

**KRISHNA UNIVERSITY, MACHILIPATNAM
ANDHRA PRADESH, INDIA**



Department of Biochemistry

Syllabus for Single Major Program in Biochemistry

4 year B.Sc. Biochemistry honors, Under CBCS

Approved by Board of Studies

(2025-2026)

Date: 17-11-2025

KRISHNA UNIVERSITY

Prof. N. Usha
REGISTRAR (UC)
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 Machilipatnam-521004,
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No.KRU/AAC/Board of Studies/Biochemistry/2025

Dated: 28-03-2025

Sub: KU – Academic Audit – The constitution of the UG Board of Studies (BoS) members in Biochemistry for the approval of the Under Graduation (UG) CBCS syllabus w.e.f 2023-24 (APSCHE-AC-Revision of syllabus under CBCS with effect from 2023-24 syllabus) – Reg.

Read: Note order's of the Vice-Chancellor, dt: 27-03-2025.

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ORDER:

In accordance with the provisions contained by the Krishna University act No.29 of 2008 of A.P. Govt., Hon'ble Vice-Chancellor is pleased to partially modify the Board of Studies in Faculty of Biochemistry with the following members.

UG BOARD OF STUDIES FOR BIOCHEMISTRY		
S.No.	Name of the Faculty	Designation
1	Dr. Syed Vazha Tahaseen SRR & CVR Government Degree College (A), Vijayawada Mobile: 9948740949, E-Mail: vazzechatahaseen@rediffmail.com	Chairperson
2	Dr. P. Pallavi Sri Durga Malleswari Siddhaddha Mahila Kalasala (A) Vijayawada Mobile: 7780754355, E-Mail: Pallaviprasanna@rediffmail.com	Member
3	Dr. R. Gangaraju Maris Stella College, Vijayawada Mobile: 9652128262, 9398153424, E-Mail: gangarajuram@rediffmail.com	Member
4	Dr. Kishore Babu Laila Nutraceuticals, Vijayawada Mobile: 9908630910, E-Mail: kishorengb@rediffmail.com	Industrialist
5	Dr. J. Naveena Lavanya Latha Department of Biosciences & Biotechnology Krishna University, Machilipatnam	University Nominee
6	Ms. Dampa Hyma SRR & CVR Government Degree College, Vijayawada Mobile: 8309580742, E-Mail: dampa@rediffmail.com	Student Member-1
7	Mr. K. Srinivas SRR & CVR Government Degree College, Vijayawada Mobile: 9491792101, E-Mail: srinivaskasireddy179@rediffmail.com	Student Member-2

The term of office of all the members including the chairman of Board of studies until further orders with effect from the date of the order or until the new boards of studies are constituted.

These orders shall come in to force with immediate effect.

(BY ORDER)

Sd/
REGISTRAR (UC)

Copy to:
 The Chairperson & all members of UG Board of Studies of the above
 All Directors and Principals of the University and Constituent Colleges/Units
 PA's to Vice-Chancellor/Registrar KRU
 Accounts Section/Establishment Section
 File.

Digitally signed by
 Nekkalapudi Usha
 Date: 29-03-2025
 16:18:15

KRISHNA UNIVERSITY, MACHILIPATNAM

BOARD OF STUDIES- BIOCHEMISTRY- SINGLE MAJOR

1. Dr. Syed Vaziha Tahaseen, M.Sc., M.Phil., Ph.D., B.Ed. Chairperson
In-charge Dept. of Biochemistry
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4. Dr. J. Naveen Lavanaya Latha University Nominee
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S.V. Oshaseen
17/11/25

A. Pallavi

R. Gangaraju
17/11/25

J.N. Latha



ANDHRA PRADESH STATE COUNCIL OF HIGHER EDUCATION

Model Syllabus for 4-Year UG Honours in B.Sc. (Biochemistry) as Major in consonance with Curriculum framework w.e.f. AY 2025-26

Prepared by Sri Venkateswara University, Tirupati

COURSE STRUCTURE

COURSE STRUCTURE

	Year S		Title of the Course	No. of Hrs /Week	No. of Credit s
I	I	1	Biomolecules	3	3
			Biomolecules-Practical	2	1
		2	Cell Biology	3	3
			Cell Biology-Practical	2	1
	II	3	Genetics and Molecular Biology	3	3
			Genetics and Molecular Biology Practical	2	1
		4	General Physiology	3	3
			General Physiology-Practical	2	1
II	III	5	Analytical techniques & Medical instrumentation	3	3
			Analytical techniques & Medical instrumentation -Practical	2	1
		6	Basic Microbiology	3	3
			Basic Microbiology-Practical	2	1
		7	Immunology	3	3
			Immunology-Practical	2	1

	IV	8	Bioenergetics & Enzymology	3	3
			Bioenergetics & Enzymology Practical	2	1
		9	Intermediary Metabolism-I	3	3
			Intermediary Metabolism-I-Practical	2	1
		10	Intermediary Metabolism -II	3	3
			Intermediary Metabolism -II-Practical	2	1

Year	Semester	Course	Title of the Course	No. of Hrs /Week	No. of Credits
	V	11	Recombinant DNA technology and Biotechnology	3	3
			Recombinant DNA technology and Biotechnology-Practical	2	1
		12	Endocrinology	3	3
			Endocrinology practical	2	1
		13	Nutritional Biochemistry & Nutraceuticals	3	3
			Nutritional Biochemistry & Nutraceuticals Practical	2	1
	VI	14	Fundamentals of Biostatistics & Bioinformatics	3	3
			Fundamentals of Biostatistics & Bioinformatics practical	2	1
		15	Clinical Biochemistry & Bioethics	3	3
			Clinical Biochemistry & Bioethics Practical	2	1
IV	VII	16	Applied Biochemistry	3	3
			Applied Biochemistry-Practical	2	1
		17	Molecular Basis of Infectious diseases	3	3
			Molecular Basis of Infectious diseases-Practical	2	1

		18	Plant and Environmental Biochemistry	3	3
			Plant and Environmental Biochemistry-Practical	2	1
		19	Molecular Basis of Non-infectious diseases	3	3
			Molecular Basis of Non-infectious diseases Practical	2	1
		20	Ecological Principles	3	3
			Ecological Principles-Practical	2	1
	VIII	21	Food safety and Quality Management	3	3
			Food safety and Quality Management-Practical	2	1
		22	Biotechnology and Nanotechnology	3	3
			Biotechnology and Nanotechnology-Practical	2	1
		23	Membrane Biology	3	3
			Membrane Biology Practical	2	1
			Bioinformatics	3	3

		24	Bioinformatics Practical	2	1
		25	Biostatistics & IPR/	3	3
			Biostatistics practical	2	1

DEPARTMENT OF BIOCHEMISTRY

Board of Studies Meeting for the year 2025-26

Agenda

1. To verify and approve the B.Sc -Honors in Biochemistry: MAJOR programme and B.Sc -Honors Biochemistry Minor programme structure
2. To design the syllabus as per NEP 2020 to promote multidisciplinary learning, research skills, employability, and flexibility through a credit-based, outcome-oriented structure aligned with local and global scientific needs.
3. To approve Semester 1 paper 1 syllabus, blueprint, model paper, and Practical Paper syllabus
4. To approve Semester 1 paper 2 syllabus , blueprint, model paper, and Practical Paper syllabus
5. To approve Semester 2 paper 3 syllabus, blueprint, model paper, and Practical Paper syllabus
6. To approve Semester 2 paper 4 syllabus, blueprint, model paper, and Practical Paper syllabus
7. . To approve the B.Sc. – Honours in BIOCHEMISTRY - MAJOR program semester III and IV syllabus. For academic year 2026-27

BOARD OF STUDIES MEETING FOR THE ACADEMIC YEAR 2025-26

Report on the Board of Studies Meeting – Biochemistry Department

A Board of Studies (BoS) meeting was conducted online on **17th November 2025** at **11:00 AM**, with the participation of the designated members appointed by Krishna University. The following dignitaries were present:

- **Chairperson:** Dr. Syed Vaziha Tahaseen
- **Members:** Dr. A. Pallavi and Dr. Ganga Raju
- **University Nominee:** Dr.J, Naveenana Lavanya Latha
- **Alumnae Representatives:** Ms. Sathvika and Ms. Siri from SRR & CVR Government Degree College

The agenda of the meeting was to revise and approve the Biochemistry APSHE syllabus in accordance with the **National Education Policy (NEP) 2020** and the **Choice-Based Credit System (CBCS)** framework with suggested modifications.

Key Decisions and Discussions:

1. **Semester 1**
 - The syllabus for **Papers 1 and 2** was thoroughly reviewed and **Approved**.
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2. **Semester II**
 - The core syllabi for **Papers 3 and 4** were discussed.
 - Various **modifications and improvements** were suggested and incorporated based on expert deliberations.
3. **Semester III**
 - The core syllabi for **Papers 5 and 6 and 7** were discussed.
4. **Semester IV**
 - The core syllabi for **Papers 8,9 and 10** were discussed.

Various **modifications and improvements** were suggested and incorporated based on expert deliberations

Additional Highlights:

- The meeting included **extensive deliberations** on each course, and **valuable suggestions** were made by all members.
- All proposed modifications were compiled and presented below in a **tabulated format** with clear **justifications** for each change.
- The recommendations provided by the **Vice Chancellor of Krishna University** during a recent summer vacation meeting were also thoroughly considered and integrated where relevant.

Course No.	Title of the Paper	Unit Number	Modifications done	Justification
01	Biomolecules	ALL Units	Galctomannas and Ramachandran plot are and	Included as additional inputs
01	Biomolecules	Unit V	Porphyrin types	Included
02	Cell Biology	All Units	Syllabus is neatly aligned	Alignment is required concept wise in sequence
03	Genetics	Unit 1	Classical genetics topics are included	Fundamentals of Mendelian genetics must be included
03	Genetics	Unit 2	Inheritance topics are included	To go from fundamentals to advanced topics
03	Genetics	Unit 3	Molecular biology topics are included as chapters 3,4,5	
04	General Physiology	Unit 2	Mechanism of muscle contraction has been added.	To understand how muscles function during contraction and
05	Analytical techniques	Title	The title of the paper has been changed as Analytical techniques and medical instrumentation	As medical techniques are introduced
05	Analytical techniques	Unit 1	Chromatography techniques introduced in separate unit - 2, Applications of centrifugation was introduced	
05	Analytical techniques	Unit 3	Centrifugation is moved to unit 1	
05	Analytical techniques	Unit 4	Spectroscopy in medicine was introduced	
05	Analytical techniques	Unit 5	Non-radioactive probes foe medical imaging and diagnosis was introduced	
05	Analytical techniques practical's		TLC. PROTEIN ESTIMATION BY Folin Lowry method was introduced	
	Basic microbiology	Unit 1	Classification of proorganisms is deleted, and erent types of microscopy niques were introduced	oscopy is very much needed for competitive exams
	Basic microbiology	Unit 4	Microbial fermentation technique is introduced as a separate unit	oretical knowledge in Industry is essential
	Basic microbiology	Unit 5	Dengue and SARS COV 2 viruses were introduced in virology paper	

6	0 Basic Microbiology	Practical s	Catalase and methylene blue reductase, Hnging drop techniques were introduced	
7	0Immunology	Unit 5	Types of Auto immune diseases concept included	
8	Enzymology and Bioenergetics	Title	Title has been changed from enzymology to enzymology & Bioenergetics	
07	Enzymology and Bioenergetics	Unit 5	Industrial uses of enzymes: Detergent enzymes, enzymes in biofuel production, enzymes in food and beverage industry, enzymes in pharmaceutical and health care	Instead of few enzymes the different enzymes from different fields are added
08	Intermediary metabolism- I	Course shuffled	Intermediary metabolism I paper is brought forward in place of Bioenergetics and Membrane biology	As Bioenergetics concepts are merged with Enzymology and Membrane biology are included in cell Biology course
09	Intermediary metabolism- I	Course shuffled	Intermediary metabolism II paper is brought forward in place of Endocrinology	To align the concepts in sequential order this course brought forward

Sd/-
A Palby

R. Gupta
17/11/25

G. K. S.

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Program & Semester: B.Sc. Biochemistry Honours – Semester

I Course No.:01

Title of the Course: Biomolecules

Total Teaching Hours: 45 Hours (3 hours/week – Theory)

Credits:3

Course Objectives

1. To understand the biological relevance of buffers in maintaining cellular and physiological pH balance.
2. To understand the roles of carbohydrates in energy storage, cell recognition, and as structural components in organisms.
3. To differentiate between saturated and unsaturated fatty acids, and analyze the properties of fats, oils, and phospholipids.
4. To explore the structures and functions of proteins, including their classification, amino acid composition, and various levels of structural organization.
5. To understand the significance of nucleic acids, including the structure of DNA and RNA, their stability, and roles in genetic information storage and transmission.

