

Biochemistry

B.Sc. (I - IV Semesters) Syllabus (CBCS)
(w.e.f. 2016 - 2017)



Faculty of Science

PALAMURU UNIVERSITY

Mahabubnagar - 509 001, Telangana

2016

Telangana State Council of Higher Education, Govt. of Telangana
B.Sc., CBCS Common Core Syllabi for all Universities in Telangana (wef 2016-'17)

PROPOSED SCHEME FOR CHOICE BASED CREDIT SYSTEM IN
B.Sc., BIOCHEMISTRY

FIRST YEAR – SEMESTER I				
Code	Course Title	Course Type	HPW	Credits
BS 101	Environmental Studies	AECC 1	2	2
BS 102	English	CC-1A	5	5
BS 103	Second Language	CC-2A	5	5
BS 104	Chemistry of Biomolecules	DSC - 1A	4T+2P=6	4+1=5
BS 105	Optional II	DSC - 2A	4T+2P=6	4+1=5
BS 106	Optional III	DSC - 3A	4T+2P=6	4+1=5
	TOTAL			27
SEMESTER II				
BS 201	Gender Sensitization	AECC 2	2	2
BS 202	English	CC-1B	5	5
BS 203	Second Language	CC-2B	5	5
BS 204	Chemistry of Nucleic acids and Biochemical Techniques	DSC -1B	4T+2P=6	4+1=5
BS 205	Optional II	DSC -2B	4T+2P=6	4+1=5
BS 206	Optional III	DSC -3B	4T+2P=6	4+1=5
	TOTAL			27
SECOND YEAR- SEMESTER III				
BS 301	Computational Biochemistry	SEC -1	2	2
BS 302	English	CC-1C	5	5
BS 303	Second Language	CC-2C	5	5
BS 304	Bioenergetics, Biological oxidation and Enzymology	DSC- 1C	4T+2P=6	4+1=5
BS 305	Optional II	DSC- 2C	4T+2P=6	4+1=5
BS 306	Optional III	DSC- 3C	4T+2P=6	4+1=5
	TOTAL			27
SEMESTER IV				
BS 401	Medical Lab Technology	SEC – 2	2	2
BS 402	English	CC-1D	5	5
BS 403	Second Language	CC-2D	5	5
BS 404	Intermediary Metabolism	DSC- 1D	4T+2P=6	4+1=5
BS 405	Optional II	DSC- 2D	4T+2P=6	4+1=5
BS 406	Optional III	DSC- 3D	4T+2P=6	4+1=5
	TOTAL			27

THIRD YEAR- SEMESTER V				
BS 501	Applied Biochemistry	SEC-3	2	2
BS 502	Physiology and Biochemistry	GE-1	2	2
BS 503	Physiology and Clinical Biochemistry	DSC-1E	3T+2P=5	3+1=4
BS 504	Optional II	DSC-2E	3T+2P=5	3+1=4
BS 505	Optional III	DSC-3E	3T+2P=5	3+1=4
BS 506	A- Molecular Biology	DSE-1E	3T+2P=5	3+1=4
	B- Cell Biology and Genetics			
BS 507	Optional II A/B/C	DSE-2E	3T+2P=5	3+1=4
BS 508	Optional III A/B/C	DSE-3E	3T+2P=5	3+1=4
	TOTAL			28
SEMESTER VI				
BS 601	Mini Project (4 weeks)	SEC- 4	2	2
BS 602	Nutrition in health and disease	GE-2	2	2
BS 603	Nutrition and Immunology	DSC-1F	3T+2P=5	3+1=4
BS 604	Optional II	DSC-2F	3T+2P=5	3+1=4
BS 605	Optional III	DSC-3F	3T+2P=5	3+1=4
BS 606	A- Microbiology and r-DNA technology	DSE-1F	3T+2P=5	3+1=4
	B- Biotechnology			
BS 607	Optional II A/B/C	DSE-2F	3T+2P=5	3+1=4
BS 608	Optional III A/B/C	DSE-3F	3T+2P=5	3+1=4
	TOTAL			28
	TOTAL CREDITS			164

CC- Core Course

AECC- Ability Enhancement Compulsory Course

DSC- Discipline Specific Core

SEC- Skill Enhancement Course

DSE- Discipline Specific Elective

GE- Generic Elective

HPW – Hours per week

SYLLABUS (I - SEMESTER)

BS104 (Theory) Chemistry of Biomolecules

Unit 1:Introduction

Scope of biochemistry

Water as biological solvent

Weak acids and bases

pH, buffers, Biological Buffers, Henderson- Hasselbalch equation.

