STUDY CENTRE FOR BIOCHEMISTRY DEPARTMENT OF CHEMISTRY

COURSE STRUCTURE

for

(M.Sc. Biochemistry)

Two Semesters (One Year)

Programme

Based on

Choice Based Credit System (CBCS)

As per Ordinance-14(2)

(Effective from 2025-26)

03/09/25

3.9.25

03-09-25

AWADHESH PRATAP SINGH UNIVERSITY, REWA (M.P.)

Semester Course of M.Sc. Biochemistry

Programme : **M.Sc. Biochemistry**

Programme Code : **508**

Duration : **2 Semester (One Year)**

Eligibility : Graduation with Biology, Botany, Zoology, Chemistry, Biotechnology, Microbiology and Biochemistry, BSc in Medical Lab Technology as one of the subjects.

Age Limit : No age limit

Admission Procedure : The admission will be done as per merit of qualifying examinations

PROGRAMME OBJECTIVES & STRUCTURE

PO #	PROGRAMME OUTCOME
PO 1	**Critical Thinking**: Take informed actions after identifying the assumptions that frame our thinking and actions, check out the degree to which these assumptions are accurate and valid, and look at our ideas and decisions (intellectual, organizational, and personal) from different Perspectives.
PO 2	**Effective Communication**: Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and Technology.
PO 3	**Social Interaction**: Elicit views of others, mediated is agreements and help reach conclusions in group settings.
PO 4	**Effective Citizenship**: Demonstrate empathetic social concern and equity- centered national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.
PO 5	**Ethics**: Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.
PO 6	**Environment and Sustainability**: Understand the issues of environmental contexts and sustainable development.
PO 7	**Self-directed and Life-long Learning**: Acquire the ability to engage in independent and life-long learning in the broadest context of socio-technological changes.

PROGRAMME SPECIFIC OUTCOME

PSO #	PROGRAMME SPECIFIC OUTCOME
PSO 1	To gain essential knowledge and skills to pursue a career in research, industry and in academic set up.
PSO 2	To integrate and apply the techniques in Analytical biochemistry, Clinical biochemistry, Microbiology, Molecular biology and Bioinformatics.
PSO 3	To understand the depth of scientific knowledge in the broad range of fields including Cell biology, Metabolism, Pharmaceutical Biochemistry, Genetics, Nutritional Biochemistry, Immunology and Enzymology.
PSO 4	Provide the biochemical basis of human diseases, protein structure and conformation, non-invasive diagnostics, biochemical pathway regulation and drug development and synthesize this knowledge and apply the same for multitude of laboratory applications.

Course Outcome (COs)

S.No.	Course Name	Course Code
Semester-I		
101	**Cytology & Human Physiology**	**BCH-101**
	Course Outcome	
CO1	Understand molecular organization and functioning of cell organelles and nucleus	
CO2	Understand the structure of cell, Bio-membrane transport and cell cycle	
CO3	Understand human nervous and muscular system and their functioning	
CO4	Discuss molecular organization and nucleus and its elements	
CO5	Understand blood and excretory system, its thorough structure and working	
102	**Practical: Cytology & Human Physiology**	**BCH-102**

Course Outcome		
CO1	Determining various blood parameters eg. bleeding time, clotting time, Hb%	
CO2	Learn microscopic observations of cell, cell organelles and its compartments, cell cycle	
CO3	Understand the identification of cells and its characters	
CO4	Demonstrating the isolation of cell organelles	
CO5	Understand animal and plant proteins and their role in life	
103	**Advanced Techniques in Biochemistry**	**BCH-103**

Course Outcome		
CO1	Understand both qualitative and quantitative analysis	
CO2	Discuss the cell fractionation by the use of centrifugation	
CO3	Understand colorimetric and spectrophotometric analysis	
CO4	Understand the principle and types of chromatography with its applications	
CO5	Understand the principle and types of electrophoresis with its applications	

104	**Practical : Advanced Techniques in Biochemistry**	**BCH-104**
	Course Outcome	
CO1	Fractionation of various cell components by appropriate techniques	
CO2	Isolation and identification of various cell samples.	
CO3	Understand the working of spectrophotometer with different samples.	
CO4	Demonstration of chromatography and its applications	
CO5	Demonstration of electrophoresis and its applications	
	Semester-II	
201	**Enzymes And Clinical Biochemistry**	**BCH-201**
	Course Outcome	
CO1	Understand nomenclature and classification of enzymes	
CO2	Discuss co-enzyme and cofactors and allosteric enzymes	
CO3	Explain multi enzyme and mechanism of enzyme regulation	
CO4	Learn to diagnose various diseases on the basis of biochemical parameters	
CO5	Learn and understand LFTs, KFTs and other marker enzymes	
202	**Practical : Enzymes And Clinical Biochemistry**	**BCH-202**