Course Outcomes

CO1 – Understand the molecular basis of life by exploring biomolecular interactions and properties, connecting structures to biological functions.

CO2 – Apply principles like pH regulation, buffers, and osmosis to solve real-world biological challenges and maintain cellular balance.

CO3 – Analyze the structures of carbohydrates, lipids, proteins, and nucleic acids, linking them to specific biological functions for deeper insights.

CO4 – Recognize biochemistry's interdisciplinary nature, fostering critical thinking and preparing for scientific exploration and contributions.

Course Content

UNIT I: Fundamentals of Biochemistry

History, scope, and avenues of Biochemistry.

Water as a biological solvent.

Measurement of pH, buffers, and biological relevance of buffers.

Outline of surface tension, adsorption, and osmosis with their biological relevance.

UNIT II: Carbohydrates

Classification of carbohydrates; monosaccharides – D and L designations, open-chain and cyclic structures, epimers, and anomers, mutarotation.

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Reactions of carbohydrates (due to hydroxyl, aldehyde, and ketone groups).
Amino sugars and glycosides.

Structure and biological importance of disaccharides (sucrose, lactose, maltose) and polysaccharides (starch, glycogen)., Glycosaminoglycans.

Additional Input: Galactomannan.

UNIT III: Lipids

Classification of fatty acids; structure of saturated and unsaturated fatty acids.
Properties of fats and oils (acid, saponification, and iodine values; rancidity).
Classification and general properties of lipids.
Structure and functions of phospholipids and lipoproteins.

Types and biological roles of lipoproteins.

UNIT IV: Amino Acids and Proteins

Classification, structure, and stereochemistry of amino acids.
Chemical reactions due to amino and carboxyl groups.
Titration curve of glycine and its pK values. Non-protein amino acids.
Peptide bond formation.
Classification of proteins based on solubility, shape, and function. Denaturation and renaturation of proteins.
Levels of structural organization – primary, secondary, tertiary, and quaternary.

Additional Input: Ramachandran plot.

UNIT V: Nucleic Acids and Porphyrins

Types and structures of DNA and RNA.
Structure of purines and pyrimidines, nucleosides, and nucleotides.
Stability and formation of phosphodiester linkages.
Effect of acids, alkali, and nucleases on DNA and RNA.
Watson–Crick model of DNA, denaturation and renaturation, T_m values and their significance, Cot curves and their relevance.
Basic structures and biological functions of porphyrins – Heme, chlorophyll, cytochromes, and vitamin B₁₂.

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References

1. Jain, J.L., Jain, S., Jain, N. – *Fundamentals of Biochemistry*, S. Chand & Co.
2. Satyanarayana, U., Chakrapani, U. – *Biochemistry*, Books & Allied Pvt. Ltd.
3. Nelson, D.L., Cox, M.M. – *Lehninger's Principles of Biochemistry*, Freeman & Co., 7th Edition.

Web Links

1. [http://aulanni.lecture.ub.ac.id/files/2012/01/15616949-Lehninger-Principles-of-](http://aulanni.lecture.ub.ac.id/files/2012/01/15616949-Lehninger-Principles-of-Biochemistry-1-copy.pdf)
 2. [Biochemistry-1-copy.pdf](http://aulanni.lecture.ub.ac.id/files/2012/01/15616949-Lehninger-Principles-of-Biochemistry-1-copy.pdf)
 3. <https://ncert.nic.in/textbook/pdf/kebo109.pdf>
 4. <https://unacademy.com/content/wp-content/uploads/sites/2/2022/10/32.->
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PRACTICAL COURSE

Title: Biomolecules (Practical)

Total Teaching Hours: 30 Hours (2 hrs/week – Practical)

Credits-1

Course Objectives

1. To understand the principle behind qualitative and quantitative biochemical estimations.
2. To apply theoretical knowledge in the identification and analysis of biomolecules.

List of Experiments

1. Safety measures in biochemistry laboratories.
2. Preparation of buffers (acidic, neutral, and alkaline) and determination of pH.
3. Qualitative identification of carbohydrates – glucose, fructose, ribose/xylose, maltose, sucrose, lactose, starch/glycogen.
4. Qualitative identification of amino acids – histidine, tyrosine, tryptophan, cysteine, arginine.
5. Qualitative identification of lipids – solubility, saponification, acrolein test, Salkowski test, Liebermann–Burchard test.
6. Determination of pKa of acetic acid and glycine.

Course Outcomes

1. Understand the classification, structure, and chemical properties of carbohydrates, lipids, and amino acids.
2. Acquire knowledge about the structure and biochemical role of porphyrins and nucleic acids.

Recommended Books

1. Jain, J.L., Jain, S., Jain, N. – *Fundamentals of Biochemistry*, S. Chand & Co.
 2. Satyanarayana, U., Chakrapani, U. – *Biochemistry*, Books & Allied Pvt. Ltd.
 3. Nelson, D.L., Cox, M.M. – *Lehninger's Principles of Biochemistry*, Freeman & Co., 7th Edition.
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BLUEPRINT

Program & Semester: B.Sc. Biochemistry Honours

Semester 1, Course No.: 01

Title of the Course: Biomolecules

Time: 3 Hours

Max. Marks: 70

Sl. No.	Unit	Short Answer (4M)	Q. No.	Essay (10 M)	Q. No.
1	Unit I	2	1& 2	2	9 & 10
2	Unit II	1	3	2	11 & 12
3	Unit III	2	4& 5	2	13 & 14
4	Unit IV	1	6	2	15 & 16
5	Unit V	2	7& 8	2	17 & 18

Total Marks: 70

- **Section A:** Any 5 out of 8 questions (Short answers) – $5 \times 4 = 20$ Marks
- **Section B:** All 5 questions (Essays with choice) – $5 \times 10 = 50$ Marks

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Model Question Paper

Program & Semester: B.Sc. Biochemistry Honours – Semester I

Course No.: 01

Title of the Course: Biomolecules

Time: 3 Hours **Maximum Marks:** 70

Part – A (Short Answers)

Answer any FIVE of the following: $5 \times 4 = 20$ Marks

1. Surface tension – biological significance.
2. Structure and biological importance of disaccharides.
3. Saturated and unsaturated fatty acids.
4. Types and functions of lipoproteins.
5. Titration curve of glycine.
6. Ramachandran plot.
7. Denaturation and renaturation of nucleic acids.
8. Structure of heme

Part – B (Essay Questions)

Answer ALL the following: $5 \times 10 = 50$ Marks

9. Explain the role of water as a biological solvent in living systems.

OR

10. Discuss the biological relevance of buffers.
11. Explain the classification of carbohydrates.

OR

12. Write about storage polysaccharides.
13. Discuss the structure and classification of lipids.

OR

14. Write about prostaglandins – structure, types, and biological role.
15. Describe the classification and structural organization of proteins.

OR

16. Explain protein denaturation and renaturation.
17. Elaborate on the Watson–Crick DNA double helix structure and explain T_m values and their biological significance.

OR

18. Discuss the types and functions of RNA molecule

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Program & Semester: B.Sc. Biochemistry Honours

Semester I, Course No.:2

Title of the Course: CELL BIOLOGY

Total Teaching Hours: 45 Hours (3 hrs/week – Theory)

Credits: 3

Course Objectives

1. To compare and contrast the functions of cell organelles in maintaining cellular processes.
2. To understand the fundamentals of membrane biology and its role in cellular function.
3. To differentiate between mitosis and meiosis, highlighting their significance in cell division.
4. To identify various types of signaling molecules and explain their roles in intercellular communication.
5. To define protein sorting and recognize its importance in maintaining cellular compartmentalization.

Course Outcomes

CO1: Understand the structural differences between prokaryotes and eukaryotes

CO2: Apply understanding to membrane transport to specific ion and molecules movement

CO3: Analyze signal transduction pathways and their components. Formulate creative and innovative therapeutic approaches

CO4: Using the principles of cell biology to address dysfunctions in cellular processes or Organelles.

Course Content

UNIT – I: Historical Aspects

Cell theory, Protoplasm theory, Ultrastructure of virus and bacteria.

Differences between prokaryotic and eukaryotic cells and their characteristics.

Ultrastructure of plant and animal cells.

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UNIT – II: Cell Organelles

Structure and functions of Endoplasmic Reticulum (Rough and Smooth ER), Golgi apparatus, Lysosomes, Centrioles, Basal bodies, Vacuoles, Ribosomes, and Microbodies (Peroxisomes and Glyoxysomes).

Mitochondria – structure, organization of the respiratory chain, and functions. Chloroplast – structure and function.

NIT – III: Nucleus and Cell Cycle

Structure of the nucleus and the nuclear pore complex, nuclear matrix, and nucleolus.

Organization of genomic DNA, chromosomes, and higher-order chromatin structure.

Cell cycle – functional domains within the nucleus, different phases, and checkpoints in the cell cycle.

UNIT – IV: Cell Division and Regulation

Mitosis, Meiosis, and their regulation.

Apoptosis and its biological importance.

Regulation of cell cycle – Cyclins, MPF, Cyclin-dependent kinases, Growth factors, Nuclear Lamins.

Inhibition of cell cycle progression, MPF and progression to Metaphase, proteolysis, and regulation of MPF activity.

UNIT – V: Biomembranes

Chemical composition of plasma and organelle membranes of animal and plant cells.

Membrane components – lipids, proteins, and carbohydrates; their molecular structure and assembly.

Fluid mosaic model of biological membranes. Micelles and liposomes.

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Blueprint: Program & Semester: B.Sc. Biochemistry Honours – Semester I

Course No.: 2

Title: Cell Biology

Time: 3 Hours

Max. Marks: 70

Sl. No.	Unit	Short Answer (4M) Q. No.	Essay (10 M) Q. No.
1	Unit I	2	1 & 2
2	Unit II	1	3 & 2
3	Unit III	2	4 & 5
4	Unit IV	1	6 & 2
5	Unit V	2	7 & 8

Total Marks: 70

- **Section A:** Any 5 out of 8 questions (Short answers) – $5 \times 4 = 20$ Marks
 - **Section B:** All 5 questions (Essays with choice) – $5 \times 10 = 50$ Marks
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Model Question Paper

Program & Semester: B.Sc. Biochemistry Honours

Semester: I, **Course No.:** 2

Title: Cell Biology

Time: 3 Hours **Max. Marks:** 70

Section – A (Short Answers)

(Answer any FIVE questions. Each question carries 4 Marks) 5×4 = 20 Marks

1. Cell theory
2. Cell wall
3. Ribosomes
4. Nuclear pore complex
5. Functional domains within the nucleus
6. Apoptosis
7. Micelle
8. Liposomes

Section – B (Essay Questions)

(Answer ALL questions) 5×10 = 50 Marks

9. Discuss the differences between plant and animal cells with labelled diagram.

OR

10. Explain the structure and function of a eukaryotic cell.
11. Describe the structure and functions of the endoplasmic reticulum.

OR

12. Discuss the structure and organization of the respiratory chain.
13. Describe the organization of genomic DNA and chromatin structure.

OR

14. Discuss the different phases of the cell cycle and checkpoints.
15. Explain the different stages of meiosis with a neat labelled diagram.

OR

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16. Explain MPF activity and its regulation during the cell cycle.
17. Explain the chemical composition and structure of the plasma membrane in animal cells.

OR

18. Describe the fluid mosaic model of biological membranes with a neat diagram.

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Practical Course

Program & Semester: B.Sc. Biochemistry Honours –
Semester I, Course No.: 2P – Cell Biology
Total Teaching Hours: 30 Hours (2 hrs/week – Practical)
Credits-1

Course Outcomes

Students will be able to:

1. Learn about cell structure and cell organelles.
 2. Understand the concept of cell division.
 3. Acquire knowledge about biological membranes.
-

List of Experiments

1. Isolation of chloroplast.
 2. Isolation of mitochondria from liver.
 3. Observation of mitosis in onion root tips.
 4. Observation of meiosis in onion flower buds.
 5. Visualization of animal and plant cells using methylene blue.
 6. Staining and visualization of mitochondria using Janus green stain.
-

Recommended Books

1. Goldman, Emanuel & Lorrence H. Green (Eds.). *Practical Handbook of Microbiology*. CRC Press, 2015.
2. Dubey, R.C. & Maheshwari, D.K. *Practical Microbiology*. S. Chand, 2002.
3. Cappuccino & Sherman. *Microbiology: A Laboratory Manual*. Pearson Education, 6th Edition.