(Simple numerical problems)

Stereo chemistry with reference to carbohydrates & amino acids.

Unit 2: Carbohydrates

Classification of carbohydrates

Mono saccharide straight chain and ring structures

Reactions of monosaccharides, mutarotation, aminosugars & glycosides

Disaccharides, oligosaccharides & polysaccharides

Storage and structural polysaccharides, glycosaminoglycans and bacterial cell wall polysaccharides.

Unit 3: Lipids

Classification of lipids, essential fatty acids. Reactions & properties of lipids

General properties and structures of neutral fats, waxes, phospholipids

sphingolipids, cholesterol, glycolipids.

Prostaglandins and lipoproteins.

Bio membranes, behavior of amphipathic lipids in water, formation of micelles, bilayers, vesicles, membrane composition and fluid mosaic model.

Unit 4: Amino acids & proteins

Classification, structure, stereochemistry and chemical reactions of amino acids.

Titration curve of glycine & pK values.

Essential, nonessential amino acids and non-protein amino acids.

Peptide bond- Nature and conformation, Naturally occurring peptides – Glutathione, enkephalin.

Outlines of protein classification, structural organization of proteins: primary, secondary, tertiary and quaternary structures (ex. hemoglobin & myoglobin).

General properties of proteins, denaturation and renaturation of proteins.

Determination of amino acid composition of proteins.

BS104 (practical) Qualitative Analysis of biomolecules

Laboratory general safety procedures.

Preparation of standard solutions

Determination of pKa values of amino acids by titration

Preparation of buffers

Qualitative identification of Carbohydrates, Amino acids & Lipids.

SYLLABUS (II - SEMESTER)

BS204 (Theory) Chemistry of Nucleic Acids & Biochemical Techniques

Unit 1:Composition of Nucleic acids

Nature (functions) of nucleic acids.

Structure of purines and pyrimidines.

Nucleosides, nucleotides, DNA & RNA.

Stability and formation of phosphodiesterlinkages, effect of acids, alkali and nucleases.

Photochemical and Spectral characteristics of Nucleic acid.

Unit 2:Structure of nucleic acids

Watson& Crick DNA double helix structure.

Introduction to circular DNA, supercoiling, helix to random coil transition, denaturation of nucleic acids.

Hyper chromic effect, T_m values and their significance.

Reassociation kinetics, cot curves and their significance.

Different types of RNA and their biological functions.

Unit3:Specrophotometric and Centrifugation Techniques.

Colorimetry and spectrophotometry.

Beer-Lamberts law and its limitations.

UV, visible spectra, molar extinction coefficient.

Principle of fluorimetry

Principle and applications of Centrifugation technique in biology

Unit.4 Chromatography techniques

Principle in chromatographic technique.

Application of chromatographic technique in paper chromatography (dimensional), TLC, gel filtration (molecular sieve), ion exchange

Chromatography and affinity chromatography.

BS204 (practical)Quantitative Analysis of Biomolecules

Aminoacid Estimation by Ninhydrin method

Protein Estimation by Folin`s Method

Total Sugar Estimation by Anthrone Method

Total Reducing Sugar Estimation by Dinitrosalicylate

Estimation ofKeto sugar by Roe`s resorcinol Method

SEC - 1**Semester – III: Paper BS 301: COMPUTATIONAL BIOCHEMISTRY
(2 Credits; 2 Hr/week)****Credit-I: Biochemical Data Analysis and Molecular Graphics**

1. Computational Science and Applications of Computers in Biochemistry
2. Biochemical data analysis and Management (Spread sheets and Databases)
3. Internet resources and data retrieval
4. Visualization of Biomolecules by computer graphics
5. Drawing and display of structures.

