

## **COURSE HANDOUT**

### **BIOCHEMISTRY (THEORY)**

**COURSE CODE: BP203T**

#### **VISION**

*Train the minds to think logically and become a success*

#### **MISSION**

*To Develop inventive, pioneering research & high-quality technical education*

#### **PROGRAMME EDUCATIONAL OBJECTIVES**

- PEO 1:** To produce graduates with sound theoretical knowledge and technical skills required for career opportunities in various domains.
- PEO 2:** To incite the students towards research and to address the challenges with their innovative Contributions for the benefit of mankind.
- PEO 3:** To bring forth a quality professional equipped with technological advances to adapt easily to changes in the ever-evolving pharma and allied industry, hospital and clinical pharmacy setup, pharma retailing and distribution, and governmental and health agencies.
- PEO 4:** To engage graduates in professional ethical practices in a multidisciplinary environment, while contributing to organization through leadership and building team spirit.
- PEO 5:** Pharmacists can become lifelong learners, absorb new technologies, and then offer leadership roles in society.

<b>Programme Name</b>	Bachelor of Pharmacy (B. Pharmacy)
<b>Course Name</b>	Biochemistry (Theory)
<b>Course Code</b>	BP203T
<b>Session</b>	
<b>Semester</b>	II
<b>Lecture/Tutorial (Per Week)</b>	3 (3-1-0)
<b>Course Credit</b>	4
<b>Course Coordinator Name</b>	

#### **1. Scope of the Course:**

Biochemistry deals with complete understanding of the molecular levels of the chemical process associated with living cells. The scope of the subject is providing biochemical facts and the principles to understand metabolism of nutrient molecules in physiological and pathological conditions. It is also emphasizing on genetic organization of mammalian genome and hetero & autocatalytic functions of DNA.

#### **2. Course Outcomes (COs):**

- 203.1** Illustrate the biochemical pathways and principles to understand carbohydrate metabolism and biological oxidation.
- 203.2** Explain the metabolic pathways and disorders involve in lipid and amino acid metabolism.
- 203.3** Summarize the genetic organization of the mammalian genome and functions of DNA in the synthesis of RNAs and proteins.
- 203.4** Provide the basic concept including classification, chemical nature and biological role of different biomolecule and their bioenergetics.
- 203.5** Understand the catalytic role of enzymes, the importance of enzyme inhibitors in design of new drugs, therapeutic and diagnostic applications of enzymes.

#### **3. Text Books:**

- TB.1 Biochemistry by D. Satyanarayan and U.Chakrapani.  
TB.2 Textbook of Biochemistry by Rama Rao.  
TB.3 Textbook of Biochemistry by Deb.

#### **4. Reference Books:**

- RB.1 Principles of Biochemistry by Lehninger.

RB.2 Harper's Biochemistry by Robert K. Murry, Daryl K. Granner and Victor W. Rodwell.  
 RB.3 Biochemistry by Stryer.

### 5. Other Readings & Relevant Websites:

Sr. No.	Link of Journals, Magazines, Websites and Research Papers
1	<a href="https://www.slideshare.net/">https://www.slideshare.net/</a>
2	<a href="https://pubchem.ncbi.nlm.nih.gov/">https://pubchem.ncbi.nlm.nih.gov/</a>
3	<a href="https://pubmed.ncbi.nlm.nih.gov/">https://pubmed.ncbi.nlm.nih.gov/</a>
4	<a href="http://www.chemspider.com/">http://www.chemspider.com/</a>
5	<a href="https://scholar.google.com/schhp?hl=en/">https://scholar.google.com/schhp?hl=en/</a>

