

SYLLABUS

B.Sc. (Honours) - Biochemistry (4th Semester)

Three/Four Years Undergraduate Degree Course [CBCS Semester Mode]

[As per the "Guidelines for Multiple Entry and Exit in Academic Programmes offered in Higher Education Institutions" issued by UGC New Delhi under NEP 2020]

Session: 2022-26

**SCHOOL OF STUDIES IN BIOCHEMISTRY
JIWAJI UNIVERSITY
GWALIOR - 474 011 (MP)**

Mujamal
velivivadam
CS

Jiwaji University, Gwalior
B.Sc. (Hons) Biochemistry 2021-25

Course Structure and Scheme of Examination

FOURTH SEMESTER (Examination June 2024)

Course Code	Course Name	Total Marks	Credit	End Sem Exam Marks		Sessional Marks	
				MAX	MIN	MAX	MIN
BCH CC-VII-T (Major Course)	Molecular Biology (Theory)	100	4	60	21	40	14
BCH CC-VIII-T (Minor Course)	Human Physiology (Theory)	100	4	60	21	40	14
BCH CC-VII-P (Major Course)	Molecular Biology-Lab	100	2	60	21	40	14
BCH CC-VIII-P (Minor Course)	Human Physiology-Lab	100	2	60	21	40	14
GE-IV-T	Chemistry-II (Chemical Energetics, Equilibria & Functional Organic Chemistry)	100	4	60	21	40	14
SEC-II-T	Clinical Biochemistry (Theory)	100	4	60	21	40	14
	Grand Total		20				

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B.Sc. [Honors] Biochemistry [CBCS Structure]

Courses (BCH CC – VII to VIII, GE – IV & SEC – II)

BCH CC – VII – T: Molecular Biology (Theory)

BCH CC – VIII – T: Human Physiology (Theory)

BCH CC – VII – P: Molecular Biology – Lab (Practical)

BCH CC – VIII – P: Human Physiology – Lab (Practical)

GE – IV – T: Chemistry – II (Theory)

(Chemical Energetics, Equilibria & Functional Organic Chemistry)

SEC – II – T: Clinical Biochemistry (Theory)

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B.Sc. [Honors] Biochemistry [CBCS Structure]

Core Courses (BCH CC – VII to VIII)

BCH CC – VII – T: Molecular Biology (Theory)

BCH CC – VIII – T: Human Physiology (Theory)

BCH CC – VII – P: Molecular Biology – Lab (Practical)

BCH CC – VIII – P: Human Physiology – Lab (Practical)

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BCH CC – VII – T: MOLECULAR BIOLOGY (THEORY)

Total Hrs: 60

Credit: 4

UNIT-I Structure of DNA, Genes and Genomic Organization

1. DNA structure, features of the double helix, various forms of DNA
2. Denaturation and reassociation of DNA
3. Genome sequence and chromosome diversity, definition of a gene, organization of genes in viruses, bacteria, animals and plants.
4. Nucleosome structure and packaging of DNA into higher order structures.

UNIT-II Replication of DNA in prokaryotes

1. The chemistry of DNA synthesis
2. DNA polymerase, the replication fork, origin of replication, enzymes and proteins in DNA replication
3. Various modes of replication, stages of replication of *E. coli* chromosome
4. Regulation of DNA Replication

UNIT-III Replication of DNA in eukaryotes and Inhibitors of Replication

1. Replication in eukaryotes.
2. Comparison of replication in prokaryotes and eukaryotes.
3. Inhibitors of DNA replication and applications in medicine.
4. Supercoiling of DNA and its importance
5. Topoisomerases: Types, inhibitors and applications in medicine.

UNIT-IV Recombination and transposition of DNA

1. Homologous recombination, proteins and enzymes in recombination
2. Site-specific recombination, serine and tyrosine recombinases
3. Biological roles of site-specific recombination, transposition
4. Transposable elements: Types, properties and importance

UNIT-V Molecular basis of mutations and Repair

1. Importance of mutations in evolution of species. Types of mutations - transition, transversions, frame shift mutations
2. Mutations induced by chemicals, radiation, transposable elements
3. Ames test.
4. DNA damage & repair

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BCH CC – VII – P: MOLECULAR BIOLOGY – LAB (PRACTICAL)

Total Hrs: 30

Credit: 2

1. Determination of DNA by diphenylamine reaction
2. Determination of RNA by means of orcinol reaction
3. Measurement of the Absorption spectrum of DNA
4. Determination of DNA and RNA concentration by measuring A_{260} .
5. Determination of the melting temperature and GC content of DNA.
6. To study the viscosity of DNA solutions.