Credit-II: Dynamics of Computational Biochemistry

1. Databases of Receptor-Biomolecule interactions
2. Study of Enzyme Kinetics
3. Metabolic databases
4. Gene identification, Protein sequence analysis
5. Principles of molecular modelling.

References:

1. An Introduction to Computational Biochemistry by C. Stan Tsai, A JOHN WILEY & SONS, INC., PUBLICATION
2. Computational Biochemistry and Biophysics by Oren M. Becker, Alexander D. MacKerell Jr., Benoit Roux, Masakatsu Watanabe. CRC Press, Taylor & Francis Group.

DSC – 1C
Semester – III: Paper-BS304 (Theory): BIOENERGETICS, BIOLOGICAL OXIDATIONS
AND ENZYMOLOGY
(4 Credits; 4 Hr/week)

Credit- I : Bioenergetics

1. Energy transformations in the living system
2. Free energy, Enthalpy and Entropy concepts.
3. Exergonic and endergonic reactions.
4. High energy compounds.
5. Phosphate group transfer potential.
6. Substrate level phosphorylation.
7. Cytochromes-structure, types and their functions

Credit – II: Biological Oxidations

1. Biological oxidations: Definition, enzymes involved- oxidases, dehydrogenases and oxygenases.
2. Redox reactions. Redox couplers. Reduction potential (ϵ , ϵ_0 , ϵ°). Standard reduction potential (ϵ°) of some biochemically important half reactions.
3. Ultrastructure of mitochondria, Electron transport chain and carriers involved.
4. Oxidative phosphorylation, theories of oxidative phosphorylation- Mitchell's chemiosmotic theory. $F_0 F_1$ - ATPase, Inhibitors of respiratory chain and oxidative phosphorylation, uncouplers.
5. Formation of reactive oxygen species and their disposal through enzymatic reactions.
6. Ultrastructure of chloroplast
7. Cyclic and non-cyclic photophosphorylation.

Credit- III : Introduction to Enzymology

1. Introduction to biocatalysis, differences between chemical and biological catalysis.
2. Nomenclature and classification of enzymes.
3. Definition of holo-enzyme, apo-enzyme, coenzyme, cofactor, Fundamentals of enzyme assay, enzyme units.
4. Methods of Enzyme purification
5. Enzyme specificity. Active site.
6. Principles of energy of activation, transition state.
7. Interaction between enzyme and substrate- lock and key, induced fit models.

Credit – IV: Enzyme Kinetics and Enzyme action

1. Rate of a Reaction – Law of Mass action, Factors affecting the catalysis- substrate concentration, pH, temperature, Time, Enzyme concentration and Product concentration
2. Michaelis - Menten equation for single substrate reaction, significance of K_M and V_{max} .
3. Enzyme inhibition- irreversible and reversible, types of reversible inhibitions- competitive and non-competitive.
4. Outline of mechanism of enzyme action- acid-base catalysis, covalent catalysis, electrostatic catalysis, and metal ion catalysis.
5. Regulation of enzyme activity- allosterism and cooperativity, ATCase as an allosteric enzyme, covalent modulation- covalent phosphorylation of phosphorylase
6. Zymogen activation- activation of trypsinogen and chymotrypsinogen.
7. Isoenzymes (LDH) and Multienzyme complexes (PDH). Ribozyme.