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Program & Semester: B.Sc. Biochemistry (Honours)

Semester II, Course No.: 3

Title of the Course: GENETICS & MOLECULAR BIOLOGY

Total Teaching Hours: 45 Hours (3 Hrs/Week – Theory) Credits: 3

COURSE SYLLABUS

COURSE SYLLABUS

UNIT – I: Principles of Inheritance

- Mendel's experiments on the garden pea and
- Principles of inheritance
- Deviation from Mendel's laws incomplete dominance
- Chromosomal Theory of Inheritance
- Linkage and Crossing Over
- Chromosomes and Sex Determination

UNIT – II:

- Genetic Material and Genome Organization
- Cris-cross inheritance x-linked inheritance
- Human karyotype, amniocentesis
- Chromosomal abnormalities and genetic disorders
In humans
- Experiments to prove DNA and RNA as genetic material
- Genome organization in Prokaryotes and Eukaryotes, Histone proteins

UNIT – III: DNA Replication

- DNA replication – Proof of semiconservative replication
- Enzymes involved in DNA replication: DNA polymerase I, II and III, Helicases, Topoisomerases, Single strand binding proteins, Primase
- Mechanism of DNA replication – Prokaryotic and Eukaryotic
- Plasmid replication (θ mode of replication), Rolling circle method (M13 Viral replication)
-

UNIT – IV: Transcription and Post-Transcriptional Modifications

- Transcription – Basic features of transcription
- Structure of RNA polymerase – Prokaryotic and Eukaryotic
- Concept of promoter – TATA box, –10 and –35 sequences
- Transcription mechanism – Prokaryotic and Eukaryotic
- post-transcriptional modifications in Eukaryotes

UNIT – V: Translation

- Translation – Genetic code: Features of the genetic code
- Codon–anticodon interaction – Wobble hypothesis
- Mechanism of translation – Prokaryotic and Eukaryotic: Initiation, Elongation and Termination
- Post translational modifications in eukaryotes

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Blueprint: Program & Semester: B.Sc. Biochemistry Honours –

Semester I, **Course No.:** 3, **Title:** Genetics

Time: 3 Hours Max. Marks: 70

Sl. No.	Unit	Short Answer (4M) Q. No.	Essay (10 M) Q. No.
1	Unit I	2	1 & 2 9 & 10
2	Unit II	1	3 11 & 12
3	Unit III	2	4 & 5 13 & 14
4	Unit IV	1	6 15 & 16
5	Unit V	2	7 & 8 17 & 18

Total Marks: 70

- **Section A:** Any 5 out of 8 questions (Short answers) – $5 \times 4 = 20$ Marks
- **Section B:** All 5 questions (Essays with choice) – $5 \times 10 = 50$ Marks

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Machilipatnam, Andhra Pradesh

MODEL QUESTION PAPER

Program & Semester: B.Sc. Biochemistry (Honours) –

Semester II, Course No.: 3

Title: GENETICS & MOLECULAR BIOLOGY

Time: 3 Hours Max. Marks: 70

SECTION – A

(Answer any FIVE questions. Each question carries 4 Marks)

1. Incomplete dominance and Co-dominance
2. Sex determination
3. Chromosomal abnormalities and genetic disorders In humans
4. Histone proteins
5. Meselson and Stahl experiment
6. Post-transcriptional modifications in Eukaryotes
7. Genetic code
8. Wobble hypothesis

SECTION – B

(Answer ALL questions. Each question carries 8 Marks)

5× 10= 50 Marks

9. Discuss about the Mendel's laws of inheritance

OR

10. Describe Chromosomal Theory of Inheritance
11. Explain the experiments that proved DNA as genetic material.

OR

12. Explain the genome organization in eukaryotes
13. Discuss in detail about the enzymes involved in DNA replication

OR

14. Explain about the mechanism of DNA replication
15. Write the mechanism of transcription in prokaryotes

OR

16. Discuss the structure of RNA polymerase and formation of pre-initiation complex
17. Explain the initiation, elongation and termination of prokaryotic translation

OR

18. Write a detailed account post translational modifications

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Machilipatnam, Andhra Pradesh

PRACTICAL SYLLABUS

**Program & Semester: B.Sc. Biochemistry (Honours) –
Semester II, Course No.: 3P – GENETICS (Practical)
Total Teaching Hours: 30 Hours (2 Hrs./Week – Practical)
Credits-1**

Course Outcomes

After successful completion, students will be able to:

1. Understand DNA and RNA as genetic material.
2. Learn bacterial transformation, transduction, and their application in genetic engineering.
3. Gain knowledge of mutations, mutagen types, and mutant isolation.

List of Experiments

1. Studying multiple allelism using Blood Group test
2. Observing the Polytene chromosomes
3. Seeing and Genetic Notation in Drosophila
4. Human Chromosome karyotyping
5. Population genetics
6. Extraction of DNA from Fish Fins
7. Isolation of RNA

Recommended Books

1. *Molecular Genetics* – D. Freifelder
2. *Cell Molecular Biology* – Bruce Alberts
3. *Molecular Cloning*, Vol. I–III – Maniatis et al.
4. *Genetics* – Gardner
5. *Molecular Biology of the Gene* – Watson
6. *Genetics* – G. Zubay
7. *Cell and Molecular Biology* – Baltimore
8. *Genes VII* – Benjamin Lewin (2000), Oxford University Press
9. *Cell and Molecular Biology* (2nd Ed., 2002) – P.K. Gupta, Rastogi Publications

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Program & Semester: B.Sc. Biochemistry Honours –

Semester II, Course No.:04

Title of the Course: General Physiology

Total Teaching Hours: 45 Hours (3 hours/week Theory)

Credits: 3

Course Objectives

1. To impart knowledge about blood composition and function and blood clotting mechanism.
2. To study about the muscular and nervous system.
3. To know about the structure of heart and respiratory system and their functions
3. To appreciate about the components of Urinary system and mechanism of Urine formation
4. To understand the structure and function and different components of Digestive system.

Course Outcomes

After successful completion of course the students will be able to

CO1 – Recognize and analyse blood cells and blood groups and Blood clotting mechanism

CO2 – Outline the muscular and nervous system, Mechanism of muscle contraction and structure of brain and spinal cord

CO3 – Acquire knowledge on structure of heart, blood pressure and respiratory system.

CO4 – Utilize the knowledge about the structure of kidney and nephron, to understand the mechanism Of Urine formation.

CO5 -- Acquire knowledge about the structure of Digestive system and Digestion process

Course Content

UNIT-I

Blood- composition & functions. Types of blood cells, morphology & function - RBC, WBC, platelets. functions of plasma proteins, Blood groups- A B O & Rhesus system, Blood clotting mechanism, anticoagulants

UNIT-II

Muscular system- types of muscles & functions. Mechanism of Muscle Contraction, Structure of brain and spinal cord, Structure of Neuron. Synapses- chemical and electrical synapse, nerve impulse transmission, action potential and neurotransmitters.

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UNIT III

Cardiovascular and Respiratory System – Structure of heart, cardiac cycle, Blood pressure, Structure of respiratory system, transportation of gases.

UNIT IV

Urinary system – Kidney structure and functions. Structure, function of nephron. Mechanism of urine formation- glomerular filtration rate, Constituents of urine.

UNIT V

Digestive system -Structure of digestive system, Mechanism of Digestion- Digestion of carbohydrates, lipids, and proteins. Role of hormones and enzymes in digestive process.

Reference Books

1. Textbook of Medical Physiology – Guyton & Hall, 11th edition, 2006
 2. Davidson's Principles and Practice of Medicine (XX Edition)- John.A.A.Hunter
 3. Human Anatomy & Physiology – Elaine N.Marieb, 3rd edition, 1995
 4. Essentials of Medical Physiology – Sembulingam, 1999
 5. Medical Physiology – Ganong
 5. Text book of Medical Biochemistry Physiology – MN.Chatterjee and, Rana Shinde, 7th ed.
 6. Animal physiology – Mariakuttikan and Arumugam
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Machilipatnam, Andhra Pradesh

PRACTICAL COURSE

Title: General Physiology-04 (Practical)

Total Teaching Hours: 30 Hours (2 hrs/week – Practical)

Credits-1

Course Objectives

1. To learn to count RBC and WBC
2. To acquire knowledge on determination of blood groups and ESR
3. To know Hemoglobin estimation

Course Outcomes

After successful completion of course the students will be able to

1. Estimate Hemoglobin
2. Count RBC and WBC
3. Determine blood groups and ESR

List of Experiments

1. RBC count & WBC count
 2. Differential leucocyte count by Leishman's staining
 3. Estimation of Hemoglobin by Sahli's acid haematin method
 4. Determination of Erythrocyte sedimentation rate
 5. Determination of blood group
 6. Measurement of blood Pressure
-

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Blueprint: Program & Semester: B.Sc. Biochemistry Honours –

Semester-II, Course No.: 4

Title: General Physiology

Time: 3 Hours

Max. Marks: 70

Sl. No.	Unit	Short Answer (4M) Q. No.	Essay (10 M) Q. No.
1	Unit I	2	1 & 2 2 9 & 10
2	Unit II	1	3 2 11 & 12
3	Unit III	2	4 & 5 2 13 & 14
4	Unit IV	1	6 2 15 & 16
5	Unit V	2	7 & 8 2 17 & 18

Total Marks: 70

- **Section A:** Any 5 out of 8 questions (Short answers) – $5 \times 4 = 20$ Marks
- **Section B:** All 5 questions (Essays with choice) – $5 \times 10 = 50$ Marks

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Machilipatnam, Andhra Pradesh

Model Question Paper

**Program : B.Sc. Biochemistry Honours –
Semester II, Course No.: 04**

Title of the Course: General Physiology

Time: 3 Hours Maximum Marks: 70

Part – A (Short Answers)

Answer any FIVE of the following: $5 \times 4 = 20$ Marks

1. Blood composition and functions
2. Functions of plasma
3. Action potential
4. Blood pressure.
5. Structure of respiratory system.
6. GFR.
7. Structure of digestive system.
8. Enzymes in digestion

Part – B (Essay Questions)

Answer ALL the following: $5 \times 10 = 50$ Marks

9. Explain the mechanism of clotting of blood.
OR
10. Describe types, morphology and functions of blood cells
11. Explain the structure of neuron and synapse.
OR
12. Discuss types of muscles and their functions.
13. Draw a neat labelled diagram of heart and write about cardiac cycle.
OR
14. Write about transportation of gases.
15. Describe the structure of nephron and mechanism of urine formation.
OR
16. Explain the structure and functions of kidney.
17. Elaborate on the digestion of carbohydrates and the enzymes involved.
OR
18. Discuss the digestion of proteins.

Program & Semester: B.Sc. Biochemistry Honours –

Semester III Course No.:05

Title of the Course: Analytical Techniques

Total Teaching Hours: 45 Hours (3 hours/week – Theory)

Credits: 3

Course Objectives

1. Understand the fundamental principles and instrumentation of major analytical techniques used in biochemistry and life sciences.
2. Explain the theoretical basis and applications of analytical techniques
3. Develop the ability to select appropriate analytical methods for the separation, identification, and characterization of biomolecules.
4. Acquire knowledge of laboratory instruments, operational principles, safety precautions, and quality control measures associated with analytical techniques.
5. Apply analytical techniques for solving biochemical and clinical problems, thereby strengthening research aptitude and diagnostic interpretation skills.

Course Outcomes

After successful completion of course the students will be able to

1. **CO1** – Understand the principles, instrumentation, and applications of major analytical techniques used in biochemistry and medical sciences.
2. **CO2** -Apply appropriate analytical techniques for the separation, identification, and analysis of biomolecules

Course Content

UNIT-I: Centrifugation

Methods of tissue homogenization, Principle of sedimentation. Different types of centrifuges and types of rotors. Principle, instrumentation, differential centrifugation, density gradient - rate zonal centrifugation, isopycnic centrifugation, ultra-centrifugation. Applications of Centrifugation in medical processes, lyophilization,

UNIT-II: Chromatography

Principle, instrumentation and applications of Paper chromatography, TLC, Gel filtration chromatography, Ion-exchange chromatography, Affinity chromatography, GC, HPLC

UNIT III: Electrophoresis

Migration of ions in electric field, factors affecting electrophoretic mobility, Gel electrophoresis: types of Gel, Principle, instrumentation and applications of Agarose gel electrophoresis, Native, SDS-PAGE, Isoelectric focusing (IEF), 2D-GE, Capillary Electrophoreses (CE)

UNIT IV: Spectroscopy

Electromagnetic radiation, Spectrum of light, Beer- Lambert's law: derivation, extinction coefficient, Instrumentation and applications of Colorimeter, UV-Visible spectrophotometry, Spectroscopy in medicine.

