Telangana State Council of Higher Education, Govt. of Telangana
B.Sc., CBCS Common Core Syllabi for all Universities in Telangana (w.e.f. 2019-20)

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

SEMESTER-I				
Code	**Course Type**	**Course Title**	**HPW**	**Credits**
BS 101	AECC 1	Environmental Science	2	2
BS 102	L-1A	English	4	4
BS 103	L-2A	Second Language	4	4
BS 104	**DSC - 1A**	**Chemistry of Biomolecules**	**4T+2P=6**	**4+1=5**
BS 105	DSC - 2A	Optional II	4T+2P=6	4+1=5
BS 106	DSC - 3A	Optional III	4T+2P=6	4+1=5
		TOTAL		**25**
SEMESTER-II				
BS 201	AECC 2	Basic Computer Skills	2	2
BS 202	L-1B	English	4	4
BS 203	L -2B	Second Language	4	4
BS 204	**DSC -1B**	**Chemistry of Nucleic acids and Biochemical Techniques**	**4T+2P=6**	**4+1=5**
BS 205	DSC -2B	Optional II	4T+2P=6	4+1=5
BS 206	DSC -3B	Optional III	4T+2P=6	4+1=5
		TOTAL		**25**
SEMESTER-III				
BS 301	SEC -1	Basics in Biochemical calculations and Biostatistics	2	2
BS 302	SEC - 2			
BS 303	L -1C	English	3	3
BS 304	L -2C	Second Language	3	3
BS 305	**DSC- 1C**	**Bioenergetics, Biological oxidation and Enzymology**	**4T+2P=6**	**4+1=5**
BS 306	DSC- 2C	Optional II	4T+2P=6	4+1=5
BS 307	DSC- 3C	Optional III	4T+2P=6	4+1=5
		TOTAL		**25**
SEMESTER-IV				
BS 401	SEC – 3	Applied and Computational Biochemistry	2	2

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BS 402	SEC – 4			
BS 403	L-1D	English	3	3
BS 404	L-2D	Second Language	3	3
BS 405	**DSC- 1D**	**Intermediary Metabolism**	**4T+2P=6**	**4+1=5**
BS 406	DSC- 2D	Optional II	4T+2P=6	4+1=5
BS 407	DSC- 3D	Optional III	4T+2P=6	4+1=5
		TOTAL		**25**
SEMESTER-V				
BS 501	GE	Physiology and Biochemistry	4T	4
BS 502	L-1E	English	3	3
BS 503	L-2E	Second Language	3	3
BS 504	**DSE-1E**	**A – Physiology, Nutrition and Clinical Biochemistry**	**4T+2P=6**	**4+1=5**
		B - Cell Biology, Genetics and Microbiology		
BS 505	DSE-2E	Optional II A/B	4T+2P=6	4+1=5
BS 506	DSE-3E	Optional III A/B	4T+2P=6	4+1=5
		TOTAL		**25**
	SEMESTER-VI			
BS 601	L-1F	English	3	3
BS 602	L-2F	Second Language	3	3
BS 603	**DSE-1F**	**A - Molecular Biology and Immunology**	**4T+2P=6**	**4+1=5**
		B – r-DNA technology and Biotechnology		
BS 604	DSE-2F	Optional II A/B	4T+2P=6	4+1=5
BS 605	DSE-3F	Optional III A/B	4T+2P=6	4+1=5
BS 606		Optionals (Theory) Biochemistry in Health and Disease	4	4
		TOTAL		**25**
		TOTAL CREDITS		**150**

AECC- Ability Enhancement Compulsory Course
DSC- Discipline Specific Core
SEC- Skill Enhancement Course
DSE- Discipline Specific Elective
GE- Generic Elective
HPW – Hours per week
*Credits under Non-CGPA : i. NSS/NCC/Sports/Extra-curricular – 2 in each year (up to 6)
ii. Summer internship – 2 in each after I & II years (up to 4)

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Semester - I
DSC -1A
Semester – I: Paper-BS104 (Theory): Chemistry of Biomolecules
(4 Credits; 4 Hr/week)

Credit- I: Introduction

1. Scope of Biochemistry
2. Water as biological solvent
3. Weak acids and bases
4. pH and concept of Buffers
5. Biological buffers and their physiological importance
6. Henderson- Hasselbalch equation (Simple numerical problems)
7. Concept of Stereo chemistry with reference to Carbohydrates and Amino acids.