References:

1. Lehninger's Principles of Biochemistry – Nelson.D.L. and Cox.M.M., Freeman & Co.
2. Biochemistry – Berg.J.M., Tymoczko.J.L. and Stryer.L., Freeman & Co.
3. Biochemistry – Voet.D and Voet., J.G., John Wiley & Sons .
4. Textbook of Biochemistry – West.E.S.,Todd.W.R,Mason.H.S..and. Bruggen, J.T.V., Oxford & IBH Publishers.
5. Outlines of Biochemistry – Conn.E.E.,Stumpf.P.K., Bruening, G and Doi.R.H., John Wiley & Sons .
6. Harper's Illustrated Biochemistry – Murray, R.K., Granner.D.K. & Rodwell,V.W., McGraw-Hill
7. Biochemistry-Lippincott's Illustrated Reviews. Champe, P.C. and Harvey, R. A. Lippincott
8. Fundamentals of Biochemistry –Jain, J.L., Jain, S., Jain, N. S. Chand & Co.
9. Biochemistry – Satyanarayana. U and Chakrapani. U, Books & Allied Pvt. Ltd.
10. Fundamentals of Enzymology – Price.N.C.and Stevens.L., Oxford University Press.
11. Understanding Enzymes – Palmer.T., Ellis Harwood.
12. Enzymes – Biochemistry, Biotechnology, Clinical Chemistry – Palmer.T., Affiliated East-West Press

DSC – 1C
Semester – III: Paper-BS304 (Practicals): ENZYMOLOGY
(1 Credits; 2 Hr/week)

1. Assay of salivary α -amylase
2. Assay of β -amylase from sweet potatoes
3. Assay of urease
4. Assay of catalase
5. Assay of phosphatase
6. Determination of optimum temperature and pH for amylase
7. Determination of optimum pH for phosphatase
8. Effect of Substrate concentration of amylase activity

References

1. Experimental Biochemistry-A student companion-Beedu Sashidhar Rao and VijayDeshpande.
2. Laboratory Manual in Biochemistry- Jayaraman, J. Wiley Eastern
3. Enzyme Assays- A practical Approach: Eisenthal, R and Dawson,M.I., IRL Press.
4. Biochemical Methods- Sadasivam,S and Manickyam,A. New Age International Publishers.

SEC - 2**Semester – IV: Paper BS 401: MEDICAL LAB TECHNOLOGY
(2 Credits; 2 Hr/week)****Credit - I: Clinical Laboratory principles and Tests**

1. Basic principles of Clinical Laboratory, Commonly used equipment and their maintenance, Preparation of reagents and Quality control
2. Phlebotomy - Collection, processing, preservation and transportation of various clinical samples
3. Physical and chemical examinations of urine, CSF, Semen,
4. Complete blood picture (CBP)
5. Tests for sickling, osmotic fragility, G6PD enzyme deficiency, Coomb's test, Identification of Blood parasites and Clinical Enzymology

Credit - II: Microbiology and Immunology

1. Histopathology and cytopathology (Preparation of common stains)
2. Microbiology – Basic principles of culture, isolation of bacteria from blood, CSF, tissue, sputum, throat swab, nasal, eye swabs, aural swab, vaginal swab, wound swab, rectal swab, urine, pleural fluid, ascetic fluid, AFB culture
3. Identification of Coci, Corynebacteria, Diptheria, Mycobacteria, Gran negatice bacilli and Gran positive bacilli
4. Techniques of RA factor, VDRL, Widal, Auto Antibodies, Hepatitis, HIV testing and EBV etc
5. Immuno-histochemical staining methods for auto-antibodies and tumour markers.

References:

1. Fischbach, 2005. Manual of lab and diagnostic tests, Lippincott Williams Wilkins, New York.
2. Gradwohls, 2000. Clinical laboratory methods and diagnosis. (ed) Ales C. Sonnenwirth and leonard jarret, M.D.B.I., New Delhi.
3. J Ochei and Kolhatkar, 2002. Medical laboratory science theory and practice, Tata McGraw-Hill, New Delhi.
4. Kanai L. Mukherjee, 2007, Medical laboratory technology Vol.1.Tata McGraw Hill

DSC – 1 D**Semester – IV: Paper-BS 404 (Theory): INTERMEDIARY METABOLISM
(4 Credits; 4 Hr/week)****Credit-I : Amino acid Metabolism**

1. General reactions of amino acid metabolism- transamination, decarboxylation and deamination
2. Urea cycle and regulation
3. Catabolism of carbon skeleton of amino acids- glycogenic and ketogenic amino acids.
4. Metabolism of glycine, serine, aspartic acid, methionine, phenylalanine and leucine.
5. Biosynthesis of creatine.
6. Inborn errors of aromatic amino acids
7. Inborn errors of branched chain amino acid metabolism.