### 6. Course Plan:

Subject: Biochemistry (Theory)		Subject Code: BP203T	
Sr. No.	Topics	No. of Lectures	
1	<b>Carbohydrate metabolism:</b> Glycolysis–Pathway, energetics and significance, Citric acid cycle- Pathway, energetics and significance, HMP shunt and its significance; Glucose-6-Phosphate dehydrogenase (G6PD) deficiency, Glycogen metabolism Pathways and glycogen storage diseases (GSD), Gluconeogenesis- Pathway and its significance, Hormonal regulation of blood glucose level and Diabetes mellitus. <b>Biological oxidation:</b> Electron transport chain (ETC) and its mechanism, Oxidative phosphorylation & its mechanism and substrate phosphorylation, Inhibitors ETC and oxidative phosphorylation/Uncouplers	10	
2	<b>Lipid metabolism:</b> $\beta$ -Oxidation of saturated fatty acid (Palmitic acid), Formation and utilization of ketone bodies; ketoacidosis, De novo synthesis of fatty acids (Palmitic acid), Biological significance of cholesterol and conversion of cholesterol into bile acids, steroid hormone and vitamin D, Disorders of lipid metabolism: Hypercholesterolemia, atherosclerosis, fatty liver and obesity.	05	
3	<b>Biomolecules:</b> Introduction, classification, chemical nature and biological role of carbohydrate, lipids, nucleic acids, amino acids and proteins. <b>Bioenergetics:</b> Concept of free energy, endergonic and exergonic reaction, Relationship between free energy, enthalpy and entropy; Redox potential, Energy rich compounds; classification; biological significances of ATP and cyclic AMP	08	
<b>ST-I (Syllabus Covered from Lecture 01 to 23)</b>			
3	<b>Amino acid metabolism:</b> General reactions of amino acid metabolism: Transamination, deamination & decarboxylation, urea cycle and its disorders, Catabolism of phenylalanine and tyrosine and their metabolic disorders (Phenylketonuria, Albinism, alkaptonuria, tyrosinemia), Synthesis and significance of biological substances; 5-HT, melatonin, dopamine, noradrenaline, adrenaline, Catabolism of heme; hyperbilirubinemia and jaundice	05	
4	<b>Nucleic acid metabolism and genetic information transfer:</b> Biosynthesis of purine and pyrimidine nucleotides, Catabolism of purine nucleotides and Hyperuricemia and Gout disease, Organization of mammalian genome, Structure of DNA and RNA and their functions, DNA replication (semi conservative model), Transcription or RNA synthesis, Genetic code, Translation or Protein synthesis and inhibitors	10	
5	<b>Enzymes:</b> Introduction, properties, nomenclature and IUB classification of enzymes, Enzyme kinetics (Michaelis plot, Line Weaver Burke plot), Enzyme inhibitors with examples, Regulation of enzymes: enzyme induction and repression, allosteric enzymes regulation, Therapeutic and diagnostic applications of enzymes and isoenzymes, Coenzymes –Structure and biochemical functions.	07	
<b>ST- II (Syllabus Covered from Lecture 24 to 45)</b>			

### 7. Lecture Plan:

Sr. No.	Topics	Dates (tentative)		CO
		Section A	Section B	
01	Glycolysis–Pathway, energetics and significance	22/07/24	24/07/24	203.1

02	Citric acid cycle- Pathway, energetics and significance	23/07/24	25/07/24	203.1
03	HMP shunt and its significance	24/07/24	26/07/24	203.1
04	Glucose-6-Phosphate dehydrogenase (G6PD) deficiency	29/07/24	31/07/24	203.1
05	Elaboration of various steps involved in glycogen metabolism pathway with their energetics.	30/07/24	01/08/24	203.1
06	Elaboration of different Glycogen storage diseases (GSD) & Hormonal regulation of blood glucose level and Diabetes mellitus	31/07/24	02/08/24	203.1
07	Gluconeogenesis- Pathway and its significance,	05/08/24	07/08/24	203.1
08	Explanation of Electron transport chain (ETC) and its mechanism	06/08/24	08/08/24	203.1
09	Mechanism involved in oxidative phosphorylation and substrate level phosphorylation	07/08/24	09/08/24	203.1
10	Inhibitors involved in ETC & oxidative phosphorylation	12/08/24	14/08/24	203.1
11	Test/Assignment	13/08/24	16/08/24	203.1
12	Introduction about fatty acid $\beta$ -Oxidation of saturated fatty acid (Palmitic acid)	14/08/24	21/08/23	203.2
13	Elaboration of various steps involved in Formation and utilization of ketone bodies; ketoacidosis	19/08/24	22/08/23	203.2
14	De novo synthesis of fatty acids (Palmitic acid)	20/08/24	23/08/23	203.2
15	Biological significance of cholesterol and conversion of cholesterol into bile acids, steroid hormone and vitamin	21/08/24	28/08/24	203.2
16	Conversion into bile acids, steroid hormone and vitamin	26/08/24	29/08/24	203.2
17	Test/Assignment	27/08/24	30/09/24	203.2
18	Introduction of biomolecules. Classification of biomolecules.	28/08/24	04/09/24	203.3
19	Introduction, classification, chemical nature and biological role of carbohydrates.	02/09/24	05/09/24	203.3
20	Introduction, classification, chemical nature and biological role of lipids and nucleic acid. Introduction, classification, chemical nature and biological role of amino acid and proteins	03/09/24	06/09/24	203.3
21	Introduction about bioenergetics. Elaboration of exergonic and endergonic reactions	04/09/24	06/09/24	203.3
22	Concept of free energy. Relationship between free energy, enthalpy and entropy. Redox potential	16/09/24	18/09/24	203.3
23	Introduction, classification of energy rich compounds.	17/09/24	19/09/24	203.3
24	Biological significance of ATP and cyclic AMP	18/09/24	20/09/24	203.3
25	Test/Assignment	23/09/24	25/09/24	203.3
26	General reactions of amino acid metabolism	24/09/24	26/09/24	203.4
27	Transamination, deamination & decarboxylation, urea cycle and its disorders	25/09/24	27/09/24	203.4
28	Catabolism of phenylalanine and tyrosine	30/09/24	03/10/24	203.4
29	Metabolic disorders(Phenylketonuria, Albinism, alkaptonuria, tyrosinemia)	01/10/24	04/10/24	203.4
30	Synthesis and significance of biological substances. Catabolism of heme.	07/10/24	09/10/24	203.4
31	Introduction about nucleic acid metabolism and steps involved in biosynthesis of purine nucleotides.	08/10/24	10/10/24	203.4
32	Steps involved in biosynthesis of pyrimidine nucleotides.	09/10/24	11/10/24	203.4
33	Catabolism of purine nucleotides	14/10/24	16/10/24	203.4
34	Elaboration of disorders like Hyperuricemia and Gout introduction about organization of mammalian genome	15/10/24	17/10/24	203.4
35	Introduction about organization of mammalian genome	16/10/24	18/10/24	203.4
36	Introduction about DNA and RNA structure with their functions.	21/10/24	23/10/24	203.4
37	Explanation of DNA replication (semi conservative model)	22/10/24	24/10/24	203.4
38	Elaboration of transcription	23/10/24	25/10/24	203.4
39	Genetic code and Translation	28/10/24	30/10/24	203.4
40	Steps involved in Protein synthesis and their inhibitors	29/10/24	31/10/24	203.4