Credit – II: Amino acids & proteins

1. Classification, structure, stereochemistry and chemical reactions of amino acids.
2. Titration curve of glycine & pk values.
3. Essential, nonessential amino acids and non-protein amino acids.
4. Peptide bond- Nature and conformation, Naturally occurring peptides –Glutathione and Brain peptides (Enkephalin)
5. Outlines of protein classification, structural organization of proteins: primary, secondary, tertiary and quaternary structures (ex. hemoglobin & myoglobin)
6. General properties of proteins, denaturation and renaturation of proteins.
7. Determination of amino acid composition of proteins.

Credit - III: Carbohydrates

1. Classification of carbohydrates
2. Monosaccharides : Structures, Fisher and Haworth projections
3. Reactions of monosaccharides, Mutarotation
4. Amino sugars and Glycosides
5. Disaccharides, Oligosaccharides and Polysaccharides
6. Storage and Structural Polysaccharides
7. Glycosaminoglycans and Bacterial cell wall polysaccharides.

Credit – IV: Lipids

1. Classification of lipids, Reactions & properties of lipids
2. Saturated, Unsaturated and Essential fatty acids
3. Structure and functions of Neutral fats, waxes, phospholipids, sphingolipids,
4. Structure and functions of cholesterol and glycolipids.
5. Prostaglandins and lipoproteins.

6. Bio membranes, behavior of amphipathic lipids in water, formation of micelles, bilayers, vesicles, Liposomes
7. Membrane composition and fluid mosaic model.

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. 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.

DSC – 1A
Semester – I: BS 104; Practicals: Qualitative Analysis of Biomolecules
(1 Credits; 2 Hr/week)

1. Laboratory general safety procedures
2. Preparation of standard solutions (Molar, Normal and percent solutions)
3. Determination of pKa values of amino acids by titration (Glycine)
4. Preparation of buffers (Acetate and Phosphate buffers)
5. Qualitative identification of Carbohydrates
6. Qualitative identification of Amino acids
7. Qualitative identification of Lipids

References

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

Semester - II
DSC – 1B
Semester – II: Paper-BS204 (Theory) Chemistry of Nucleic Acids and Biochemical Techniques
(4 Credits; 4 Hr/week)

Credit - I: Composition of Nucleic acids

1. Nature (functions) of nucleic acids.
2. Structure of purines and pyrimidines.
3. Nucleosides and Nucleotides
4. DNA & RNA.
5. Stability and formation of phosphodiester linkages
6. Effect of acids, alkali and nucleases and phosphodiester linkages
7. Photochemical and Spectral characteristics of Nucleic acid.

Credit - II: Structure of nucleic acids

1. Watson& Crick DNA double helix structure.
2. Introduction to circular DNA, supercoiling, helix to random coil transition,
3. denaturation of nucleic acids.
4. Hyperchromic effect
5. Tm values and their significance.
6. Reassociation kinetics, cot curves and their significance.
7. Different types of RNA and their biological functions.

Credit - III: Spectrophotometric and Centrifugation Techniques

1. Colorimetry and spectrophotometry.
2. Beer-Lamberts law and its limitations.
3. UV and Visible spectra
4. Molar extinction coefficient.
5. Principle of fluorimetry
6. Principle of Centrifugation techniques
7. Types of centrifugation and their applications

Credit – IV: Chromatography and Electrophoresis techniques

1. Introduction and principles of chromatographic techniques
2. Paper chromatography and applications
3. Thin layer chromatography and applications
4. Gel filtration (molecular sieve) chromatography
5. Ion exchange Chromatography
6. Affinity chromatography
7. Principle of electrophoresis and applications: Native, SDS-PAGE and Agarose gel electrophoresis