Credit- II : Carbohydrate Metabolism

1. Concept of anabolism and catabolism.
2. Glycolytic pathway, energy yield. Fate of pyruvate- formation of lactate and ethanol, Pasteur effect.
3. Citric acid cycle, regulation, energy yield, amphipathic role. Anaplerotic reactions.
4. Glycogenolysis and glycogenesis.
5. Pentose phosphate pathway.
6. Gluconeogenesis.
7. Photosynthesis- Light and Dark reactions, Calvin cycle and C₄ Pathway, CAM Pathway

Credit – III: Lipid Metabolism

1. Catabolism of fatty acids (β - oxidation) with even and odd number of carbon atoms
2. Ketogenesis
3. *de novo* synthesis of fatty acids
4. Elongation of fatty acids in mitochondria and microsomes
5. Biosynthesis and degradation of triacylglycerol
6. Biosynthesis of lecithin.
7. Biosynthesis of cholesterol.

Credit – IV : Nucleic acid Metabolism

1. Biosynthesis of purine and pyrimidine nucleotides, *de novo* and salvage pathways.
2. Regulation of purine and pyrimidine nucleotides
3. Catabolism of purines and pyrimidines.
4. Biosynthesis of deoxyribonucleotides- ribonucleotide reductase and thymidylate synthase and their significance.
5. Disorders of nucleotide metabolism- Gout, Lesch- Nyhan syndrome.
6. Biosynthesis of heme
7. Degradation of heme

References

1. Lehninger's Principles of Biochemistry – Nelson.D.L. and Cox.M.M., Freeman & Co.
2. Biochemistry – Berg.J.M., Tymoczko.J.L. and Stryer.L., Freeman & Co.
3. Biochemistry – Voet.D and Voet., J.G., John Wiley & Sons .
4. Textbook of Biochemistry – West.E.S.,Todd.W.R,Mason.H.S..and. Bruggen, J.T.V., Oxford & IBH Publishers.
5. Principles of Biochemistry: General Aspects-Smith, E. L., Hill, R.L. Lehman, I. R. Lefkowitz, R.J. Handler, P., and White, A. McGraw-Hill
6. Outlines of Biochemistry – Conn.E.E.,Stumpf.P.K., Bruening, G and Doi.R.H., John Wiley & Sons .
7. Harper's Illustrated Biochemistry – Murray, R.K., Granner.D.K. & Rodwell,V.W., McGraw-Hill
8. Bichemistry-Lippincott's Illustrated Reviews. Champe, P.C. and Harvey, R. A. Lippincott
8. Fundamentals of Biochemistry –Jain, J.L., Jain, S., Jain, N. S. Chand & Co.
9. Biochemistry – Satyanarayana. U and Chakrapani. U, Books & Allied Pvt. Ltd.
10. Biochemistry – Rama Rao. A and Ratna Kumari. D, Kalyani Publishers.
11. Biochemistry- The Molecular Basis of Life – McKee. T and McKee, J. R, McGraw-Hill.

DSC – 1 D

**Paper-BS404 (Practicals): BIOCHEMICAL PREPARATIONS AND SEPARATIONS
(1 Credits; 2 Hr/week)**

1. Absorption maxima of colored substances- *p*-Nitrophenol, Methyl orange and KMnO_4 .
2. Absorption spectra of Amino acid – Tyrosine; protein-BSA, nucleic acids- Calf thymus DNA.
3. Isolation of egg albumin from egg white.
4. Isolation of cholesterol from egg yolk.
5. Isolation of starch from potatoes.
6. Isolation of casein from milk.
7. Separation of amino acids by Paper chromatography
8. Separation of Plant pigments by TLC

References

1. Experimental Biochemistry-A student companion-Beedu Sashidhar Rao and VijayDeshpande.
2. Laboratory Manual in Biochemistry- Jayaraman, J. Wiley Eastern