UNIT V: Radioisotopes

Units of Radioactivity, Measurement of radioactivity by GM counters. Radiation hazards and precautions taken while handling radioisotopes. Radioisotopes and their applications in biological research and medical field. Non-radioactive probes used for medical imaging and diagnosis.

Additional inputs: Fluorescent spectroscopy, AAS
Advanced concepts GCMS, LCMS,

Recommended Books

- 1) Physical Biochemistry- Application to Biochemistry and Molecular Biology: Friefelder D. WH Freeman and Company
- 2) Principles and Techniques of Biochemistry and Molecular Biology: - Ed. K. Wilson and J. Walker, Cambridge Univerity Press.
- 3) The Tools of Biochemistry: Cooper T.G., John Wiley and Sons Publication
- 4) Biophysical chemistry. Principles and Techniques: Upadhayay A, Upadhayay K and Nath N., Himalaya publishing house.
- 5) Experimental Biochemistry. Cark Jr J. M. and Switzer R.L, W.H. Freeman and Company.
- 6) Research Methodology for Biological Sciences: Gurumani.N. M.J.P. Publishers., Chennai, India.
- 7) Instrumental Methods of Chemical Analysis: Chatwal. G and Anand.S., Himalaya Publishing House, Mumbai, India.
- 8) A Biologist's Guide to Principles and Techniques of Practical Biochemistry: Williams.B.L. And Wilson. K. (ed.) Edward Arnold Ltd. London
- 9) Jayaraman, J. (2011). Laboratory Manual in Biochemistry, New Age International (P) Ltd.
- 10) Sadasivam, S. and Manickam, A. (2005). Biochemical Methods, Second edition, New Age International (P) Lt

PRACTICAL COURSE

Title: Analytical Techniques (Practical). 5P

Total Teaching Hours: 30 Hours (2 hrs/week)

Credits-1

Objectives

- 1) To develop practical skills in the separation, isolation, and analysis of biomolecules using chromatographic, electrophoretic, and centrifugation techniques.
- 2) To familiarize students with the principles and operation of basic biochemical instruments and laboratory methods used in analytical biochemistry.
- 3) To enable students to perform quantitative biochemical estimations and accurately interpret experimental data for biological and clinical applications.

Course Outcomes

- 1) Students will be able to perform chromatographic, electrophoretic, and centrifugation techniques for the separation and characterization of biomolecules.
- 2) Students will be able to estimate biochemical constituents such as proteins and phosphorus using standard analytical methods and construct calibration curves for quantitative analysis.
- 3) Students will acquire laboratory skills, data interpretation ability, and good laboratory practices required for research, diagnostic, and industrial biochemistry laboratories.

List of Experiments

1. Separation of Amino acids by Paper Chromatography/TLC
 2. Isolation of plant pigments by column chromatography
 3. Collection of serum from blood using centrifugation
 4. Separation of DNA using Agarose gel electrophoresis
 5. Separation of Protein using SDS PAGE
 6. Construction of protein standard curve by Follin-Lowry method
 7. Estimation of phosphorus by Fiske and Subbarow method.
-

Blueprint: Program & Semester: B.Sc. Biochemistry Honours

Semester III, Course No.: 5

Title: Analytical Techniques

Time: 3 Hours

Max. Marks: 70

Sl. No.	Unit	Short Answer (4M) Q. No.	Essay (10M) Q. No.
1	Unit I	2	1 & 2
2	Unit II	1	3
3	Unit III	2	4 & 5
4	Unit IV	1	6
5	Unit V	2	7&8

Total Marks: 70

- **Section A:** 5 out of 10 questions (Short answers) – $5 \times 4 = 20$ Marks
- **Section B:** All 5 questions (Essays with choice) – $5 \times 10 = 50$ Marks

Model Question Paper

Program & Semester: B.Sc. Biochemistry Honours

Semester III, **Course No.:** 05

Title of the Course: Analytical Techniques

Time: 3 Hours **Maximum Marks:** 70

Part – A (Short Answers)

1. Types of tissue homogenization techniques
2. Principle and significance of lyophilization
3. Principle and applications of TLC
4. Principle of affinity chromatography?
5. Isoelectric focusing
6. Gel electrophoresis
7. Beer-Lambert's law.
8. Colorimetry

Answer any FIVE of the following: $5 \times 4 = 20$ Marks

Part – B (Essay Questions)

Answer ALL the following: $5 \times 10 = 50$ Marks

9. Write about the principle, types and applications of density gradient ultra centrifugation.
OR
10. Discuss the application of centrifugation techniques in medical processes
11. Explain the principle and applications of gel filtration chromatography.
OR
12. Describe the instrumentation, working principle and applications of HPLC.
13. Explain the principle of SDS-PAGE and its significance in determining the molecular weight of a protein
OR
14. Explain two-dimensional gel electrophoresis (2D-GE) and its significance in proteomics.
15. Describe in brief about the various spectroscopies in medical field
OR
16. Explain the various components and applications of a UV-Visible spectrophotometer with a neat diagram.

17. Describe the principle and working of a Geiger-Müller (GM) counter.

OR

18. Explain the applications of non-radioactive probes in imaging and diagnosis

Question Bank

Title of the Course: Analytical Techniques

UNIT-I: Centrifugation

Short Answer Questions

1. Tissue homogenization methods
2. Types of rotors.
3. Lyophilization
4. Density gradient centrifugation
5. Rate zonal centrifugation

Essay Questions

1. Discuss applications of Centrifugation in medical processes
2. Explain the Differential centrifugation process and its applications
3. Describe the principle, types and applications of density gradient centrifugation
4. Explain principle of sedimentation and discuss the types of centrifuges

UNIT-II: Chromatography

Short Answer Questions

1. HPLC
2. GC
3. Thin Layer Chromatography
4. Paper Chromatography
5. Capillary Electrophoreses
6. Native Gel electrophoresis

Essay Questions

1. Explain the principle and applications of Gel filtration chromatography
2. Explain principle and applications of Ion-exchange chromatography
3. Explain the principle and applications of Affinity chromatography

UNIT III: Electrophoresis

Short Answer Questions

1. Factors affecting electrophoretic mobility
2. 2D-Gel electrophoresis
3. Capillary Electrophoreses
4. Agarose gel electrophoresis

Essay Questions

1. Describe the principle and applications of Isoelectric focusing
2. Explain the principle and applications of SDS PAGE
3. Write about the types of Gel and discuss Principle and applications of Agarose gel electrophoresis

UNIT IV: Spectroscopy

Short Answer Questions

1. Beer- Lambert's law
2. How the concentration of a compound giving colour to the solution is measured using colorimetry

Essay Questions

1. Elaborate the applications of Spectroscopy in medicine.
2. Discuss the principle, instrumentation and applications of UV-Visible spectrophotometry

UNIT V: Radioisotopes

Short Answer Questions

1. Radioisotopes hazards
2. Geiger Muller counters
3. Radioisotopes in medical field
4. Precautions taken while handling radioisotopes

Essay Questions

1. Explain the applications of non-radioactive probes in medical diagnosis
2. Describe the applications of radioisotopes in biological research
3. Define the units of radio activity and discuss how it is measured by GM counters

Program & Semester: B.Sc. Biochemistry Honours

Semester III Course No.:06

Title of the Course: Basic Microbiology

Total Teaching Hours: 45 Hours (3 hours/week – Theory)

Credits: 3

Course Objectives: To make students

- 1) Understand the historical development of microbiology and explain the contributions of pioneering scientists, principles of microscopy, and their applications in studying microorganisms.
- 2) Describe the structure, classification, cultivation, and growth characteristics of bacteria
- 3) Explain the morphology, classification, cellular organization, and economic importance of algae and fungi.
- 4) Differentiate major groups of microorganisms and understand the principles of microbial fermentation and industrial applications of microorganisms.
- 5) Understand the structure, classification, replication, transmission, and prevention of viral diseases

Course Outcomes

After successful completion of course the students will be able to

CO1. Explain the historical milestones in microbiology and demonstrate knowledge of various microscopic techniques and their applications in microbial studies.

CO2. Describe the ultrastructure, classification, cultivation, and growth patterns of bacteria

CO3. Classify algae and fungi, explain their cellular organization, and evaluate their beneficial and harmful roles

CO4. Compare microorganisms and discuss the principles and applications of microbial fermentation.

CO5. Describe the structure and classification of viruses, analyze modes of viral transmission.

Course Content

UNIT-I History of Microbiology and Microscopy

Contributions of Louis Pasteur, Antonie van Leeuwenhoek, Robert Koch, and Edward Jenner to the field of microbiology, Microscopy: Principles and applications of compound microscopy, Dark-field, Phase-contrast, and fluorescence microscopy. Confocal Microscopy, Electron Microscopy: TEM and SEM

UNIT-II Bacterial Cell Structure, Cultivation, and Growth

Bacteria: Ultrastructure of a bacterial cell- Structure and functions of the **slime layer, capsule**, flagella and fimbriae, Cell wall organization of Gram-positive and Gram-negative bacteria. Types of Bacterial plasmids R, F, Col plasmids. Bacterial culture media types, Isolation and cultivation of bacteria, bacterial growth curve, Sterilization techniques (Physical & Chemical methods),

UNIT III Algae and Fungi: Classification, Structure, and Applications

Algae-General characteristics, Structure of the algal cell and its major components. Applications of algae in agriculture, food industry, environmental management, biotechnology, and industrial processes.

Fungi- General characteristics, Ultrastructure of the fungal cell and its major components. Economic importance of fungi in agriculture, industry, medicine, food production, environmental processes, biodeterioration, and mycotoxin production.

UNIT IV Microbial Fermentation

Fermentation: Definition and principles of microbial fermentation, aerobic and anaerobic fermentation, basic structure of fermentor, Types of Fermentors, Industrial production of wine and Pencillin. Applications of fermentation techniques in agriculture, food industry, industrial biotechnology and environmental biotechnology.

UNIT V Virology

Properties and General characteristics of Viruses. Classification of viruses on the basis of nucleic acids composition. Basic Structure of Lamda and M13 DNA Virus. Brief idea of lytic cycle and lysogeny. Viral Transmission: Different modes (HIV, dengue, SARS-CoV- 2) and their preventive measures

Recommended Books

- 1) Microbiology by Pelczar, Chan and Krieg 5th edn. 1995 Mc Graw- Hill.
- 2) General Microbiology: Boyd, R.F., Times Mirror/ Mosby College, 1984.
- 3) A Textbook of Microbiology, R.C.Dubey and D.K.Maheswari, S.Chand Co (2001).
- 4) Pharmaceutical Microbiology, By Hugo and Russell, Blackwell Scientific (1987).
- 5) An Introduction to Viruses by S.B.Biswas, Vikas Publishing house.
- 6) Microbiology 4th edition, Prescott, Harley, Klein (Mc Graw Hill)
- 7) Fundamentals of Microbiology – M. Frebisher
- 8) Vasanthakumari.R, (2009) Practical Microbiology, BI Publishers Pvt Ltd, India
- 9) Dubey.R.C and Maheshwari D.K., (2002), Practical Microbiology, S.Chand & comp Ltd, NewDelhi.

PRACTICAL COURSE

Title: Basic Microbiology (Practical)

Total Teaching Hours: 30 Hours (2 hrs/week Practical)

Credits-1

Course Objectives

- 1) To develop practical skills in microbiological techniques, including culture media preparation, isolation, staining, and identification of microorganisms.
- 2) To familiarize students with laboratory biosafety practices and the application of microbiological methods for studying bacterial growth and biochemical characteristics.