	Course Outcome	
CO1	Understand diagnostic role of enzymes in various diseases	
CO2	Understand the drugs and their effects on different diseases	
CO3	Learn clinical part of various blood parameters	
CO4	Understand Biochemical aspects of Hematology and related pathology	
CO5	Understand Liver function test Renal function test	

203	Statistics in Biochemistry	
CO1	Explain introduction of Biostatistics, measures of central tendency	
CO2	Understand probability and its functions in data analysis	
CO3	Understand correlation and regression analysis	
CO4	Discuss the fundamentals of standard deviation, student's t-test	
CO5	Understand basics of computer, internet and its applications in biology	
302	**Practicals : Statistics in Biochemistry**	
CO1	Finding probability of the given data and its statistical analysis	
CO2	Application of correlation and regression analysis in large and small samples	
CO3	Determination of standard deviation, student's t-test	
CO4	Learn to use F-test for small population study cases	
CO5	Application of various soft wares and use of internet, web net	

M.Sc. BIOCHEMISTRY (FOUR SEMESTER COURSE) SCHEME OF EXAMINATION

(NEP Based Syllabus)

(Effective from 2025-26)

First Year

Semester	Course Level	Core Course	Practical Course	Internship	Tota Cred
Semester -I	500	Cytology & Human Physiology (6)	Cytology & Human Physiology (4)	Internship/Apprentice-ship/Seminar	
	500	Advanced Techniques in Biochemistry (6)	Advanced Techniques in Biochemistry (4)	(2)	22
Semeste -II	500	Enzymes & Clinical Biochemistry (6)	Enzymes & Clinical Biochemistry (4)	Value Added Course	
	500	Statistics in Biochemistry	Statistics in Biochemistry	(2)	22

		(6)	(4)		

M.Sc. BIOCHEMISTRY

Semester-I

Paper-I

BCH-101: Cytology & Human Physiology

COURSE OBJECTIVES

- The course is designed to assist the students to learn and understand fundamental concepts and principles of respiratory, renal, digestive, cardiovascular, muscle and neuro physiology.
- To develop a vocabulary of appropriate terminology to effectively communicate information related to anatomy and physiology.
- To study the interrelationships within and between anatomical and physiological systems of the human body.
- To understand the basic mechanisms of homeostasis by integrating the functions of cells, tissues, organs, and organ systems.
- To study the roll and mechanism of endocrine system in metabolism, regulation of normal homeostatic condition of body and other physiological functions.

UNIT-I

Cell Organization : Molecular organization and biogenesis Cell, cell wall and Extracellular Matrix (ECM) Organization, differentiation of prokaryotic and Eukaryotic cells, Virus, bacteria, cyanobacteria.

Cell Organelles : Molecular organization and biogenesis and functions of Mitochondria, Endoplasmic reticulum, Golgi apparatus, lysosome, Vacuoles, Ribosome, Peroxisome, Nucleus and nucleolus.

UNIT-II

Bio-membrane Transport- Physiochemical properties of cell membranes. Molecular constitution of membranes, Simple diffusion, passive- active transport, primary and secondary group translocation, transport ATPases. Transport mechanism- mobile carriers and pores mechanisms. Transport by vesicle formation, endocytosis, exocytosis.

UNIT-III

Cell cycle- Cell division by Mitosis and Meosis, Comparison of Meiosis and Mitosis, regulation of cell cycle, cell lysis, Cytokinesis, Cell signaling, Cell communication, Cell adhesion and Cell junction, apoptosis.

UNIT-IV

Blood- Composition of blood, structure & functions of formed elements, plasma and its constituents & function of plasma proteins. **Blood coagulation-** Mechanism & regulation, fibrinolysis, role of Hb in oxygen & carbon dioxide transport.

Excretory system- Structure of nephron, mechanism of urine formation, clearance values, composition of urine, Homeostasis & acid- base balance & imbalance.

UNIT-V

Muscles- Types and Structure of skeletal muscles, sarcoplasmic reticulum and myofibrils. Actin, myosin, tropomyosin, troponin, Z-disc and H-line components. The sliding filament mechanisms and other theories metabolic and chemical changes during muscle constriction.
Nervous System - Structure of neuron, conduction of impulses across the nerve fiber, saltatory conduction. Synaptic transmission, role of neurotransmitter.