SUGGESTED READINGS

1. Lewin's Genes XII (2017) 12th Edition, Krebs, J.E., Goldstein, E.S. & Kilpatrick, S.T., Jones and Bartlett Publishers, Inc. USA, ISBN-10: 1284104494
2. Molecular Biology of the Gene (2008) 6th ed., Watson, J.D., Baker, T.A., Bell, S.P., Gann, A., Levine, M. and Losick, R., Cold Spring Harbor Laboratory Press, Cold Spring Harbor (New York), ISBN:0-321-50781 / ISBN:978-0-321-50781-5.
3. Lehninger: Principles of Biochemistry (2013) 6th ed., Nelson, D.L. and Cox, M.M., W. H. Freeman & Company (New York), ISBN:13: 978-1-4292-3414-6 / ISBN:10-14641-0962- 1.
4. Principles of Genetics (2010) 5th ed., Snustad, D.P. and Simmons, M.J., John Wiley & Sons Asia, ISBN:978-0-470-39842-5.

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BCH CC – VIII – T: HUMAN PHYSIOLOGY (THEORY)

Total Hrs: 60

Credit: 4

UNIT-I Homeostasis and the organization of body fluid compartments & Cardiovascular Physiology

1. Intracellular, extracellular and interstitial fluid. Homeostasis, control system and their components.
2. Plasma, RBC, mechanism of blood coagulation, role of vitamin K in coagulation,
3. Anticoagulant and fibrinolytic systems. Anemias, polycythemia, haemophilia and thrombosis.
4. Pressure, flow and resistance. Anatomy of heart.
5. Physiology of the cardiac muscle, automaticity of the cardiac muscle contraction, excitation contraction coupling. The arterial system, venous system, the microcirculation and mechanics of capillary fluid exchange. Control of blood flow to the tissues.

UNIT-II Respiration and Renal physiology

1. Organization of the pulmonary system.
2. Mechanism of respiration, pulmonary ventilation and related volumes, pulmonary circulation.
3. Principles of gas exchange and transport. Regulation of respiration.
4. Anatomy of the kidney and the nephron, Regulation of renal blood flow, Bowmans' capsule, glomerular filtration and GFR. Regulation of ECF electrolyte and water content, renal and pulmonary control of blood pH.

UNIT-III Gastrointestinal and hepatic physiology and Musculoskeleton System

1. Histology of the gastrointestinal tract.
2. Propulsion and motility of food and digested material. Enteric reflexes, secretory functions of the gastrointestinal tract, digestion and absorption of macro and micronutrients.
3. Anatomy of the hepatic lobule and blood flow into the liver. Formation and secretion of bile. Liver function tests. Jaundice, liver cirrhosis and fatty liver.
4. Bone structure and formation, Physiology of muscle contraction.

UNIT-IV Reproductive physiology

1. Sex determination and differentiation.
2. Development of male genital tracts. Spermatogenesis, capacitation and transport of sperm, blood testis barrier.
3. Development of female genital tracts. Ovarian function and its control. Uterine changes, fertilization and implantation.
4. Placenta, gestation and parturition.

UNIT-V Neurochemistry and neurophysiology

1. Central Nervous system. Peripheral Nervous system.
2. Blood brain barrier
3. Synaptic transmission. Neurotransmitters.
4. Somatic sensation, EEG, sleep, coma, learning and memory.

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BCH CC – VIII – P: HUMAN PHYSIOLOGY – LAB (PRACTICAL)

Total Hrs: 30

Credit: 2

1. Hematology
 - a. RBC and WBC counting
 - b. Differential leucocyte count.
 - c. Clotting time.
2. Determination of haemoglobin content.
3. Separation of plasma proteins.
4. Determination of total iron binding capacity.
5. Pulmonary function tests, spirometry and measurement of blood pressure.
6. Histology of connective tissue, liver and/ brain permanent slides.

SUGGESTED READINGS

1. Vander's Human Physiology (2008) 11th ed., Widmaier, E.P., Raff, H. and Strang, K.T., McGraw Hill International Publications (New York), ISBN: 978-0-07-128366-3.
2. Harper's Biochemistry (2012) 29th ed., Murray, R.K., Granner, D.K., Mayes and P.A., Rodwell, V.W., Lange Medical Books/McGraw Hill. ISBN:978-0-07-176-576-3.
3. Textbook of Medical Physiology (2011) 10th ed., Guyton, A.C. and Hall, J.E., Reed Elseviers India Pvt. Ltd. (New Delhi). ISBN: 978-1-4160-4574-8.
4. Fundamental of Anatomy and Physiology (2009), 8th ed., Martini, F.H. and Nath, J.L., Pearson Publications (San Francisco), ISBN: 10:0-321-53910-9 / ISBN: 13: 978-0321-53910-6.

