



B. Sc. Biochemistry Semester-4

Course Code	US04MABIC01	Title of the Course	Understanding of Biomolecules and Immunology
Total Credits of The Course	04	Hours per Week	04

Course Objectives:	<ol style="list-style-type: none">1. To learn the fundamentals of molecules that deals with life such as amino acids, proteins2. To develop understanding of structure, types and significance of amino acids.3. To learn fundamentals of various types of proteins and their biological role.4. To develop understanding of structure, types and significance of lipids and vitamins.5. To learn classification of various types of lipids and their biological role.6. To study the basics of immunity and defense mechanism of the body.7. To study types of antigen and antibodies.
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Course Content		
Unit	Description	Weightage* (%)
1.	Amino Acids & Proteins <ul style="list-style-type: none">• Non standard amino acids; D amino acids non-protein amino acids.• Amino acids as zwitter ions, isoelectric point, pKa of amino acids, amino acid titration curve (Glycine) and optical activity of amino acids.• Reactions of amino acids due to carboxylic groups (decarboxylation and amide formation), amino groups (transamination, deamination)• Protein Denaturation, coagulation• Precipitations reactions of proteins.• Understanding the structure and importance of Hemoglobin and Myoglobin• Overview of protein database: PDB and others.	25%



2.	<p>Lipids and Vitamins</p> <p>Lipids</p> <ul style="list-style-type: none">• Fatty acids – free and esterified fatty acids, length of hydrocarbon chain, straight and branched chain fatty acids, hydroxyl and cyclic fatty acids, saturated and unsaturated fatty acids, nomenclature of fatty acids, omega classification of fatty acids.• Nutritional classification of fatty acids: essential fatty acids, examples, dietary sources and functions and deficiency of essential fatty acids.• Structure, properties and different biochemical tests for triglycerides (Saponification no, Iodine no, RM value, Peroxide value. Definition of rancidity, types of rancidity and prevention of rancidity of fats and oils. Triglycerides as storage lipids.• Lipids in biological membranes – Brief description of their structures and functions: glycerophospholipids, Sphingolipids, Glycolipids, Sulpholipids, and sterols.• Structure, composition and functions of different Lipoproteins: Chylomicrons, VLDL, LDL and HDL. <p>Vitamins</p> <ul style="list-style-type: none">• Definition of vitamins, Fat and Water soluble vitamins Classification & Biochemical Functions of Vitamins of B Complex• Biochemical functions of different water soluble vitamins as coenzymes.• Comparative account of Water soluble v/s fat soluble vitamins. • Definition, Biochemical Functions of fat soluble vitamins A, D, E and K.	25%
3.	<p>Basic Concept of Immunology: Introduction & definition of immunity, Local immunity, Herd immunity, Infection, Pathogens, Saprophytes, Parasites</p> <p>Types of Immunity:</p> <p>A) Innate Immunity</p> <ol style="list-style-type: none">1. Levels of innate Immunity2. Factors influence levels of innate Immunity3. External defence (1st line of defence)4. Internal defence (2nd line of defence) <p>B) Acquired Immunity</p> <ol style="list-style-type: none">i) Types of Acquired Immunityii) Cells involved in Acquired Immunity(3rd line of defence)	25%
4.	<p>Fundamentals of immune components Introduction & definition of antigen, Haptens, antigenicity, Epitope, Antibody</p> <p>Antigens:</p> <ol style="list-style-type: none">a) General features of Antigenb) Types of antigens <p>Antibodies:</p> <ol style="list-style-type: none">a) General features of Antibodyb) Structure of Antibodyc) Classes of Antibody	25%



Teaching-Learning Methodology	Direct Teaching through Chalk-Walk and Talk ICT enabled teaching Question-Answer Class discussion led by teacher/students Case Studies Literature review Problem solving activities Debate Collaborative and Co-operative Learning Think Pair Share Jigsaw Inquiry Based Learning Panel Discussion Project Based Learning Flipped Classroom Blended Learning designs Concept Mapping
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Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written/Practical Examination(As per CBCSR.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance(As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: On the successful completion of the course, the students will be able to understand	
	Students who complete this course will earn various amino acids, their structure and importance.
	Students will be able to understand fundamental properties of proteins and the types of proteins along with its role.
	Students will have fundamentals of nucleotides along with the structures of DNA and RNA
	Students will be able to understand the chemistry of lipids.