References

1. Biochemistry – Voet.D and Voet., J.G., John Wiley & Sons
2. Textbook of Biochemistry – West.E.S.,Todd.W.R,Mason.H.S..and. Bruggen, J.T.V., Oxford & IBH Publishers.
3. Outlines of Biochemistry – Conn.E.E.,Stumpf.P.K., Bruening, G and Doi.R.H., John Wiley & Sons .
4. Principles and Techniques of Practical Biochemistry- Wilson, K. and Walker, J. Cambridge Press.
5. The Tools of Biochemistry- Cooper, T. G. John Wiley & Sons Press.
6. Physical Biochemistry- Friefelder, D. W.H. Freeman Press.
7. Analytical Biochemistry – Holme.D.J. and Peck.H., Longman.
8. Biophysical Chemistry: Principle and techniques- Upadhyay A, Upadhyay K and Nath. N. Himalaya Publishing House.
9. Experimental Biochemistry- Clark Jr. J.M and Switzer, R. L. Freeman & Co..

DSC – 1B

Semester – II: Paper-BS204; Practicals: Quantitative Analysis of Biomolecules

(1 Credits; 2 Hr/week)

1. Amino acid Estimation by Ninhydrin method
2. Protein Estimation by Biuret
3. Protein estimation by Folin`s Method
4. Estimation of Total Sugars by Anthrone Method
5. Estimation of Total Reducing Sugars by Dinitrosalicylate method
6. Estimation of Keto sugar by Roe`s resorcinol Method
7. Estimation of total sugars by Phenol-sulphuric acid method

References

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

SEMESTER-III

SEC - 1

Semester III- Paper BS 301: BASICS IN BIOCHEMICAL CALCULATIONS AND BIOSTATISTICS
(2 Credits; 2 Hr/week)

Credit-I: Basic Biochemical Calculations

1. Units and measurements
2. Concentration of analyte: Mole, Molarity, Normality and percent solutions
3. Concept of density and specific gravity
4. Enzyme activity, Specific activity and Purity index
5. pH scale and measurement of redox potential
6. Concept of buffers and Buffer preparations
7. Construction of calibration curve and absorption curve (λmax)

Credit-II: Biostatistics

1. Basic statistical concepts: Population, sampling and variables
2. Biostatistics: Measures of central tendency (Mean, Median Mode) :
3. Measurement of dispersion: Standard deviation, standard error, Spread sheets
4. Depiction of data by graphical methods
5. t-Test
6. Regression and Correlation, precision and accuracy
7. ANOVA

References

1. Experimental Biochemistry-A student companion-Beedu Sashidhar Rao and Vijay Deshpande.
2. Laboratory Manual in Biochemistry- Jayaraman, J. Wiley Eastern
3. Enzyme Assays- A practical Approach: Eisenthal, R and Dawson,M.I., IRL Press.
4. Biostatistics – Arora & Malhan, Himalaya Publishing House.

DSC – 1C

Semester – III: Paper-BS305 (Theory): BIOENERGETICS, BIOLOGICAL OXIDATIONS AND ENZYMOLOGY
(4 Credits; 4Hr/week)

Credit- I : Bioenergetics

1. Laws of thermodynamics
2. Energy transformations in the living system
3. Free energy, Enthalpy and Entropy concepts.
4. Exergonic and endergonic reactions.
5. High energy compounds, Substrate level phosphorylation
6. Phosphate group transfer potential.
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_o, ε'_o). Standard reduction potential (ε'_o) of some biochemically important half reactions.
3. Ultrastructure of mitochondria, Electron transport chain (ETC) and carriers involved.
4. Oxidative phosphorylation, theories of oxidative phosphorylation- Mitchell's chemiosmotic theory. F_o F_1- ATPase, Inhibitors of ETC and oxidative phosphorylation, uncouplers.
5. Formation of reactive oxygen species and their disposal through enzymatic reactions.
6. Ultrastructure and functions of chloroplast
7. Cyclic and non-cyclic photophosphorylation.