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B.Sc. [Honors] Biochemistry [CBCS Structure]

Generic Electives Course (GE – IV – T)

Chemistry – II – T: Chemical Energetics, Equilibria & Functional Organic Chemistry (Theory)

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Generic Elective – IV – T (Theory)

Chemistry – II – T: Chemical Energetics, Equilibria & Functional Organic Chemistry (Theory)

[Theory Course is offered by School of Studies in Chemistry]

Total Hrs: 60

Credit: 4

UNIT-I Chemical Energetics

1. Review of thermodynamics and the Laws of Thermodynamics. Important principles and definitions of thermochemistry.
2. Concept of standard state and standard enthalpies of formations, integral and differential enthalpies of solution and dilution.
3. Calculation of bond energy, bond dissociation energy and resonance energy from thermochemical data. Variation of enthalpy of a reaction with temperature – Kirchoff's equation. Statement of Third Law of thermodynamics and calculation of absolute entropies of substances.
4. Chemical Equilibrium: Free energy change in a chemical reaction.

UNIT-II Chemical and Ionic Equilibrium

1. Thermodynamic derivation of the law of chemical equilibrium. Distinction between ΔG and ΔG° , Le Chatelier's principle.
2. Relationships between K_p , K_c and K_x for reactions involving ideal gases. (8 Lectures)
3. Ionic Equilibria: Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization
4. Ionization constant and ionic product of water.


UNIT-III Acid, Base, Buffers and Aromatic hydrocarbons

1. Ionization of weak acids and bases, pH scale, common ion effect. Salt hydrolysis- calculation of hydrolysis constant, degree of hydrolysis and pH for different salts.
2. Buffer solutions. Solubility and solubility product of sparingly soluble salts – applications of solubility product principle.
3. Functional group approach for the following reactions to be studied in context to their structure. Aromatic hydrocarbons Preparation (Case benzene): from phenol, by decarboxylation, from acetylene, from benzene sulphonic acid.

UNIT-IV Chemical Reactions, Alkyl and Aryl Halides

1. Reactions: (Case benzene): Electrophilic substitution: nitration, halogenation and sulphonation.
2. Friedel-Craft's reaction (alkylation and acylation) (upto 4 carbons on benzene). Side chain oxidation of alkyl benzenes (upto 4 carbons on benzene).
3. Alkyl and Aryl Halides Alkyl Halides (Upto 5 Carbons) Types of Nucleophilic Substitution (S_N1 , S_N2 and S_Ni) reactions. Preparation: from alkenes and alcohols.
4. Reactions: hydrolysis, nitrite & nitro formation, nitrile & isonitrile formation. Williamson's ether synthesis: Elimination vs substitution. Aryl Halides Preparation: (Chloro, bromo and iodo-benzene case): from phenol, Sandmeyer & Gattermann reactions.

*Prepared by
Neha Sivarani*



UNIT-V Reactions of alcohols, phenol, aldehydes and ketones

1. Reactions (Chlorobenzene): Aromatic nucleophilic substitution (replacement by $-OH$ group) and effect of nitro substituent. Benzyne Mechanism: KNH_2/NH_3 (or $NaNH_2/NH_3$).
2. Reactivity and Relative strength of C-Halogen bond in alkyl, allyl, benzyl, vinyl and aryl halides.
3. Alcohols, Phenols and Ethers (Upto 5 Carbons) Alcohols: Preparation: Preparation of 1 $^\circ$, 2 $^\circ$ and 3 $^\circ$ alcohols: using Grignard reagent, Ester hydrolysis, Reduction of aldehydes, ketones, carboxylic acid and esters. Reactions: With sodium, HX (Lucas test), esterification, oxidation (with PCC, alk. $KMnO_4$, acidic dichromate, conc. HNO_3).
4. Phenols: (Phenol case) Preparation: Cumenehydroperoxide method, from diazonium salts. Reactions: Electrophilic substitution: Nitration, halogenation and sulphonation. Reimer-Tiemann Reaction, Gattermann-Koch Reaction, Houben-Hoesch Condensation, Schotten - Baumann Reaction. Ethers (aliphatic and aromatic): Cleavage of ethers with HI.
5. Aldehydes and ketones (aliphatic and aromatic): (Formaldehyde, acetaldehyde, acetone and benzaldehyde) Preparation: from acid chlorides and from nitriles. Reactions - Reaction with HCN, ROH, $NaHSO_3$, NH_2-G derivatives. Iodoform test. Aldol Condensation, Cannizzaro's reaction, Wittig reaction, Benzoin condensation.