Books Suggested

1. Cell Biology Protocols by Harris, R., Graham, J. & Rickwood, D.
2. Color Atlas of Biochemistry by Koolman, J. & Roehm, K. H.
3. Molecular Biology of The Cell - Bruce Alberts.
4. Molecular cell Biology by Harvey Lodish. W. H. Freeman; Sol edition (2007).
5. Cell Biology Protocols by Harris, R., Graham, J. & Rickwood, D.

- Human Physiology by Devis.
- Harper's Biochemistry (Lange Medical Books) (Paperback)By Robert K. Murray,Daryl K. Granner, Peter A. Mayes and Victor W. Rodwell. Publisher: Appelton and Lange.
- Clinical Biochemistry By Richard Luxton. Scion Publishing Ltd.
- Text book of Biochemistry and Human Biology -Talwar , G.P. and Srivastava. L.M., Printice Hall of India.
- Human Physiology Chatterjee.C.C, Medical Allied Agency.

COURSE OUTCOMES

- This course will provide a sound basis in human physiology to support in-depth understanding of physiological processes of all body systems in detail and on an appropriate level.
- Students will able to explain how the activities of organs are integrated for maximum efficiency.
- Students will be prepared to identify how changes in normal physiology lead to disease and it will support further study in health and medical sciences or related fields.
- By the end of the course, the students will be able to demonstrate advanced knowledge and understanding of aspects basic knowledge of the structural and functional properties of cells, cell organization, cell cycle, cell death

Practicals

Semester-I

BCH – 102 : Cytology & Human Physiology

1. Preparation of Blood film and identification of various blood cells such as RBCs, WBCs, Lymphocytes, Macrophages, Phagocytic Cells etc..
2. Observation of various cell organelles like Mitochondria, Endoplasmic Reticulum, Ribosom Golgi Body, Nucleus and others in the preformed slides using microscope.
3. Extraction of proteins and estimation of it from plant cell material by appropriate method.

4. Extraction of proteins and estimation of it from animal cell material using suitable method..
5. Observation and noting salient features of various stages of cell division from the permanent slides, also identifying them as a spot.
6. Staining, identification and characterization of bacterial cell using appropriate method.
7. Determination of Hb% (gram percentage of Hemoglobin) by Sahli's hemometer in human blood samples.
8. To determine the Prothrombin Time in the given blood samples.
9. Microscopic observation of LS and TS of Reproductive organs and tissue, stomach tissue.
10. Microscopic observation of Skin Muscles, heart Muscles.

M.Sc. BIOCHEMISTRY

Semester-I

Paper-II

BCH-103: Advanced Techniques in Biochemistry

COURSE OBJECTIVE

- The objectives of this paper is to develop student's knowledge and capabilities in areas of analytical chemistry that are particularly relevant to the analysis of a range of sample types
- To understand the physical principles of a range of quantitative and quantitative analytical techniques.
- To study the range of spectroscopic technique to characterize the biomolecules.
- To understand the governing mechanisms and driving forces of various advanced separation processes.

UNIT-I

Water- Physical properties & Structure of water, hydrogen bonding, Ionization of water. pH scale, concept of acids-bases & buffers, behavior of amino acids as buffers, Henderson- Hasselbalch equation, Biological buffering system. Principle of osmosis- Electro endosmosis, Donan- membrane equilibrium & its biological applications.

UNIT-II

Centrifugation- Basic principle of sedimentation, centrifuge and its uses. Preparative & analytical centrifugation and their application in biochemistry.

Electrophoresis-General principle, factors affecting electrophoretic mobility, moving boundary & zonal electrophoresis, paper & gel electrophoresis, isoelectric focusing.

UNIT-III

Thermodynamics- Open, closed & isolated system, first & second laws of thermodynamics and their applications in living organisms. Molecular basis of entropy, Helmholtz & Gibbs free energy, equilibrium constant. Chemical potential, Phosphate group transfer potential coupled reactions.

UNIT-IV

Chromatography- General principle of partition, absorption, paper, column, thin layer, ion exchange & gas chromatography (GLC, GSC). Affinity & high performance liquid chromatography (HPLC) & Gel filtration chromatography.

UNIT – V

Spectroscopic techniques- Basic concepts of spectroscopy, General principle of NMR, ESR, UV, IR & Visible spectrophotometers Single beam and Double beam, Nanodrop spectrophotometer .