Credit- III : Introduction to Enzymology

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

Credit – IV: Enzyme Kinetics and Enzyme action

1. Rate of a Reaction – Law of Mass action, Factors affecting the catalysis- substrate concentration, *p*H, 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 co-operatitvity, ATCase as an allosteric enzyme
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. 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. Fundamentals of Enzymology – Price.N.C.andStevens.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-BS305 (Practicals): ENZYMOLOGY
(1 Credits; 2Hr/week)

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

References

1. Experimental Biochemistry-A student companion-BeeduSashidharRao and Vijay Deshpande.
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.

SEMESTER-IV

SEC - 3

Semester – III: Paper BS 401: APPLIED AND COMPUTATIONAL BIOCHEMISTRY (2 Credits; 2 Hr/week)

Credit – I: Enzyme and Protein purification methods

1. Homogenization techniques
2. Centrifugation methods
3. Ammonium sulfate precipitation and Dialysis
4. Column chromatography and determination of molecular weight
5. UV-Vis spectrophotometry
6. Native PAGE
7. SDS-PAGE

Credit-II: Computational Biochemistry

1. Introduction to Computational Science and applications
2. Software packages used in Docking studies
3. Principles of molecular modeling-Drug designing
4. Drug-Biomolecule, Receptor-Biomolecule interactions
5. Applications in Enzyme Kinetics (Km & Vmax)
6. Metabolic databases (KEGG)
7. Gene identification, Protein Data Bank

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.
3. Applied Biochemistry and Bioengineering by Lemuel Wingard, JR., Ephraim Katchalski-Katzir and Leon Goldstein, Academic Press Inc.
4. Protein purification – Principles and practice by Robert K. Scopes, Springer-verlag
5. Protein purification – Principles, High resolution methods and applications by Jan-Christer Janson, Wiley
6. Enzyme purification and related techniques, Vol 22, Nathan KaplanNathan Colowick, Elsevier

DSC – I D

Semester – IV: Paper-BS405 (Theory): INTERMEDIARY METABOLISM

(4 Credits; 4Hr/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. Glycolysis, energy yield. Fate of pyruvate - formation of lactate and ethanol
2. Citric acid cycle, regulation, energy yield, amphipathic role. Anaplerotic reactions.
3. Glycogenolysis and glycogenesis.
4. Pentose phosphate pathway.
5. Gluconeogenesis.
6. Photosytnthesis- Light and Dark reactions, Calvin cycle and C_4 Pathway. CAM Pathway
7. Metabolic disorders of carbohydrates – Galactosemia and Pentosuria

Credit – III: Lipid Metabolism

1. Catabolism of fatty acids (β- oxidation) with even and odd number of carbon atoms, Ketogenesis
2. *de novo*synthesis of fatty acids
3. Elongation of fatty acids in mitochondria and microsomes
4. Biosynthesis and degradation of triacylglycerol
5. Biosynthesis of lecithin.
6. Biosynthesis of cholesterol
7. Metabolic disorders of lipid metabolism – Nieman-pick disease and Fabry's disease

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 RatnaKumari. D, Kalyani Publishers.
11. Biochemistry- The Molecular Basis of Life – McKee. T and McKee, J. R, McGraw-Hill.

DSC – 1 D

Semester – IV: Paper-BS405 (Practicals): BIOCHEMICAL PREPARATIONS AND SEPARATIONS

(1 Credits; 2Hr/week)

1. Isolation of egg albumin from egg white.
2. Isolation of cholesterol from egg yolk.
3. Isolation of starch from potatoes.
4. Isolation of casein from milk.
5. Separation of amino acids by Paper chromatography
6. Separation of Plant pigments by TLC
7. Absorption maxima of colored substances- *p*-Nitrophenol, Methyl orange, BSA and DNA

References

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

Semester - V

GE
Semester – V: Paper – BS 501: Biochemistry and Physiology
(4 Credits; 4 Hr/week)

Credit – I: Biomolecules

1. Water properties, pH and Buffers
2. Carbohydrates – Classification (mono, di, oligo and poly), properties and importance
3. Amino acids – Classification, properties and importance. Structure of proteins.
4. Lipids – Classification, properties and importance
5. Nucleic acids – Purines, Pyrimidines, Nucleosides, Nucleotides. Structure and types of DNA and RNA and denaturation
6. Enzymes – Classification, Factors affecting enzyme activity, Clinically important enzymes (SGOT, SGPT, LDH and CPK)
7. Vitamins (Fat soluble and water soluble) and Trace elements