Course Outcomes

- 1) Students will be able to perform microbiological laboratory techniques safely, including media preparation, aseptic handling, and isolation of pure bacterial cultures.
 - 2) Students will be able to identify and characterize bacteria using staining methods, motility tests, growth studies, and biochemical assays
-

List of Experiments

- 1) Microbiology Laboratory Practices and Biosafety.
 - 2) Preparation of culture media – Nutrient Broth, Nutrient Agar, MacConkey's agar
 - 3) Selective and differential media for identifying Microorganisms
 - 4) Bacterial growth curve
 - 5) Isolation of pure cultures of bacteria by streak plate method.
 - 6) Identification of bacteria by staining techniques – simple, differential and Gram staining
 - 7) Motility test by hanging drop
 - 8) Catalase test and Methylene blue reductase test
-

Blueprint: Program & Semester: B.Sc. Biochemistry Honours

Semester III, Course No.: 6

Title: Basic Microbiology

Time: 3 Hours

Max. Marks: 70

Sl. No.	Unit	Short Answer (4M) Q. No.	Essay (10M) Q. No.
1	Unit I	2	1 & 2
2	Unit II	1	3
3	Unit III	2	4 & 5
4	Unit IV	1	6
5	Unit V	2	7 & 8

Total Marks: 70

- **Section A:** 5 out of 10 questions (Short answers) – $5 \times 4 = 20$ Marks
- **Section B:** All 5 questions (Essays with choice) – $5 \times 10 = 50$

Model Question Paper

Program & Semester: B.Sc. Biochemistry Honours

Semester III, **Course No.:** 6

Title of the Course: Basic Microbiology

Time: 3 Hours **Maximum Marks:** 70

Part – A (Short Answers)

Answer any FIVE of the following: $5 \times 4 = 20$ Marks

1. Explain the contributions of Louis Pasteur to microbiology.
2. Differentiate between Transmission Electron Microscopy (TEM) and Scanning Electron Microscopy (SEM).
3. Differentiate between Gram-positive and Gram-negative bacteria.
4. Write a note on the fungal cell structure and its major components
5. Write short notes on biodeterioration
6. Differentiate between aerobic and anaerobic fermentation.
7. Applications of Fermentation in food industry
8. Differentiate between the lytic cycle and the lysogenic cycle.

Part – B (Essay Questions)

Answer ALL the following: $5 \times 10 = 50$ Marks

9. Discuss the principle and applications of fluorescent microscopy.

OR

10. Explain the principles and applications of phase-contrast, microscopy.

13. Describe the bacterial growth curve and explain the different types of bacterial culture media

OR

14. Explain the different types of sterilisation techniques

15. Discuss the applications of algae in agriculture, the food industry, environmental management, and biotechnology.

OR

16. Describe the economic importance of fungi in different fields

17. Describe the principles of microbial fermentation and the different types of fermenters.

OR

18. Explain the applications of fermentation in industrial biotechnology

19. Describe the general characteristics of viruses.

OR

20. Explain the modes of transmission and preventive measures of deng

Question Bank

Title of the Course: Microbiology

UNIT-I

Short Answer Questions

1. Explain the contributions of Louis Pasteur to microbiology.
2. Differentiate between Transmission Electron Microscopy (TEM) and Scanning Electron Microscopy (SEM).
3. Kochs postulates
4. Antonie van leeuwenhoek

Essay Questions

1. Discuss the principle and applications of fluorescent microscopy.
2. Explain the principles and applications of phase-contrast, microscopy.

UNIT-II

Short Answer Questions

1. Types of culture media
2. Isolation of bacteria
3. Bacterial growth curve

Essay Questions

1. Discuss the ultrastructure of a bacterial cell with a neat, labelled diagram.
 2. Explain the structure and functions of slime layer, capsule, flagella, and fimbriae.
 3. Describe the cell wall organization of Gram-positive and Gram-negative bacteria and explain gram staining principle
 4. Explain the types of bacterial plasmids (R, F, and Col plasmids) and their importance.
 5. Discuss the physical and chemical methods of sterilization
-

UNIT III:

Short Answer Questions

1. General characteristics of algae
 2. Structure of algal cell
 3. Applications of algae in environmental management
 4. General characteristics of fungi
 5. Structure of fungal cell
 6. Economic importance of fungi
 7. Mycotoxins
 8. Biodegradation by fungi
-

Essay Questions

1. Explain the general characteristics and ultrastructure of algal cells with a neat diagram.
2. Discuss the applications of algae in agriculture and food industry
3. Explain the general characteristics and ultrastructure of fungal cells with a neat diagram.

4. Discuss the economic importance of fungi in agriculture and medicine

UNIT IV:

Short Answer Questions

1. Fermentation
2. Aerobic and anaerobic fermentation
3. Fermentor basic design
4. Types of fermentors
5. Wine production
6. Penicillin production
7. Applications of fermentation

Essay Questions

1. Define microbial fermentation and explain its principles.
2. Describe the basic structure of a fermentor with a neat, labeled diagram.
3. Discuss the different types of fermentors and their applications.
4. Explain the industrial production of wine.
5. Explain the industrial production of penicillin.
6. Discuss the applications of fermentation techniques in food industry and industrial biotechnology

UNIT V:

Short Answer Questions

1. Classification of viruses
2. Lambda phage
3. M13 virus
4. Lytic cycle
5. Lysogeny
6. HIV transmission
7. Dengue transmission
8. SARS-CoV-2 transmission

Essay Questions

1. Discuss the general characteristics of viruses.
2. Describe the structure of Lambda DNA virus with a neat, labelled diagram.
3. Explain the structure of M13 DNA virus with a neat, labeled diagram.
4. Discuss the lytic cycle and lysogenic cycle with suitable diagrams.
5. Explain the modes of viral transmission with special reference to HIV, Dengue, and SARS-CoV-2.

Program : B.Sc. Biochemistry Honours

Semester III Course No.:07 Title of the Course: Immunology

Total Teaching Hours: 45 Hours (3 hours/week – Theory) Credits: 3

Course Objectives:

- 1) **To** understand the fundamental concepts of the immune system organization, and mechanisms immunity.
 - 2) To develop knowledge of antigens, antibodies, antigen-antibody interactions
 - 3) To explain the mechanisms of immune responses, immune regulation, and the role of MHC complex
 - 4) To familiarize students with immunological techniques and diagnostic methods
 - 5) To impart an understanding of immunological disorders and transplantation immunology
-

Course Outcomes

Upon successful completion of this course, students will be able to:

- 1) CO 1 Explain the structure, organization, and functions of the immune system
- 2) CO 2 Describe the properties of antigens and antibodies, interpret antigen-antibody reactions
- 3) CO3 Analyze the mechanisms of humoral and cell-mediated immunity and the components mediating the reactions
- 4) CO4 Demonstrate an understanding of major immunodiagnostic techniques
- 5) CO5 Discuss the immunological basis of hypersensitivity, autoimmune diseases and transplantation mechanism

Course Content

UNIT 1: Immune system

Historical perspectives of immunology, Immunity and types of immunity- Innate and Adaptive. Overview of immune system- hematopoiesis, cells of the immune system and their functions. Organs of the immune system: Primary lymphoid organs- Bone marrow, thymus, Secondary lymphoid organs- Spleen, lymph node, MALT and their functions

UNIT-II: Antigen and Antibody

Antigens- specificity, epitope, haptens, adjuvants, Immunogenicity and factors affecting immunogenicity. Immunoglobulin-structure, classes and functions. Antigen– antibody reactions- agglutination, precipitation, complement fixation. Hybridoma technology-Monoclonal antibodies and their applications in immunodiagnostics.

UNIT III: Humoral and cell mediated immunity

Humoral and cell mediated immunity response. Overview of T and B cell receptors Primary and secondary immune response. Brief description of cytokines and interleukins. Major Histocompatibility Complex (MHC) –

Structure and functions of Class I and Class II MHC molecules. Complement pathways.

UNIT IV: Immunodiagnostics

Immunodiffusion – Radial immuno diffusion, Ouchterlony double diffusion, immunoelectrophoresis, Rocket electrophoresis, haemagglutination assay. ELISA, RIA, Vaccination- Discovery, principles, and significance. Types of Vaccines – Live, attenuated, killed, toxoids, recombinant-based (mRNA and Protein).

UNIT V: Hypersensitivity reactions

Types of hypersensitive reactions- type I, II, III and IV. Fundamentals of autoimmune disorders. Brief account on immune suppression. Transplantation immunology: graft acceptance and rejection (in brief).

Recommended Books

1. Immunology, T .J. Kindt, R. A. Goldsby, and B.A. Osborne. (2007) W.H.Freeman and Co, New York.
2. Biochemistry, Voet, D. and Voet, J.G. (2004). 3rd Edition, John Wiley C Sons, Inc. USA.
3. Immunology – Kuby
4. Immunology - J. Kannan, MJP Publishers, Chennai-5 Immunology - Roitt Ivan, Jonathan Brastoff, David Male, 1993.
5. Immunology - Janis Kuby, 4th edition, 2000.
6. Immunology - An introduction, Tizarrd, R. 1995.
7. Fundamentals of Immunology – Lippincot Praven publications, 4th edition
8. Essential and clinical Immunology - Halen chapel, Mansal Haney, Siraj Misbah and Nial Snowda

PRACTICAL COURSE

Title: Immunology (Practical)

Total Teaching Hours: 30 Hours (2 hrs/week – Practical)

Course Objectives

1. To develop practical skills in performing basic immunological techniques and diagnostic assays.
 2. To familiarize students with experimental procedures and virtual laboratory methods used in immunology research and clinical practice.
-

Course Outcomes

1. Students will be able to perform and interpret common immunological assays such as blood grouping, agglutination, ELISA, and immunodiffusion.
 2. Students will be able to demonstrate laboratory competence and understand experimental animal handling procedures through virtual laboratory simulation
-

List of Experiments

1. Blood Grouping experiment
2. Latex agglutination assay
3. ELISA
4. Quantitative immune precipitation assay
5. Immuno diffusion Ouchterlony Double Diffusion
6. Removal of Thymus and Spleen from Mice (Amrita Virtual Lab)
7. Mouse Anesthesia and Blood Collection (Amrita Virtual Lab)

Blueprint: Program & Semester: B.Sc. Biochemistry Honours

Semester III, Course No.: 7

Title: Basic Immunology Time: 3

Hours

Max. Marks: 70

Sl. No.	Unit	Short Answer (4M) Q. No.	Essay (10M) Q. No.
1	Unit I	2	1 & 2
2	Unit II	1	3
3	Unit III	2	4 & 5
4	Unit IV	1	6
5	Unit V	2	7 & 8

Total Marks: 70

- **Section A:** 5 out of 10 questions (Short answers) – $5 \times 4 = 20$ Marks
- **Section B:** All 5 questions (Essays with choice) – $5 \times 10 = 50$

Model Question Paper

Program: B.Sc. Biochemistry Honours

Semester III, **Course No.:** 7

Title of the Course: Immunology

Time: 3 Hours **Maximum Marks:** 70

Part – A (Short Answers)

Answer any FIVE of the following: $5 \times 4 = 20$ Marks

1. Differentiate between innate immunity and adaptive immunity.
2. Write a short note on B and T lymphocytes
3. Define hapten and adjuvant with suitable examples.
4. Explain the structure of an immunoglobulin (antibody).
5. Write a short note on cytokines and interleukins.
6. Explain the principle of ELISA..
7. Brief note on auto immune diseases
8. Write a short note on graft rejection.

Part – B (Essay Questions)

Answer ALL the following: $5 \times 10 = 50$ Marks

9. Describe the different cells of the immune system

OR

10. Explain the structure and functions of primary and secondary lymphoid organs with neat, labeled diagrams.

11. Explain the structure, classes, and functions of immunoglobulins.

OR

12. Describe hybridoma technology and discuss the applications of monoclonal antibodies.

13. Explain humoral immunity and cell-mediated immunity, highlighting their differences.

OR

14. Describe the structure and functions of MHC Class I and MHC Class II molecules.

15. Explain ELISA with its principle, types, and applications.

OR

16. Describe the different types of vaccines with suitable examples.

17. Explain Types hypersensitivity reactions with suitable examples.

OR

18. Describe transplantation immunology and explain the mechanisms of graft acceptance and graft rejection.

Question Bank

Title of the Course: Immunology

UNIT-I:

Short Answer Questions

6. Innate immunity
7. Active and passive immunity
8. Haematopoiesis
9. Immune cells
10. Primary lymphoid organs
11. Secondary lymphoid organs

Essay Questions

5. Define immunity and discuss the types of immunity
6. Explain the structure and functions of lymphoid organs
7. Discuss about the mechanisms of innate immunity

UNIT-II:

Short Answer Questions

7. Haptens and adjuvants
8. Factors affecting immunogenicity
9. Complement fixation
10. Immunoglobulin structure
11. Hybridoma Technology

Essay Questions

4. Discuss the structure, types and functions of antibodies
5. Explain the types of antigen and antibody reactions
6. Explain the technique for monoclonal antibody production and write the applications of monoclonal antibodies

UNIT III:

Short Answer Questions

5. T cell and B cell receptors
6. Immune response
7. Cytokines
8. Interleukins
9. MHC
10. Humoral immune response

Essay Questions

4. Discuss the chemical messengers of the immune system
5. Explain the structure and functions of class I and ii MHC complex

6. Describe the humoral and cell mediated immune response
7. Define complement proteins and explain the complement pathways and their role in immunity

UNIT IV:

Short Answer Questions

3. Immunodiffusion
4. Principle of RIA
5. Significance of vaccination
6. Immunoelectrophoresis
7. Haemagglutination assay
8. Recombinant vaccines

Essay Questions

3. Define vaccination and discuss the types of Vaccines
4. Write the principle and applications of ELISA
5. Explain the different types of immune diffusion techniques

UNIT V:

Short Answer Questions

5. Mechanism of allergic reaction
6. Immune suppression
7. Graft rejection
8. Delayed hypersensitivity

Essay Questions

4. Explain the types of hypersensitive reactions
5. Discuss the autoimmune disorders
6. Write detailed account on immune suppression
7. Give a brief account on transplantation immunology

BIOENERGETICS & ENZYMOLOGY

Program & Semester: B.Sc. Biochemistry Honours

Semester IV Course No.:08

Title of the Course: BIOENERGETICS & ENZYMOLOGY

Total Teaching Hours: 45 Hours (3 hours/week – Theory) Credits: 3

Course Objectives

After completing this course, students will be able to:

1. Understand the basic concepts of bioenergetics and the role of enzymes in biological systems.
2. Learn the classification, nomenclature, and kinetic properties of enzymes.
3. Explain different types of enzyme inhibition and enzyme regulation.
4. Understand enzyme immobilization techniques and their industrial applications.
5. Apply the knowledge of enzymes and bioenergetics to biotechnology and related fields.