Books Suggested

1. Analytical Biochemistry by Holme, D. J. & Peck, H.
2. Biochemical calculation by Segel.

3. Introduction to Protein Architecture: The structural biology of proteins by Lesk, A. M.
4. Modern Experimental Biochemistry by Boyer, R.
5. Biochemistry by Todd, W. B., Mason, M., Bruggen, R. V. & Macmillan
6. Wilson.K.AndWalker.J.Pub:CambridgePress2.PhysicalBiochemistry-Friefelder,Publisher D.W.H.FreemanPress.
7. Biophysical Chemistry:Principles and Techniques, 2nd edition by A.Upadhyay, K. Upadhyayand N.Nath. Himalaya Publishing House.

COURSE OUTCOMES

- To understand the concepts of preparation of buffers, molarity, normality, ionization, molality.
- The understanding of different types of chemical bonding, molecular machinery of living cells, principles that govern the structures of macromolecules and their participation in living system.

- To identify with the classification and structural properties of carbohydrates, proteins, nucleic acids and lipids, glycoproteins and glycolipids and their significance in biological systems.
- By the end of the course, the students will be able to demonstrate advanced knowledge and understanding of aspects of physical and chemical properties of aqueous solutions, concepts of free energy.

Semester-I

Practicals

BCH-104: Advanced Techniques in Biochemistry

1. Determination of absorption spectrum of any given sample based on Beer Lambert's Law.
2. Quantitative detection of glucose by Oxidase - peroxidase method.
3. Qualitative and quantitative estimation of fructose by Seliwanoff's method.
4. Determination of Protein by the application of Biurett method.
5. Estimation of Cholesterol in the given sample by Zak's ferric chlorides method.
6. Estimation of different amino acid by the application of Ninhydrin method.
7. Separation of sugar & amino acid by paper chromatography.
8. Concentration detection of protein samples from animal and plant origin by the use of UV Spectros
9. Human/Plant sample fractionation or separation by applying the technique (centrifugation).
10. Demonstration of Electrophoresis, PAGE and others with the use of various samples.

M.Sc. BIOCHEMISTRY

Semester-II

Paper-I

BCH-201: Enzymes & Clinical Biochemistry

COURSE OBJECTIVES

- To study classification and basic structural properties of enzyme
- Detailed study on mechanical and kinetics properties of enzyme including various models of kinetics and various types of inhibition
- To acquire a detail knowledge of mechanism of enzyme action, regulation and allostery in enzyme
- To develop an understating on application and technological aspects of commercial valuable enzyme.

UNIT-I

Nomenclature and classification of enzymes, Factors affecting the rate of enzyme catalyzed reactions, Michaelis-Menten concept of uni-substrate reaction, Enzyme turnover and its significance, concept of Bi and multisubtrate reaction classification and examples, Ping-pong and ordered bi-bi mechanism.

UNIT-II

Co-enzyme and cofactors, Metallo enzymes, protein-ligand binding, cooperativity, Hill equation and plot, immobilized enzymes and their industrial applications. Multi enzyme and allosteric enzymes, mechanism of action and regulatior of pyruvate dehydrogenase and fatty acid synthetase complexes, symmetrical and sequential models for action of allosteric enzymes and their significance.

UNIT-III

Disorders of Blood: Complete blood count (CBC), Bleeding time, Clotting time, Hemoglobinopathies, Thalassemia's & anemias, Prothrombin Time.

Liver Function Tests: Van den Bergh test for bilirubin, urine and fecal urobilinogen, epinephrine test, Detoxification and excretion tests, Determination of blood ammonia.
Kidney Function Tests: Urea clearance test, Creatinine clearance test, renal plasma flow, Concentration and dilution test, Function tests of pancreases.

Unit -IV
Disorders of Carbohydrates Metabolism: Diabetes mellitus, HbA1c,, various types of glucose tolerance tests.

Disorders of Lipids: Hypoliproteinemia, Hyperlipoproteinemia, Atherosclerosis,

Diagnostic tests for HDL - cholesterol, LDL - cholesterol and triglycerides. Fatty liver, Ketone bodies.

UNIT-V

Enzymes in different diagnosis of disease & their clinical significance: Serum Aspartate aminotransferase, alanine aminotransferase, creatine kinase, gamma glutamyl transpeptidase, alkaline phosphatase.

COURSE OUTCOMES

- Students will be prepared for theoretically & practically to understand properties of enzyme.
- Enzymes are functional and its role in living system is unique.

- To understand ability to difference between a chemical catalyst and biocatalyst along with concept of enzymes-substrate kinetics and its importance in biological reactions.
- Advanced understanding and knowledge of theoretical and practical aspects of blood biochemistry and its components.
- Connection of blood to entire organ system of body in single circulatory channel and consequences of environmental and genetic factors of blood disorders.
- Rationale and theoretical basis for methods and tools used in the diagnosis of common biochemical disorders.