SUGGESTED READINGS

1. Graham Solomon, T.W., Fryhle, C.B. & Snyder, S.A. Organic Chemistry, John Wiley & Sons (2014).
2. McMurry, J.E. Fundamentals of Organic Chemistry, 7th Ed. Cengage Learning India Edition, 2013.
3. Sykes, P. A Guidebook to Mechanism in Organic Chemistry, Orient Longman, New Delhi (1988)
4. Finar, I.L. Organic Chemistry (Vol. I & II), E.L.B.S. • Morrison, R.T. & Boyd, R.N. Organic Chemistry, Pearson, 2010.
5. Bahl, A. & Bahl, B.S. Advanced Organic Chemistry, S. Chand, 2010. • Barrow, G.M. Physical Chemistry Tata McGraw-Hill (2007).
6. Castellan, G.W. Physical Chemistry 4th Ed. Narosa (2004).
7. Kotz, J.C., Treichel, P.M. & Townsend, J.R. General Chemistry Cengage Learning India Pvt. Ltd., New Delhi (2009). • Mahan, B.H. University Chemistry 3rd Ed. Narosa (1998).
8. Petrucci, R.H. General Chemistry 5th Ed. Macmillan Publishing Co.: New York (1985).

*My personal
reference*

B.Sc. [Honors] Biochemistry [CBCS Structure]
Skill Enhancement Course – II – Theory (SEC – II – T)

SEC – II – T: Clinical Biochemistry (Theory)

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Skill Enhancement Course – II – Theory

SEC – II – T: Clinical Biochemistry (Theory)

[Theory Course is offered by School of Studies in Biochemistry]

Total Hrs: 60

Credit: 4

UNIT-I Introduction

1. Organization of clinical laboratory, Introduction to instrumentation and automation in clinical biochemistry laboratories
2. Safety regulations and first aid.
3. General comments on specimen collection, types of specimen for biochemical analysis.
4. Precision, accuracy, quality control, precautions and limitations.

Exercises

- Collection of blood and storage.
- Separation and storage of serum.

UNIT-II Evaluation of biochemical changes in diseases

1. Basic hepatic, renal and cardiovascular physiology.
2. Biochemical symptoms associated with disease and their evaluation.
3. Diagnostic biochemical profile.

UNIT-III Assessment of glucose metabolism in blood

1. Clinical significance of variations in blood glucose. Diabetes mellitus.

Exercises

- Estimation of blood glucose by glucose oxidase peroxidase method.

UNIT-IV Lipid profile & Tests for cardiovascular diseases

1. Composition and functions of lipoproteins. Clinical significance of elevated lipoprotein.

Exercises

- Estimation of triglycerides.
- 2. Involvement of enzymes in diagnostics of heart disease including aspartate transaminase, creatine kinase and lactate dehydrogenase.

Exercises

- Estimation of aspartate transaminase.

UNIT-V Liver function tests, Renal function tests and urine analysis

1. Group of liver function tests and their diagnostic significance

Exercises

- Estimation of bilirubin (direct and indirect)

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2. Use of urine strip / dipstick method for urine analysis.

Exercises

- Quantitative determination of serum creatinine and urea.

SUGGESTED READINGS

1. Medical Laboratory Technology - a Procedure Manual for Routine Diagnostic Tests Vol. I (2010), Mukherjee, K.L., Tata McGraw-Hill Publishing Company Limited (New Delhi). ISBN:9780070076594 / ISBN:9780070076631
2. Medical Laboratory Technology - a Procedure Manual for Routine Diagnostic Tests Vol. II (2010), Mukherjee, K.L., Tata McGraw - Hill Publishing Company Ltd. (New Delhi), ISBN: 9780070076648.
3. Medical Biochemistry (2005) 2nd ed., Baynes, J.W. and Dominiczak, M.H., Elsevier Mosby Ltd. (Philadelphia), ISBN:0-7234-3341-0.
4. Experimental Biochemistry: A Student Companion (2005) Rao, B.S. and Deshpande, V., IK International Pvt. Ltd. (New Delhi), ISBN:81-88237-41-8.

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