Suggested References:

Sr.No.	References
1.	Lehninger Principles of Biochemistry by David L. Nelson, Michael Cox Publisher:WH Freeman
2.	Biochemistry by Donald Voet, Judith G., Voet Publisher:Wiley
3.	Biochemistry – By U Satyanarayana and U Chakrapani Publishers:Elsevier
4.	Immunology by Kubay

On-line resources to be used if available as reference material

On-line Resources:

https://onlinecourses.nptel.ac.in/noc22_cy06/preview

https://onlinecourses.nptel.ac.in/noc21_bt19/preview

<https://vlab.amrita.edu/?sub=3&brch=63>

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B. Sc. Biochemistry Semester-4

Course Code	US04MABIC02	Title of the Course	Essentials of clinical Biochemistry-II
Total Credits of The Course	04	Hours per Week	04

Course Objectives:	<ol style="list-style-type: none">1. This course emphasis on the major organs and the processes of Digestive system including digestion and absorption of Biomolecules.2. To get aware of liver function test, production of bilirubin and jaundice and its types.3. Students will understand the cellular components underlying mitotic cell division.4. To learn fundamentals of stem cells, apoptosis and its various pathways.
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Course Content		
Unit	Description	Weightage* (%)
1.	DIGESTIVE SYSTEM: <ul style="list-style-type: none">• Components of digestive system:<ol style="list-style-type: none">a) Major organb) Accessory organ• Functions of each organ of digestive system• Digestion and absorption of<ol style="list-style-type: none">a) Carbohydrateb) Proteinc) Lipid	25%
2.	ORGAN FUNCTION TEST - <ol style="list-style-type: none">1) Liver function test :<ul style="list-style-type: none">• functions of liver,• classification of liver function test• Detail: Test based on bile pigment formation and serum enzyme activities2) Formation of bilirubin: Free bilirubin, conjugated bilirubin and unconjugated bilirubin3) Jaundice : types – Hemolytic, Hepatic, Obstructive<ul style="list-style-type: none">• Jaundice due to genetic defect: Neonatal Jaundice, Crigler-Najjar syndrome type 1 and II, Gilbert's disease.	25%



3.	CELL CYCLE 1. Introduction of Cell Cycle 2. Importance of Cell Cycle 3. Phases of cell cycle 4. Molecular events during different phases of cell cycle. 5. Mitosis - different phases of Mitosis 6. Meiosis- different phases of Meiosis 7. Significance of Mitosis and Meiosis 8. Cell Cycle Regulation- Cyclin Dependent kinases	25%
4.	APOPTOSIS AND STEM CELL 1. Introduction of Apoptosis 2. Mechanism of Apoptosis a)The extrinsic pathway of Apoptosis b)The intrinsic pathway of Apoptosis 3. Significance of Apoptosis 4. Introduction of Stem cells 5. Types of Stem cells/ Classification of Stem cells 6. Application of Stem cells.	25%

Teaching-Learning Methodology	Direct Teaching through Chalk-Walk and Talk ICT enabled teaching Question-Answer Class discussion led by teacher/students Case Studies Literature review Problem solving activities Debate Collaborative and Co-operative Learning Think Pair Share Jigsaw Inquiry Based Learning Panel Discussion Project Based Learning Flipped Classroom Blended Learning designs Concept Mapping
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Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written/Practical Examination(As per CBCSR.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance(As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: On the successful completion of the course, the students will be able to understand	
	Major organs and the processes of Digestive system including digestion and absorption of Biomolecules.
	Get aware of liver function test, production of bilirubin and jaundice and its types.
	Students will understand the cellular components underlying mitotic cell division.
	To learn fundamentals of stem cells, apoptosis and its various pathways.

Suggested References:	
Sr.No.	References
1	Lehninger Principles of Biochemistry by David L. Nelson, Michael Cox Publisher: WH Freeman
2	Biochemistry by Donald Voet, Judith G. Voet Publisher: Wiley
3	Biochemistry – By U Satyanarayana and U Chakrapani Publishers: Elsevier
4	Principles of Anatomy and Physiology- By Gerard J. Tortora, Bryan H. Derrickson Publishers: John Wiley & Sons, Inc.