Course Outcomes (COs)

At the end of the course, students will be able to:

1. Explain the principles of bioenergetics and energy changes in living organisms.
2. Classify enzymes and interpret enzyme kinetics using Michaelis–Menten and Lineweaver–Burk plots.
3. Differentiate between various types of enzyme inhibition and regulation with suitable examples.
4. Describe the methods of enzyme immobilization and the properties of isoenzymes and zymogens.
5. Explain the industrial applications of enzymes such as amylase, papain, chymotrypsin, and detergent enzymes.

UNIT-I

Bioenergetics and introduction to enzymes: Laws of thermodynamics, Concept of free energy, Free energy changes in biological transformations in living systems High energy phosphates, oxidation and reduction reactions in biological systems Introduction to enzymes: nature, enzyme complex, Active site, Enzyme

substrate binding theories

Unit-II

Enzyme classification and kinetics: IUB system of classification and nomenclature of enzymes (Class and subclass with one example) Transition state and Activation energy, Factors affecting enzyme activity, Derivation of Michaelis -Menten equation, K_m and V_{max} value determination and its significance. Lineweaver- Burk plot (for single substrate enzyme catalyzed reaction).

UNIT-III

Enzyme inhibition: Enzyme activity- units, enzyme assay, Reversible and irreversible – examples. Reversible- competitive, noncompetitive and uncompetitive inhibition- explanation of double reciprocal plot with examples, allosteric regulation- example Aspartate Transcarbamoylase

UNIT-IV

Enzyme regulation – Covalently modulated enzymes with examples of adenylation and phosphorylation, and. Isoenzymes-Lactate dehydrogenase and creatine phosphokinase, Zymogens, Ribozymes

UNIT-V

Immobilization of enzymes: Methods of immobilization. Industrial uses of enzymes: Detergent enzymes, enzymes in biofuel production, enzymes in food and beverage industry, enzymes in pharmaceutical and health care

Reference Books

1. Enzymes: M. Dixon and E. C. Webb. Longman Publication
2. Enzymology: Nicholas and Price
3. Biochemistry: D.Voet and J. G. Voet, John Wiley C sons Inc. New York Chischester Brisbane, Toronto, Singapore ISBN 0-471-58651-X
4. Biochemistry: L. Stryer. and Hall, J.E., Library of Congress cataloguing-in publication Data, Bery, Jeremy mark ISBN -0-7167-4684-0.
5. Enzymes: Trevor Palmer Affiliated East- West Press Pvt. Ltd, New Delhi ISBN 81 7671- 0

PRACTICAL COURSE

Title: Bioenergetics and enzymology

Total Teaching Hours: 30 Hours (2 hrs/week – Practical)

\Course Objectives

Practical Course Objectives

1. To perform enzyme assays and measure the activity of enzymes under laboratory conditions.
2. To study the effects of pH, temperature, and substrate concentration on enzyme activity.

To determine enzyme kinetic parameters such as the optimum pH and K_m value using experimental data
Course outcomes

At the end of the practical course, students will be able to:

1. Perform enzyme assays and accurately measure enzyme activity using standard laboratory techniques.
2. Analyze the effects of pH, temperature, and substrate concentration on enzyme activity and interpret the results.
3. Determine important enzyme kinetic parameters such as the optimum pH and K_m value and relate them to enzyme function.

Practical syllabus:

1. Assay of α - amylase activity in saliva
2. Determination of optimum pH of a plant/animal or microbial enzyme.
3. Studying the effect of different temperatures during enzyme activity measurements.
4. Studying the effect of different pH during enzyme activity measurements.
5. Substrate saturation and determination of K_m value from Michaelis Menten curve.

Blueprint: Program & Semester: B.Sc. Biochemistry Honours

Semester IV, Course No.: 8

Title: BIOENERGETICS & ENZYMOLOGY

Time: 3 Hours

Max. Marks: 70

Sl. No. Unit Short Answer (4M) Q. No. Essay (10M) Q. No.

1	Unit I	2	1 & 2	2	09 & 10
2	Unit II	1	3	2	11 & 12
3	Unit III	2	4 & 5	2	13&14
4	Unit IV	1	6	2	15&16
5	Unit V	2	7 & 8	2	17 & 18

Total Marks: 70

- **Section A:** 5 out of 10 questions (Short answers) – $5 \times 4 = 20$ Marks
- **Section B:** All 5 questions (Essays with choice) – $5 \times 10 = 50$

Model Question Paper

Program & Semester: B.Sc. Biochemistry Honours

Semester-IV, Course No.: 8

Title of the Course: BIOENERGETICS & ENZYMOLOGY

Time: 3 Hours Maximum Marks: 70

Part – A (Short Answers)

Answer any FIVE of the following: $5 \times 4 = 20$ Marks

- 1) Oxidation and reduction reactions in biological systems
- 2) Structure and function of active site
- 3) Determination of Significance of K_m and V_{max}
- 4) Ribozymes
- 5) Allosteric inhibition
- 6) Zymogens
- 7) Feedback inhibition
- 8) Detergent enzymes

Part – B (Essay Questions)

Answer ALL the following: $5 \times 10 = 50$ Marks

- 9) Explain Gibb's free energy concept and free energy transformations in living systems
OR
- 10) Explain the role of High energy phosphates in biological reactions
- 11) Discuss about the IUB classification of enzymes
OR
- 12) Explain the MM equation for single substrate enzyme catalyzed reactions
- 13) Explain the types of enzyme inhibitions using double reciprocal plots
OR
- 14) Discuss the allosteric enzyme inhibition using aspartate transcarbamoylase
- 15) Describe the enzyme regulation by covalent modulation
OR
- 16) What are isoenzymes give examples and significance
- 17) Describe the methods of enzyme immobilization
OR
- 18) Discuss the industrial importance of enzymes

Question Bank

Title of the Course: Bioenergetics and Enzymology

UNIT-I:

Short Answer Questions

12. ATP
13. Concept of free energy
14. Active site structure and functions
15. Lock and key and induced fit theories

Essay Questions

8. Discuss the free energy transformations in biological systems
9. What are high energy phosphates give examples
10. Discuss the oxidation reduction reactions in biological systems
11. Explain the enzyme substrate binding theories and the significance

UNIT-II:

Short Answer Questions

12. Enzyme classification in brief
13. Activation energy
14. Transition state
15. V_{max} and K_m
16. Lineweaver-Burk plot

Essay Questions

7. Describe the enzyme classification by IUB system
8. Discuss about the factors affecting enzyme activity
9. Explain the MM equation derivation and its significance

UNIT III:

Short Answer Questions

11. Enzyme activity units
12. Immune assay
13. Allosteric regulation
14. Competitive inhibition

Essay Questions

8. Discuss the types of enzyme inhibitions with examples
9. Explain the competitive inhibition using double reciprocal plot
10. Describe the allosteric regulation taking Aspartate transcarbamylase as an example

UNIT IV:

Short Answer Questions

9. Enzyme phosphorylation
10. Enzyme adenylation
11. Lactate dehydrogenase
12. Ribozymes

Essay Questions

6. Discuss the enzyme regulation by phosphorylation and adenylation
7. Define isoenzymes and give examples
8. Define zymogens and give examples

UNIT V:

Short Answer Questions

9. Enzyme immobilisation
10. Detergent enzymes
11. Enzymes in health care
12. Enzymes in pharma
13. Enzymes in biofuel production

Essay Questions

8. Explain the enzyme immobilisation methods
9. Discuss about the industrial applications of enzymes
10. Give an account on the enzymes used in pharma and health care
11. Discuss the applications of enzymes in food and beverage industry

Program: B.Sc. Biochemistry Honours –

Semester IV Course No.:09

Title of the Course: INTERMEDIARY METABOLISM -1

Total Teaching Hours: 45 Hours (3 hours/week – Theory) Credits: 3

Course Objectives (COs): To make students

Understand the fundamental pathways of carbohydrate metabolism and their regulation **Explain** the metabolic adaptations involved in carbohydrate metabolism in plants, **Describe** the biochemical pathways of lipid metabolism, their regulation **Interpret** the mechanisms of cellular energy production through oxidative phosphorylation **Develop** an integrated understanding of metabolic regulation and energy homeostasis

Course Outcomes (CLOs): Upon successful completion of the course, students will be able to:

CO1. Explain the major pathways of carbohydrate metabolism along with their regulatory mechanisms.

CO2. Analyze photosynthetic carbon metabolism, cell wall polysaccharide biosynthesis.

CO3. Describe the pathways of lipid digestion, transport, β -oxidation and explain the biochemical basis of lipid storage diseases.

CO4. Explain the mechanisms of biological energy transduction, , and the physiological significance of reactive oxygen species.

CO5. Integrate knowledge of carbohydrate, lipid, and energy and metabolic disorders in biological systems.

Course syllabus:

UNIT I: Carbohydrate Metabolism – I

Metabolism: Catabolism and anabolism. Glycolysis and its regulation. Fate of pyruvate. Formation of acetyl-CoA. Citric Acid Cycle (TCA cycle): reactions, regulation, amphibolic role, and anaplerotic reactions. Pentose Phosphate Pathway (HMP shunt) and its significance.

UNIT II: Carbohydrate Metabolism – II

Gluconeogenesis and its regulation. Cori cycle, Glycogen metabolism: glycogenesis, glycogenolysis, and significance. Coordinated regulation of the glyoxylate cycle and the citric acid cycle in plants.

UNIT III: Photosynthesis and Plant Carbohydrate Metabolism

Ultrastructure of chloroplast. Photosynthetic carbon fixation: Calvin cycle and its regulation. Regulation of starch and sucrose synthesis. Photorespiration. C_4 and CAM pathways. Biosynthesis of cell wall polysaccharides. Integration of carbohydrate metabolism in plant cells.

UNIT IV: Lipid Metabolism

Digestion, mobilization, and transport of triacylglycerols and cholesterol. Transport of fatty acids into mitochondria (carnitine shuttle). β -Oxidation of saturated and unsaturated fatty acids and its regulation. Ketone bodies: formation and utilization. Fatty acid biosynthesis and its regulation. Cholesterol biosynthesis and its regulation. Lipid storage diseases: Fabry disease and Gaucher disease.

UNIT V: Oxidative Phosphorylation

Ultrastructure of mitochondria. Electron Transport Chain (ETC) and its components. Mitchell's Chemiosmotic Theory. ATP synthesis by the F_0-F_1 ATP synthase complex. Respiratory chain inhibitors and uncouplers of oxidative phosphorylation. Generation of Reactive Oxygen Species (ROS) in mitochondria and their biological significance.

PRACTICAL COURSE

Title: INTERMEDIARY METABOLISM -1

Total Teaching Hours: 30 Hours (2 hrs/week – Practical)

Course Objectives

- To develop proficiency in performing basic biochemical experiments for the qualitative and quantitative analysis of biomolecules
 - To acquire practical skills in microbial, enzymatic, and biochemical assays.
 - To utilize bioinformatics resources such as the KEGG database for retrieving, analyzing, and interpreting biochemical pathways and metabolic processes relevant to experimental biology.
1. Estimation of blood glucose by glucose oxidase method
 2. Sugar fermentation of microorganisms.
 3. Assay of salivary amylase.
 4. Isolation of cholesterol from egg yolk and its estimation.
 5. [Using the KEGG Database Resource for metabolic pathways](#)

Blueprint: Program & Semester: B.Sc. Biochemistry Honours

Semester IV, Course No.: 9

Title: : INTERMEDIARY METABOLISM -1

Time: 3 Hours

Max. Marks: 70

Sl. No. Unit Short Answer (4M) Q. No. Essay (10M) Q. No.