41	Test/Assignment	30/10/24	06/11/24	203.4
42	Introduction, nomenclature and IUB classification of enzymes	04/11/24	07/11/24	203.5
43	Discussion about enzyme kinetics (Michaelis plot & Line Weaver Burke plot)	05/11/24	08/11/24	203.5
44	Elaboration of various enzyme inhibitors with their suitable examples	06/11/24	13/11/24	203.5
45	Introduction about enzyme regulation, Enzyme regulations	11/11/24	13/11/24	203.5
46	Introduction about isoenzyme and therapeutic and diagnostic application of enzyme, Structure and biochemical functions of co-enzymes	12/11/24	14/11/24	203.5
47	Test/Assignment	13/11/24	14/11/24	203.5

## 8. Tutorial Plan

Tutorial No.	Topic	Tentative date
1	Glycolysis–Pathway, energetics and significance	27/07/24
2	Electron transport chain (ETC) and its mechanism	03/08/24
3	$\beta$ -Oxidation of saturated fatty acid (Palmitic acid)	10/08/24
4	De novo synthesis of fatty acids (Palmitic acid)	17/08/24
5	Biological significance of cholesterol and conversion of cholesterol into bile acids, steroid hormone and vitamins	24/08/24
6	Concept of Free energy, classification of energy rich compounds.	31/08/24
7	Catabolism of phenylalanine and tyrosine	07/09/24
8	Biosynthesis of purine nucleotides	21/09/24
9	Biosynthesis of pyrimidine nucleotides	28/09/24
10	Catabolism of purine nucleotides	05/10/24
11	Introduction about organization of mammalian genome	19/10/24
12	DNA replication (semi conservative model)	26/10/24
13	Transcription and Translation	02/11/24
14	Enzyme kinetics (Michaelis plot & Line Weaver Burke plot)	09/11/24
15	Enzyme inhibitors	16/11/24

## 9. Assignments Plan:

Sr. No.	Type of Assignment	Assignment	Marks	CO	PO (Annexure I)	Tentative Date
1	Problem-solving	Explore different types of carbohydrate, their structure, sources and how they are metabolized in the body	10	203.1	PO1, PO2, PO3, PO8, PO10, PO11	13/08/24, 16/08/24
2	Comparative study	Comparative study of various edible oils examine their distinct nutrition composition to determine the most beneficial option for health.	10	203.2	PO1, PO6, PO8, PO11	27/08/24, 30/08/24
3	Subjective	Nucleic acid metabolism	10	203.3	PO1, PO5, PO8	23/09/24, 25/09/24
4	Project Assignments	Project Assignments on structural models of biomolecules	10	203.4	PO1, PO6, PO11	30/10/24, 06/11/24
5	MCQ	MCQ Based assignment on Enzyme	10	203.5	PO1, PO5, PO8	13/11/24, 14/11/24