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5	Human Physiology By Dr C C Chatterjee Publishers: Medical Allied Agency
6	Textbook of medical biochemistry by M. N. Chatterjea and Rana Shinde
7	Cell and Molecular Biology: Concepts and Experiments By Gerald Karp and James G. Patton Publisher: John Wiley & Sons Inc
8	The Cell by Cooper Publisher: Sinauer Associates

On-line resourcestobeusedifavailableasreferencematerial

On-lineResources:

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B. Sc. Biochemistry Semester-4
Major Biochemistry Practical

Course Code	US04MABIC03	Title of the Course	Biochemistry Practical
Total Credits of the Course	04	Hours per Week	08

Course Objectives:	To have understanding of quantification of SGPT, SGOT and bilirubin. To have understanding of quantification of carbohydrates and lipid. To get knowledge regarding cell division.
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SECTION-I	
1.	Estimation of protein by FolinLowry method.
2.	Qualitative analysis of lipid.
3.	Precipitation reaction of Protein.
4.	Estimation of protein by Bradford's method.
5.	Demonstration of ELISA.
6.	Widal slide test.
7.	Qualitative analysis of Milk.
SECTION-II	
1.	Estimation of SGPT and its clinical significance.
2.	Estimation of SGOT and its clinical significance.
3.	Estimation of bilirubin
4.	Study of mitosis
5.	Study of meiosis
6.	Estimation of lipid by phosphovaline method
7.	Estimation of reducing sugar by Benedict's method.



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Teaching-Learning Methodology	Direct Teaching through Chalk-Walk and Talk ICT enabled teaching Question-Answer Class discussion led by teacher/students Case Studies Literature review Problem solving activities Debate Collaborative and Co-operative Learning Think Pair Share Jigsaw Inquiry Based Learning Panel Discussion Project Based Learning Flipped Classroom Blended Learning designs Concept Mapping
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Course Outcomes: On the successful completion of the course, the students will be able to understand
By learning this course students will acquire knowledge of lab safety rules and regulations
To have understanding of quantification of SGPT, SGOT and bilirubin.
To have understanding of quantification of carbohydrates and lipid.
To get knowledge regarding cell division.



Suggested References:

Sr. No.	References
1.	Standard Methods of Biochemical Analysis S.K. Thimmaiah Publishers: Kalyani
2.	Principles & Techniques of Practical Biochemistry – Wilson, Walker- Cambridge Univ. Press.
3.	An Introduction to Practical Biochemistry by David T. Plummer

On-line resources to be used if available as reference material

On-line Resources:

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B. Sc. Biochemistry Semester-4

Course Code	US04MIBIC01	Title of the Course	Introduction to Biomolecules-I
Total Credits of the Course	02	Hours per Week	02

Course Objectives:	<ol style="list-style-type: none">1. To learn the fundamentals of molecules that deals with life such as amino acids, proteins2. To develop understanding of structure, types and significance of aminoacids.3. To learn fundamentals of various types of proteins and their biological role.
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Course Content		
Unit	Description	Weightage* (%)
1.	<p>AMINOACIDS</p> <ul style="list-style-type: none">• Definition: general Structure, properties of amino acids• Structural classification of amino acids based on R groups• Classification of amino acids based on polarity• Classification of amino acids based on their metabolic fates; glycogenic and ketogenic amino acids.• Nutritional classification of amino acids: essential, semi-essential and non essential amino acids with their examples.• Importance of amino acids	50%
2.	<p>PROTEINS</p> <ul style="list-style-type: none">• Definition: Food sources of protein• Classification of proteins based on their composition and solubility (Simple Proteins, Conjugated Proteins and Derived Proteins)• Nutritional classification of protein (Complete protein, partially complete and Incomplete Protein)• Classification of proteins based on their functions• An overview of protein structure, peptide bond, primary and secondary	50%



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	ystructuresofproteins • Various biological functions of protein	
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Teaching-Learning Methodology	Direct Teaching through Chalk-Walk and Talk ICT enabled teaching Question-Answer Class discussion led by teacher/students Case Studies Literature review Problem solving activities Debate Collaborative and Co-operative Learning Think Pair Share Jigsaw Inquiry Based Learning Panel Discussion Project Based Learning Flipped Classroom Blended Learning designs Concept Mapping
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Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%



Course Outcomes: On the successful completion of the course, the students will be able to understand	
	By learning this course students will acquire knowledge of various types of amino acids and their food sources.
	Students will expand their knowledge regarding structural organization of proteins and types of proteins.
	Students will achieve knowledge about functions of proteins and reactions of amino acids and proteins.