1	Unit I	2	1 & 2	2	09 & 10
2	Unit II	1	3	2	11 & 12
3	Unit III	2	4 & 5	2	13&14
4	Unit IV	1	6	2	15&16
5	Unit V	2	7 & 8	2	17 & 18

Total Marks: 70

- **Section A:** 5 out of 10 questions (Short answers) – $5 \times 4 = 20$ Marks
- **Section B:** All 5 questions (Essays with choice) – $5 \times 10 = 50$

Model Question Paper

Program & Semester: B.Sc. Biochemistry Honours

Semester IV, Course No.: 9

Title of the Course: INTERMEDIARY METABOLISM I

Time: 3 Hours Maximum Marks: 70

Part – A (Short Answers)

Answer any FIVE of the following: $5 \times 4 = 20$ Marks

1. Explain the fate of pyruvate under aerobic and anaerobic conditions.
2. Write a short note on the Pentose Phosphate Pathway and its significance.
3. Describe the steps involved in glycogenolysis.
4. Explain the structure of chloroplast with a neat, labeled diagram.
5. Differentiate between C_4 and CAM pathways.
6. Write a short note on ketone bodies and their biological significance.
7. State Mitchell's Chemiosmotic Theory.
8. Write a note on respiratory chain inhibitors.

Part – B (Essay Questions)

Answer ALL the following: $5 \times 10 = 50$ Marks

9. Explain the steps in glycolysis with its regulation.

OR

10. Describe the Citric Acid Cycle, its regulation, amphibolic role, and anaplerotic reactions.
11. Describe gluconeogenesis with its regulation.

OR

12. Explain glycogen metabolism with hormonal regulation and discuss glycogen storage diseases.
13. Explain the Calvin cycle with its regulation.

OR

14. Describe the light reactions in photosynthesis
15. Explain β -oxidation of saturated and unsaturated fatty acids with its regulation.

OR

16. Describe cholesterol biosynthesis and its regulation.
17. Explain the Electron Transport Chain and ATP synthesis by the F_0-F_1 ATP synthase complex.

OR

18. Describe oxidative phosphorylation and write about respiratory chain inhibitors and uncouplers

Program & Semester: B.Sc. Biochemistry Honours

– Semester IV Course No.:10

Title of the Course: INTERMEDIARY METABOLISM II Total

Teaching Hours: 45 Hours (3 hours/week – Theory) Credits: 3

Course Objectives

1. Understanding the fundamental reactions involved in amino acid metabolism
2. To explain the metabolism of s amino acids and inherited metabolic disorders.
3. To describe the metabolism and regulation of purine and pyrimidine nucleotides.
4. To interpret the principles of bioenergetics, ATP synthesis, and cellular homeostasis.
5. To understand the mechanisms of redox regulation, antioxidant defense systems

Course Outcomes: Upon successful completion of this course, students will be able to:

1. Explain the major pathways of amino acid metabolism
2. Differentiate glucogenic and ketogenic amino acids and major inherited metabolic disorders.
3. Describe the biosynthesis and degradation of purine and pyrimidine nucleotides.
4. Illustrate the organization and function of mitochondria
5. Explain cellular redox metabolism and antioxidant defense mechanisms

UNIT – I: Amino Acid Metabolism

General reactions of amino acid metabolism: transamination, oxidative and non-oxidative deamination, decarboxylation of amino acids, hyperammonemia, urea cycle, and regulation of the urea cycle. Formation of biologically important compounds from amino acids: histamine (from histidine), serotonin and melatonin (from tryptophan), dopamine, norepinephrine, and epinephrine (from tyrosine), and γ -aminobutyric acid (GABA) (from glutamate).

UNIT – II: Specialized Amino Acid Metabolism

Glucogenic and ketogenic amino acids. Metabolism of glycine, serine, cysteine, and tyrosine. Biosynthesis and biological significance of heme (from glycine), glutathione (from cysteine, glutamate, and glycine), nitric oxide (from arginine), and creatine and creatinine (from glycine, arginine, and methionine). Inborn errors of amino acid metabolism: phenylketonuria, albinism, maple syrup urine disease, and homocystinuria.

UNIT – III: Nucleotide Metabolism

Biosynthesis of purine and pyrimidine nucleotides by the **de novo** and salvage pathways, degradation of purine and pyrimidine nucleotides, and conversion of ribonucleotides to deoxyribonucleotides. Disorders of nucleotide metabolism: orotic aciduria and gout.

UNIT – IV: Homeostasis

Homeostasis: concept of homeostasis and the role of major organs and tissues in maintaining homeostasis. Special emphasis on liver, skeletal muscle, brain, heart; brown and white adipocytes etc.; Importance of endocrine organs and hormones in metabolic regulations Interconnections between carbohydrate, protein and lipid metabolism

UNIT – V: Redox Biology and Antioxidant Systems

Reactive oxygen species (ROS): generation and biological significance. Concepts of redox metabolism and cellular redox regulation. Glutathione: structure and functions, glutathione S-transferases, and glutathione-dependent catalysis. Glutaredoxin and thioredoxin systems. Antioxidant defense systems and cellular protection against oxidative stress.

PRACTICAL COURSE

Title: Intermediary Metabolism II

Total Teaching Hours: 30 Hours (2 hrs/week – Practical) Course Objectives

Practical syllabus

- 1) Assay of aminotransferases: (a) Aspartate (b) alanine aminotransferases.**
- 2) Assay of phenylalanine ammonia lyase.**
- 3) Assay of nitrate and nitrite reductase.**
- 4) Assay of Glutamine synthase.**
- 5) Estimation of Allantoin and allantoic acid.**
- 6) Assay of nitrogenase**

Blueprint: Program & Semester: B.Sc. Biochemistry Honours

Semester IV, Course No.: **10**

Title: INTERMEDIARY METABOLISM II

Time: 3 Hours

Max. Marks: 70

Sl. No.	Unit	Short Answer (4M) Q. No.	Essay (10M) Q. No.
1	Unit I	2	1 & 2
2	Unit II	1	3
3	Unit III	2	4 & 5
4	Unit IV	1	6
5	Unit V	2	7 & 8

Total Marks: 70

- **Section A:** 5 out of 10 questions (Short answers) – $5 \times 4 = 20$ Marks
- **Section B:** All 5 questions (Essays with choice) – $5 \times 10 = 50$

Model Question Paper

Program & Semester: B.Sc. Biochemistry Honours

Semester IV, Course No.: 10

Title of the Course: INTERMEDIARY METABOLISM II

Time: 3 Hours Maximum Marks: 70

Part – A (Short Answers)

Answer any FIVE of the following: $5 \times 4 = 20$ Marks

1. Explain the process of transamination.
2. Write a short note on hyperammonemia.
3. Differentiate between glucogenic and ketogenic amino acids.
4. Write a note on glutathione and its biological significance.
5. Write a short note on gout.
6. Define homeostasis. Explain its importance in maintaining metabolic balance
7. Write a short note on the role of brown and white adipose tissue in energy metabolism.
8. What are Reactive Oxygen Species (ROS)? Mention their biological significance.

Part – B (Essay Questions)

Answer ALL the following: $5 \times 10 = 50$ Marks

9. Describe the general reactions of amino acid metabolism

OR

10. Explain the urea cycle with its regulation
11. Describe the metabolism of glycine, serine, and cysteine

OR

12. Discuss the biosynthesis and biological significance of heme,

13. Explain the de novo pathways of purine nucleotide biosynthesis.

OR

14. Describe the degradation of purine and pyrimidine nucleotides.

15. Discuss the role of major organs in maintaining metabolic homeostasis.

16. Describe the role of endocrine organs and hormones in metabolic regulation.

17. Explain the generation of Reactive Oxygen Species (ROS), redox metabolism, and cellular redox regulation.

OR

18. Describe the antioxidant defense systems

**KRISHNA UNIVERSITY, MACHILIPATNAM
ANDHRA PRADESH, INDIA**



Department of Biochemistry

Syllabus for Minor Program in Biochemistry

Approved by Board of Studies

(2025-2026)

Date: 17-11-2025

KRISHNA UNIVERSITY

Prof. N. Usha
REGISTRAR (UC)
 Rudravaram
 Machilipatnam-521004,
 Mobile : 9440130368
 E-mail : registrar@krishnauniversity.ac.in



No.KRU/AAC/Board of Studies/Biochemistry/2025

Dated: 28-03-2025

Sub: KU – Academic Audit – The constitution of the UG Board of Studies (BoS) members in Biochemistry for the approval of the Under Graduation (UG) CBCS syllabus w.e.f 2023-24 (APSCHE-AC-Revision of syllabus under CBCS with effect from 2023-24 syllabus) – Reg.

Read: Note order's of the Vice-Chancellor, dt: 27-03-2025.

-oOo-

ORDER:

In accordance with the provisions contained by the Krishna University act No.29 of 2008 of A.P. Govt., Hon'ble Vice-Chancellor is pleased to partially modify the Board of Studies in Faculty of Biochemistry with the following members.

UG BOARD OF STUDIES FOR BIOCHEMISTRY		
S.No.	Name of the Faculty	Designation
1	Dr. Syed Vazha Talaseen SRR & CVR Government Degree College (A), Vijayawada Mobile: 9948740949, E-Mail: vazzechatalaseen@icloud.com	Chairperson
2	Dr. P. Pallavi Sri Durga Malleswari Siddhaddha Mahila Kalasala (A) Vijayawada Mobile: 7780754355, E-Mail: Pallaviprasanna168@gmail.com	Member
3	Dr. R. Gangaraju Maris Stella College, Vijayawada Mobile: 9652128262, 9398153424, E-Mail: gangarajumpakshi@gmail.com	Member
4	Dr. Kishore Babu Laila Nutraceuticals, Vijayawada Mobile: 9908630910, E-Mail: kishorengbharu@gmail.com	Industrialist
5	Dr. J. Naveena Lavanya Latha Department of Biosciences & Biotechnology Krishna University, Machilipatnam	University Nominee
6	Ms. Dampa Hyma SRR & CVR Government Degree College, Vijayawada Mobile: 8309580742, E-Mail: dampa.hyma396@gmail.com	Student Member-1
7	Mr. K. Srinivas SRR & CVR Government Degree College, Vijayawada Mobile: 9491792101, E-Mail: srinivaskasireddy179@gmail.com	Student Member-2

The term of office of all the members including the chairman of Board of studies until further orders with effect from the date of the order or until the new boards of studies are constituted.

These orders shall come in to force with immediate effect.

(BY ORDER)

Sd
REGISTRAR (UC)

Copy to:
 The Chairperson & all members of UG Board of Studies of the above
 All Directors and Principals of the University and Constituent Colleges/Units
 PA's to Vice-Chancellor/Registrar KRU
 Accounts Section/Establishment Section
 File.

Digitally signed by
 Nekkalapudi Usha
 Date: 29-03-2025
 16:18:15

KRISHNA UNIVERSITY, MACHILIPATNAM

BOARD OF STUDIES- BIOCHEMISTRY- SINGLE MAJOR

1. Dr. Syed Vaziha Tahaseen, M.Sc., M.Phil., Ph.D., B.Ed. Chairperson
In-charge Dept. of Biochemistry
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S.V. Oshaseen
17/11/25

A. Pallavi

R. Gangaraju
17/11/25

J.N. Latha



ANDHRA PRADESH STATE COUNCIL OF HIGHER EDUCATION

Model Syllabus for Biochemistry (Minor) in consonance with Curriculum framework w.e.f. AY 2025-26

Prepared by Sri Venkateswara University, Tirupati

COURSE STRUCTURE

Year	Semester	Course	Title of the Course	No. of Hrs /Week	No. of Credits
II	III	1	Analytical techniques	3	3
			Analytical techniques-Practical	2	1
	IV	2	Bioenergetics & Enzymology	3	3
			Bioenergetics & Enzymology-Practical	2	1
III	V	3	Nutritional Biochemistry	3	3
			Nutritional Biochemistry-Practical	2	1
		4	Intermediary Metabolism- I	3	3
			Intermediary Metabolism- I-Practical	2	1
	VI	5	Intermediary Metabolism -II	3	3
			Intermediary Metabolism -II-Practical	2	1
		6	Clinical Biochemistry	3	3
			Clinical Biochemistry-Practical	2	1

Program & Semester: B.Sc. Biochemistry Honours –

Semester III Course No.:01

Title of the Course: **Analytical Techniques**

Total Teaching Hours: 45 Hours (3 hours/week – Theory)

Credits: 3

Course Objectives

1. Understand the fundamental principles and instrumentation of major analytical techniques used in biochemistry and life sciences.
2. Explain the theoretical basis and applications of analytical techniques
3. Develop the ability to select appropriate analytical methods for the separation, identification, and characterization of biomolecules.
4. Acquire knowledge of laboratory instruments, operational principles, safety precautions, and quality control measures associated with analytical techniques.
5. Apply analytical techniques for solving biochemical and clinical problems, thereby strengthening research aptitude and diagnostic interpretation skills.