Semester-II

Practicals

BCH-202 : Enzymes & Clinical Biochemistry

1. Determination of enzyme activity in various human samples such as saliva, blood, urine etc.
2. Learn to isolate a specific enzyme from a given biological sample
3. Quantitative estimation test of various important minerals.
4. Determination of Temperature curve, pH curve, substrate curve of amylase.
5. Finding the specific activity and staining of amylase
6. Determination of BMR, Waist and Hip ratio, BMI

7. Estimation of Hemoglobin, Bleeding time & Clotting time
8. Total counting of Red Blood Cells & White Blood Cells by using appropriate stains and method.
9. Preparation of differential smear for differential blood cells count.
10. Identification of different blood groups & blood typing.
11. Determination of activity of SGOT and SGPT

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Semester-II

Paper-II

BCH-203 : Biostatistics & Bionformatics

COURSE OBJECTIVE

- Detailed understanding of genome projects, related disciplines of Bioinformatics use of Databases and Tools in Biological Discovery, Major Bioinformatics Resources.

- To gain detail on biological databases like primary sequence databases, protein three dimensional databases, Protein Structure Mathematical model databases, PCR and quantitative PCR primer databases, Chemical Databases, Drug & Drug Target /Therapeutic Target Databases, Disease databases, Immunological database.

- In depth study of various types of tools including sequence submission tools, Chemical molecule designing software, Protein & Chemical molecule visualization tools,

UNIT– I

Introduction to Biostatistics, applications, Methods of sampling, tabulation of data, its diagrammatic a graphical representation. Measurement of central tendency – mean, mode, median and average.

UNIT– II

Measures of dispersion, variance and standard deviation, mean deviation, standard error, Range, Coefficient of variation.

Correlation and Regression analysis, correlation and regression coefficients, linear regression and regression equation,

UNIT– II

Probability – Meaning, Basic concepts, and properties of probability, Probability Distribution, frequency distribution.
t- test and types of significance, chi-square test and analysis of variance. Design of experiment, randomization, replication, local control, complementary randomized block design. Factor analysis, path analysis.

UNIT IV

introduction to computer fundamentals, storage of data, operating system, concept of hardware and software and general operating commands (MS-DOS, MSWORD, Excel, PowerPoint), Introduction to internet and its application, introduction to bioinformatics: Introduction to MEDLINE on PubMed system for accessing biological information,

UNIT-V

Ethics in Biological Research, Core ethical principles, Practical applications in Biological Research, Importance of ethics, Regulations and guidelines in research, Publication and research writing ethics, Research data and its open access, Scientific Conduct and integrity.

Books Suggested

1. Fundamentals of Biostatistics by Bernard Rosner 5th Ed.
2. Bioinformatics Methods and Applications by Rastogi, S.C.
3. Bioinformatics for Dummies by Jean-Michel Claverie.
4. Textbook of bioinformatics by Subramaniam, C.
5. Introductory Biostatistics by Chap T. Le.
6. Fundamentals of Biostatistics by Bernard Rosner.
7. Review & Research papers from Bioinformatics & related Journals.
8. Arthur M. Lesk, Introduction to Bioinformatics, Oxford University Press, 2008.
9. David W. Mount, Bioinformatics- Sequence and Genome analysis, 2004.

COURSE OUTCOMES

- Students will choose appropriate experimental strategy for research in basic and applied biostatistics.
- Explanation and integration of biostatistics principles and its applications to basic and applied biology.
- Students will gain *in silico* training on data mining, database searching, software application, quantitative analysis and interpretation, molecular modeling, QSAR and various DNA, RNA and Protein analytical tools.
- Moreover, this paper enables students to acquire the knowledge of statistical analysis and its principles.

Semester-II

Practicals

BCH-204 : Statistics in Biochemistry

1. Learn to enter the given numbers in columns according to their frequency distribution and making MS-Excel worksheet for the same
2. Find out the probability of a given in data and also event / trial analysis
3. For a given sample which method of central tendency is used and why ?
4. Finding the mean deviation and standard deviation of the given data
5. Calculation of Mean and Variance of the given frequency distribution.
6. Application of student's t-test in the given population
7. Application of various biological softwares and use of internet, webnet in the clinical research
8. Learn to calculate the variance and co-variance in a given biological sample.
9. To prepare the given topic in the form of a research article/research paper using various application softwares.