## 10. Class Tests Schedule:

Sr.	Test Type	Topics	Marks	CO	PO	Tentative
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No.					(Annexure I)	Date
1	Subjective	Explain in detail about Glycolysis along with its energetics. Explain in detail about Citric acid cycle.	10	203.1	PO1, PO5, PO9, PO8	13/08/24, 16/08/24
2	Subjective	Discuss the steps of biosynthesis of fatty acid.	10	203.2	PO1, PO5, PO8	27/08/24, 30/08/24
3	Subjective	Discuss in detail the replication of DNA	10	203.3	PO1, PO5, PO8, PO9	23/09/24, 25/09/24
4	Subjective	Write a note on high energy-rich compounds Discuss the concept of free energy.	10	203.4	PO1, PO5, PO8,	30/10/24 06/11/24
5	Subjective	Discuss in detail various types of enzyme inhibition with suitable examples.	10	203.5	PO1, PO5, PO8	13/11/24 14/11/24

### 11. Content Beyond Syllabus (CBS):

Sr. No.	Topics	PO to be Achieved (Annexure I)
1	Modern Laboratory Tools Such as Modern Diagnostic Kits	PO1, PO4, PO6, PO11

### 12. Proposed Activity:

Sr. No.	Type of Activity	Topics	Tentative Date
1	Guest Lecture	Demonstration of various Laboratory modern tools such as Modern Diagnostic Kits	16/11/24

### 13. Evaluation Scheme:

The marks allocated for continuous mode of internal assessment shall be awarded for attendance, academic activities and student-teacher interaction. Two sessional exams shall be conducted during mid of the semester. The average marks of two sessional exams shall be computed for internal assessment. Sessional exam shall be conducted for 30 marks and shall be computed for 15 marks. Weightage for various evaluation components is as below:

Sr. No.	Evaluation Component	Weightage
1	Internal Assessment 1. Continuous Mode 2. Sessional Exams	10 15
2	End Semester Exam	75
	<b>Total</b>	<b>100</b>

As per PCI and University guidelines minimum 75% attendance is required to become eligible for appearing in the End Semester Examination.

### This Document is approved by:

Designation	Name
Course Coordinator	
HOD	
Principal	

## **ANNEXURE I: PROGRAM OUTCOMES**

1. **Pharmacy knowledge:** Possess knowledge and comprehension of the core and basic knowledge associated with the profession of pharmacy, including biomedical sciences; pharmaceutical sciences; behavioral, social, and administrative pharmacy sciences; and manufacturing practices.
2. **Planning abilities:** Demonstrate effective planning abilities including time management, resource management, delegation skills and organizational skills. Develop and implement plans and organize work to meet deadlines.
3. **Problem analysis:** Utilize the principles of scientific enquiry, thinking analytically, clearly and critically, while solving problems and making decisions during daily practice. Find, analyze, evaluate and apply information systematically and shall make defensible decisions.
4. **Modern tool usage:** Learn, select, and apply appropriate methods and procedures, resources, and modern pharmacy-related computing tools with an understanding of the limitations.
5. **Leadership skills:** Understand and consider the human reaction to change, motivation issues, leadership and team-building when planning changes required for fulfilment of practice, professional and societal responsibilities. Assume participatory roles as responsible citizens or leadership roles when appropriate to facilitate improvement in health and wellbeing.
6. **Professional identity:** Understand, analyse and communicate the value of their professional roles in society (e.g., health care professionals, promoters of health, educators, managers, employers, employees).
7. **Pharmaceutical ethics:** Honour personal values and apply ethical principles in professional and social contexts. Demonstrate behaviour that recognizes cultural and personal variability in values, communication and lifestyles. Use ethical frameworks; apply ethical principles while making decisions and take responsibility for the outcomes associated with the decisions.
8. **Communication:** Communicate effectively with the pharmacy community and with society at large, such as, being able to comprehend and write effective reports, make effective presentations and documentation, and give and receive clear instructions.
9. **The pharmacist and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety and legal issues and the consequent responsibilities relevant to the professional pharmacy practice.
10. **Environment and sustainability:** Understand the impact of the professional pharmacy solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
11. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change. Self-assess and use feedback effectively from others to identify learning needs and to satisfy these needs on an ongoing basis.