Course Outcomes

After successful completion of course the students will be able to

1. **CO1** – Understand the principles, instrumentation, and applications of major analytical techniques used in biochemistry and medical sciences.
2. **CO2** -Apply appropriate analytical techniques for the separation, identification, and analysis of biomolecules

Course Content

UNIT-I: Centrifugation

Methods of tissue homogenization, Principle of sedimentation. Different types of centrifuges and types of rotors. Principle, instrumentation, differential centrifugation, density gradient - rate zonal centrifugation, isopycnic centrifugation, ultra-centrifugation. Applications of Centrifugation in medical processes, lyophilization,

UNIT-II: Chromatography

Principle, instrumentation and applications of Paper chromatography, TLC, Gel filtration chromatography, Ion-exchange chromatography, Affinity chromatography, GC, HPLC

UNIT III: Electrophoresis

Migration of ions in electric field, factors affecting electrophoretic mobility, Gel electrophoresis: types of Gel, Principle, instrumentation and applications of Agarose gel electrophoresis, Native, SDS-PAGE, Isoelectric focusing (IEF), 2D-GE, Capillary Electrophoreses (CE)

UNIT IV: Spectroscopy

Electromagnetic radiation, Spectrum of light, Beer- Lambert's law: derivation, extinction coefficient, Instrumentation and applications of Colorimeter, UV-Visible spectrophotometry, Spectroscopy in medicine.

UNIT V: Radioisotopes

Units of Radioactivity, Measurement of radioactivity by GM counters. Radiation hazards and precautions taken while handling radioisotopes. Radioisotopes and their applications in biological research and medical field. Non-radioactive probes used for medical imaging and diagnosis.

Additional inputs: Fluorescent spectroscopy, AAS
Advanced concepts GCMS, LCMS,

Recommended Books

- 1) Physical Biochemistry- Application to Biochemistry and Molecular Biology: Friefelder D. WH Freeman and Company
- 2) Principles and Techniques of Biochemistry and Molecular Biology: - Ed. K. Wilson and J. Walker, Cambridge University Press.
- 3) The Tools of Biochemistry: Cooper T.G., John Wiley and Sons Publication
- 4) Biophysical chemistry. Principles and Techniques: Upadhayay A, Upadhayay K and Nath N., Himalaya publishing house.
- 5) Experimental Biochemistry. Cark Jr J. M. and Switzer R.L, W.H. Freeman and Company.
- 6) Research Methodology for Biological Sciences: Gurumani.N. M.J.P. Publishers., Chennai, India.
- 7) Instrumental Methods of Chemical Analysis: Chatwal. G and Anand.S., Himalaya Publishing House, Mumbai, India.
- 8) A Biologist's Guide to Principles and Techniques of Practical Biochemistry: Williams.B.L. And Wilson. K. (ed.) Edward Arnold Ltd. London
- 9) Jayaraman, J. (2011). Laboratory Manual in Biochemistry, New Age International (P) Ltd.
- 10) Sadasivam, S. and Manickam, A. (2005). Biochemical Methods, Second edition, New Age International (P)

PRACTICAL COURSE

Title: Analytical Techniques (Practical). 1P

Total Teaching Hours: 30 Hours (2 hrs/week)

Credits-1

Objectives

- 1) To develop practical skills in the separation, isolation, and analysis of biomolecules using chromatographic, electrophoretic, and centrifugation techniques.
- 2) To familiarize students with the principles and operation of basic biochemical instruments and laboratory methods used in analytical biochemistry.
- 3) To enable students to perform quantitative biochemical estimations and accurately interpret experimental data for biological and clinical applications.

Course Outcomes

- 1) Students will be able to perform chromatographic, electrophoretic, and centrifugation techniques for the separation and characterization of biomolecules.
- 2) Students will be able to estimate biochemical constituents such as proteins and phosphorus using standard analytical methods and construct calibration curves for quantitative analysis.
- 3) Students will acquire laboratory skills, data interpretation ability, and good laboratory practices required for research, diagnostic, and industrial biochemistry laboratories.

List of Experiments

1. Separation of Amino acids by Paper Chromatography/TLC
 2. Isolation of plant pigments by column chromatography
 3. Collection of serum from blood using centrifugation
 4. Separation of DNA using Agarose gel electrophoresis
 5. Separation of Protein using SDS PAGE
 6. Construction of protein standard curve by Follin-Lowry method
 7. Estimation of phosphorus by Fiske and Subbarow method.
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Program & Semester: B.Sc. Biochemistry Honours

Semester III, **Course No.:** 01

Title of the Course: Analytical Techniques

Time: 3 Hours **Maximum Marks:** 70

Part – A (Short Answers)

1. Types of tissue homogenization techniques
2. Principle and significance of lyophilization
3. Principle and applications of TLC
4. Principle of affinity chromatography?
5. Isoelectric focusing
6. Gel electrophoresis
7. Beer-Lambert's law.
8. Colorimetry

Answer any FIVE of the following: $5 \times 4 = 20$ Marks

Part – B (Essay Questions)

Answer ALL the following: $5 \times 10 = 50$ Marks

9. Write about the principle, types and applications of density gradient ultra centrifugation.

OR

10. Discuss the application of centrifugation techniques in medical processes

11. Explain the principle and applications of gel filtration chromatography.

OR

12. Describe the instrumentation, working principle and applications of HPLC.

13. Explain the principle of SDS-PAGE and its significance in determining the molecular weight of a protein

OR

14. Explain two-dimensional gel electrophoresis (2D-GE) and its significance in proteomics.

15. Describe in brief about the various spectroscopies in medical field

OR

16. Explain the various components and applications of a UV-Visible spectrophotometer with a neat diagram.

17. Describe the principle and working of a Geiger-Müller (GM) counter.

OR

18. Explain the applications of non-radioactive probes in imaging and diagnosis

BIOENERGETICS & ENZYMOLOGY

Program & Semester: B.Sc. Biochemistry Honours

Semester IV Course No.:02

Title of the Course: BIOENERGETICS & ENZYMOLOGY

Total Teaching Hours: 45 Hours (3 hours/week – Theory) Credits: 3

Course Objectives

After completing this course, students will be able to:

1. Understand the basic concepts of bioenergetics and the role of enzymes in biological systems.
2. Learn the classification, nomenclature, and kinetic properties of enzymes.
3. Explain different types of enzyme inhibition and enzyme regulation.
4. Understand enzyme immobilization techniques and their industrial applications.
5. Apply the knowledge of enzymes and bioenergetics to biotechnology and related fields.

Course Outcomes (COs)

At the end of the course, students will be able to:

1. Explain the principles of bioenergetics and energy changes in living organisms.
2. Classify enzymes and interpret enzyme kinetics using Michaelis–Menten and Lineweaver–Burk plots.
3. Differentiate between various types of enzyme inhibition and regulation with suitable examples.
4. Describe the methods of enzyme immobilization and the properties of isoenzymes and zymogens.
5. Explain the industrial applications of enzymes such as amylase, papain, chymotrypsin, and detergent enzymes.

UNIT-I

Bioenergetics and introduction to enzymes: Laws of thermodynamics, Concept of free energy, Free energy changes in biological transformations in living systems High energy phosphates, oxidation and reduction reactions in biological systems Introduction to enzymes: nature, enzyme complex, Active site, Enzyme substrate binding theories

Unit-II

Enzyme classification and kinetics: IUB system of classification and nomenclature of enzymes (Class and subclass with one example) Transition state and Activation energy, Factors affecting enzyme activity, Derivation of Michaelis -Menten equation, K_m and V_{max} value determination and its significance. Lineweaver- Burk plot (for single substrate enzyme catalyzed reaction).

UNIT-III

Enzyme inhibition: Enzyme activity- units, enzyme assay, Reversible and irreversible – examples. Reversible- competitive, noncompetitive and uncompetitive inhibition- explanation of double reciprocal plot with examples, allosteric regulation- example Aspartate Transcarbamoylase

UNIT-IV

Enzyme regulation – Covalently modulated enzymes with examples of adenylation and phosphorylation, and. Isoenzymes-Lactate dehydrogenase and creatine phosphokinase, Zymogens, Ribozymes

UNIT-V

Immobilization of enzymes: Methods of immobilization. Industrial uses of enzymes: Detergent enzymes, enzymes in biofuel production, enzymes in food and beverage industry, enzymes in pharmaceutical and health care

Reference Books

1. Enzymes: M. Dixon and E. C. Webb. Longman Publication
2. Enzymology: Nicholas and Price
3. Biochemistry: D.Voet and J. G. Voet, John Wiley C sons Inc. New York Chischester Brisbane, Toronto, Singapore ISBN 0-471-58651-X
4. Biochemistry: L. Stryer. and Hall, J.E., Library of Congress cataloguing-in publication Data, Bery, Jeremy mark ISBN -0-7167-4684-0.
5. Enzymes: Trevor Palmer Affiliated East- West Press Pvt. Ltd, New Delhi ISBN 81 7671- 0

PRACTICAL COURSE

Title: Bioenergetics and enzymology

Total Teaching Hours: 30 Hours (2 hrs/week – Practical)

\Course Objectives

Practical Course Objectives

1. To perform enzyme assays and measure the activity of enzymes under laboratory conditions.
2. To study the effects of pH, temperature, and substrate concentration on enzyme activity.

To determine enzyme kinetic parameters such as the optimum pH and K_m value using experimental data Course outcomes

At the end of the practical course, students will be able to:

1. Perform enzyme assays and accurately measure enzyme activity using standard laboratory techniques.
2. Analyze the effects of pH, temperature, and substrate concentration on enzyme activity and interpret the results.
3. Determine important enzyme kinetic parameters such as the optimum pH and K_m value and relate them to enzyme function.

Practical **syllabus:**

1. Assay of α - amylase activity in saliva
2. Determination of optimum pH of a plant/animal or microbial enzyme.
3. Studying the effect of different temperatures during enzyme activity measurements.
4. Studying the effect of different pH during enzyme activity measurements.
5. Substrate saturation and determination of K_m value from Michaelis Menten curve.

Blueprint: Program & Semester: B.Sc. Biochemistry Honours

Semester IV, Course No.: 2

Title: BIOENERGETICS & ENZYMOLOGY

Time: 3 Hours

Max. Marks: 70

Sl. No.	Unit	Short Answer (4M) Q. No.	Essay (10M) Q. No.
1	Unit I	2	1 & 2
2	Unit II	1	3
3	Unit III	2	4 & 5
4	Unit IV	1	6
5	Unit V	2	7 & 8

Total Marks: 70

- **Section A:** 5 out of 10 questions (Short answers) – $5 \times 4 = 20$ Marks
- **Section B:** All 5 questions (Essays with choice) – $5 \times 10 = 50$

Model Question Paper

Program & Semester: B.Sc. Biochemistry Honours

Semester-IV, Course No.: 2

Title of the Course: BIOENERGETICS & ENZYMOLOGY

Time: 3 Hours Maximum Marks: 70

Part – A (Short Answers)

Answer any FIVE of the following: $5 \times 4 = 20$ Marks

- 1) Oxidation and reduction reactions in biological systems
- 2) Structure and function of active site
- 3) Determination of Significance of K_m and V_{max}
- 4) Ribozymes
- 5) Allosteric inhibition
- 6) Zymogens
- 7) Feedback inhibition
- 8) Detergent enzymes

Part – B (Essay Questions)

Answer ALL the following: $5 \times 10 = 50$ Marks

- 9) Explain Gibb's free energy concept and free energy transformations in living systems
OR
- 10) Explain the role of High energy phosphates in biological reactions
- 11) Discuss about the IUB classification of enzymes
OR
- 12) Explain the MM equation for single substrate enzyme catalyzed reactions
- 13) Explain the types of enzyme inhibitions using double reciprocal plots
OR
- 14) Discuss the allosteric enzyme inhibition using aspartate transcarbamoylase
- 15) Describe the enzyme regulation by covalent modulation
OR
- 16) What are isoenzymes give examples and significance
- 17) Describe the methods of enzyme immobilization
OR
- 18) Discuss the industrial importance of enzymes

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Sd. V. O. Ganesan
17/11/25

A. Palay

J. M. L. n.

R. Gupta
17/11/25

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