO1	CO1 CO2 CO3	CO1 CO2 CO3	
10	MEL610	<b>Elective* -1</b>	4	CO 1	CO 1	CO 1	CO 1					
11	MBC701	Endocrinology, Immunology & Heme metabolism	4	CO1 CO2 CO3 CO4								
12	MBC703	Clinical biochemistry & laboratory management	4	CO1 CO2	CO1 CO2	CO1 CO2			CO1 CO2	CO1 CO2	CO1 CO2	
13	MBC705	Lab 4: Electrophoresis, Quantitation by semi automation, POCT & blood gas analysis	4	CO1 CO2	CO1 CO2	CO1 CO2	CO1 CO2	CO1 CO2	CO1 CO2	CO1 CO2	CO1 CO2	
14	MBC707	Lab 5: Clinical lab 1 - ELISA, Clinical enzymology, Automation - QC analysis	4		CO1 CO2 CO3		CO1 CO2 CO3	CO1 CO2 CO3		CO1 CO2 CO3	CO1 CO2 CO3	
15	MEL709	<b>Elective*2</b>	4	CO 1	CO 1	CO 1	CO 1	CO 1				
16	MBC 702	Molecular biology & Genetics	4	CO1 CO2 CO3							CO2 CO3	
17	MBC704	Lab 6: Molecular biology techniques	3		CO1							
18	MBC 706	Lab 7: Clinical lab 2: Organ function Tests	3		CO1 CO2		CO1	CO1 CO2		CO1 CO2	CO1 CO2	
19	MBC 798	Project*	10	CO1	CO1	CO1	CO1	CO1	CO1	CO1	CO1	