Suggested References:	
Sr. No.	References
4.	Biochemistry – By U Satyanarayana and U Chakrapani Publishers: Elsevier
5.	Lehninger Principles of Biochemistry by David L. Nelson, Michael Cox Publisher: WH Freeman
6.	Biochemistry by Donald Voet, Judith G. Voet Publisher: Wiley

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B. Sc. Biochemistry Semester-4

Course Code	US04MIBIC02	Title of the Course	Biochemistry Practical
Total Credits of the Course	02	Hours per Week	04

Course Objectives:	<ol style="list-style-type: none">1. To learn how to identify proteins and amino acids.2. To understand the use of equipment such as colorimeter.3. To study verification of Beer's law.4. To have understanding of basic chromatography technique.5. To understand the quantitative estimation of proteins and amino acids.
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Sr No	Name of the Practical
1.	Color reaction of amino acids.
2.	Precipitation reaction of Protein.
3.	Demonstration of colorimeter
4.	Verification of Beer's law using methylene blue.
5.	Separation of amino acids by paper chromatography.
6.	Estimation of protein by Biuret method
7.	Estimation of amino acids by ninhydrin method.
8.	Estimation of proteins by Folin-Lowry method

Teaching-Learning Methodology	Direct Teaching through Chalk-Walk and Talk ICT enabled teaching Question-Answer Class discussion led by teacher/students Case Studies Literature review Problem solving activities Debate Collaborative and Co-operative Learning Think Pair Share Jigsaw Inquiry Based Learning
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	Panel Discussion Project Based Learning Flipped Classroom Blended Learning designs Concept Mapping
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Course Outcomes: On the successful completion of the course, the students will be able to understand
By learning this course students will acquire knowledge of qualitative determination of proteins and amino acids
Students will gain a good understanding of sophisticated instruments like colorimeter.
Students will develop the fundamentals of separation of biomolecules by chromatography.

Suggested References:	
Sr. No.	References
1.	Standard Methods of Biochemical Analysis S.K. Thimmaiah Publishers: Kalyani
2.	Principles & Techniques of Practical Biochemistry – Wilson, Walker- Cambridge Univ. Press.
3.	An Introduction to Practical Biochemistry by David T. Plummer
4.	Textbook of Medical Laboratory Technology by Praful B. Godkar; Darshan P. Godkar



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B. Sc. Biochemistry Semester-4
Skill Enhancement Course (SEC)

Course Code	US04SEBIC01	Title of the Course	Tools and Techniques in Biochemistry-IV
Total Credits of the Course	02	Hours per Week	02

Course Objectives:	1) Students will gain a good understanding of separation of biomolecules.
	2) They will acquire knowledge of different chromatographic techniques
	3) To get knowledge of electrophoretic techniques

Course Content		
Unit	Description	Weightage* (%)
1.	Chromatographic Techniques 1. Classification and General Principle of chromatography 2. Principle, method and applications for the following: a) Paper chromatography b) TLC c) Affinity Chromatography	50%
2.	Electrophoretic Techniques 1. Introduction of electrophoresis, 2. Difference between zone and free electrophoresis 3. Understanding of Horizontal and vertical eletrophoretic unit 4. General Principle, method and applications for following methods A. Agarose gel electrophoresis, B. Polyacrylamide gel electrophoresis C. Native-PAGE and SDS-PAGE	50%

Teaching-Learning Methodology	Direct Teaching through Chalk-Walk and Talk ICT enabled teaching Question-Answer Class discussion led by teacher/students Case Studies
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	Literature review Problem solving activities Debate Collaborative and Co-operative Learning Think Pair Share Jigsaw Inquiry Based Learning Panel Discussion Project Based Learning Flipped Classroom Blended Learning designs Concept Mapping
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Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	25%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	25%
3.	University Examination	50%

Course Outcomes: On the successful completion of the course, the students will be able to understand	
	Students will gain a good understanding of separation of biomolecules.
	They will acquire knowledge of different chromatographic techniques
	To get knowledge of electrophoretic techniques



Suggested References:

Sr. No.	References
1.	Biophysical chemistry- Principles and techniques- Upadhyay, Upadyay and Nath Himalaya Publication house Mumbai.
2.	Principles and techniques of biochemistry&moleculer biology. Wison and Walker. Andreas Hofmann and Samuel clokie
3.	An Introduction to Practical Biochemistry by David T. Plummer

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