Credit – II: Metabolism

1. Amino acid metabolism – General reactions, metabolism of aromatic amino acids
2. Carbohydrate metabolism – Glycolysis and TCA cycle
3. Gluconeogenesis and Glycogen metabolism
4. Lipid metabolism - β-oxidation of fatty acids
5. De novo synthesis of fatty acids
6. Nucleic acid metabolism – Synthesis and degradation of purines and pyrimidines
7. Metabolic disorders

Credit – III: Physiology

1. Physiology of digestion
2. Physiology of vision
3. Physiology of muscle
4. Physiology of nerve and mechanism of nerve impulse transmission
5. Composition of blood and blood coagulation
6. Structure of heart and cardiac cycle
7. Factors controlling blood pressure

Credit – IV: Endocrinology

1. Introduction to Endocrinology and Organization of endocrine system
2. Hormones of Hypothalamus
3. Hormones of Pituitary
4. Hormones of Thyroid and Clinical Relevance
5. Hormones of Pancreas and Clinical Relevance
6. Hormones of Adrenal gland
7. Hormones of Gonads

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. Textbook of Biochemistry and Human Biology – Talwar, G.P. and Srivastava. L.M., Printice Hall of India
9. Human Physiology – Chatterjee.C.C, Medical Allied Agency
10. William's Textbook of Endocrinology – Larsen, R. P. Korenberg, H. N. Melmed, S. and Polensky, K. S. Saunders
11. Lehninger's Principles of Biochemistry – Nelson.D.L. and Cox.M.M., Freeman & Co.
12. Biochemistry – Berg.J.M., Tymoczko.J.L. and Stryer.L., Freeman & Co
13. Fundamentals of Biochemistry –Jain, J.L., Jain, S., Jain, N. S. Chand & Co.

DSC – 1 E

Semester – V: Paper-BS 504 A (Theory) : Physiology, Nutrition and Clinical Biochemistry

(4 Credits; 4Hr/week)

Credit-I: Physiology

1. Digestion and absorption of carbohydrates, lipids and proteins
2. Composition of blood and coagulation of blood
3. Hemoglobin and transport of gases in blood (oxygen and CO_2)
4. Heart- structure of the heart, Cardiac cycle, cardiac factors controlling blood pressure
5. Physiology of Vision
6. Muscle- kinds of muscles, structure of myofibril, organization of contractile proteins and mechanism of muscle contraction.
7. Structure of Neuron and propagation of nerve impulse

Credit-II: Endocrinology

1. Endocrinology- organization of endocrine system. Classification of hormones.
2. Mechanism of hormonal action- Steroid and peptide hormones such as adrenaline, glucocorticoids and insulin.
3. Chemistry, physiological role and disorders of hormones of Pituitary, Hypothalamus and Thyroid
4. Chemistry, physiological role and disorders of hormones of Pancreas
5. Chemistry, physiological role and disorders of hormones of Parathyroid
6. Chemistry, physiological role and disorders of hormones of Gonads, Placenta and Adrenals
7. Gastrointestinal hormones and their physiological role

Credit – III: Nutrition

1. Balanced diet. Calorific values of foods and their determination by bomb calorimeter.
2. BMR and factors affecting BMR. Specific dynamic action of foods.
3. Energy requirements and recommended dietary allowance (RDA) for children, adults, pregnant and lactating women.
4. Sources of complete and incomplete proteins. Biological value of proteins. Role of essential fatty acids in human nutrition.
5. Malnutrition- Kwashiorkar, Marasmus and PEM.
6. Vitamins- sources, structure, biochemical roles, deficiency disorders of water and fat soluble vitamins; Bulk and trace elements-Ca, Mg, Fe, I, Cu, Mo, Zn, Se and F.
7. Nutraceuticals; Obesity and starvation.

Credit-IV: Clinical Biochemistry and Organ Function tests

1. Structure and functions of the liver, Liver function tests- conjugated and total bilurubin in serum, albumin: globulin ratio, hippuric acid and bromsulphthalein tests. Serum enzymes in liver diseases- SGPT, GGT and alkaline phosphatase.
2. Kidneys-structure of nephron and Mechanism of urine formation, Normal and abnormal constituents of urine
3. Biological buffers. Role of kidneys in maintaining acid-base and electrolyte balance in the body.
4. Renal function tests- creatinine and urea clearance tests, phenol red test.

5. Biochemical tests for the diagnosis of heart diseases- HDL/LDL cholesterol, SGOT, LDH, CK, C-reactive protein, cardiac troponins.
6. Brain function tests - EEG
7. GI tract test - Endoscopy

References

1. Textbook of Biochemistry and Human Biology – Talwar, G.P. and Srivastava, L.M., Printice Hall of India
2. Review of Medical Physiology-Ganong, McGraw-Hill.
3. Human Physiology – Chatterjee.C.C, Medical Allied Agency
4. Textbook of Medical Physiology – Guyton.A.G and Hall.J.E., Saunders
5. William's Textbook of Endocrinology – Larsen, R. P. Korenberg, H. N. Melmed, S. and Polensky, K. S. Saunders
6. Mammalian Biochemistry- White, A. Handler, P. and Smith, E. L. McGraw-Hill.
7. Textbook of Human Nutrition- Bamji, PralhadRaoand Reddy V. Oxford & IBH Publishers.
8. Foods: Facts & Principle- Shakuntala andShadaksharaswamy. Wiley Ester Press.
9. Essentials of Food and Nutrition – Swaminathan.M. Bangalore Press.
10. Human Nutrition and Dietetics. Davidson, S. and Passmore, J. R. ELBS.
11. A Textbook of Biochemistry: Molecular and Clinical Aspects. Nagini, S. Scitech Publishers.
12. *Tietz* Fundamentals of Clinical Chemistry- Burtis, A. A. and Ashwood, E. R. Saunders-imprint Elsevier Pub.
13. Textbook of Biochemistry with Clinical Correlations – Devlin.T.M.,Wiley – Liss
14. Textbook of Medical Biochemistry – Chatterjea.M.N. and Shinde.R, Jaypee Brothers Medical Publishers.
15. Textbook of Medical Biochemistry- Ramakrishnan, S., Prasannan, K. G. and Rajan, R. Orient Longman
16. Essentials of Food and Nutrition –Swaminathan M. Bangalore Press

DSC – 1E

Semester – V: Paper - BS 504 A (Practicals): Physiology, Nutrition and Clinical Biochemistry

(1 Credits; 2Hr/week)

1. Estimation of hemoglobin in blood, Total count and Differential count – RBC and WBC
2. Urine analysis for albumin, sugars and ketone bodies.
3. Estimation of urinary creatinine.
4. Estimation of total serum cholesterol.
5. Estimation of vitamin C by 2, 6 - DCPIP method.
6. Determination of iodine value of oil.
7. Determination of peroxide value of oil.

References

1. Experimental Biochemistry-A student companion-Beedu Sashidhar Rao and Vijay Deshpande.
2. Laboratory Manual in Biochemistry- Jayaraman, J. Wiley Eastern
3. Biochemical Methods- Sadasivam,S and Manickyam,A. New Age International Publishers

DSC – 1 E

Semester – V: Paper-BS 504 B (Theory): Cell Biology, Genetics and Microbiology

(4 Credits; 4Hr/week)

Credit – I: Cell Biology

1. Cell as basic unit of living organisms; Ultra-structure of prokaryotic cell and eukaryotic cell
2. Composition & functions of cell organelles
3. Cytoskeleton- Microfilaments, Microtubules & Intermediate filaments
4. Chromosome organization in Prokaryotes and Eukaryotes and structure of chromosomes (Polytene and Lamp Brush)
5. Cell cycle
6. Mitosis and Meiosis
7. Cell death – Apoptosis and Necrosis

Credit – II: Genetics

1. Basic concepts of Genetics - Mendel's laws
2. Non-Mendelian inheritance: Extra chromosomal inheritance (*Paramoecium* & *Drosophila*).
3. Partial or incomplete dominance and Co-dominance
4. Maternal inheritance (Coiling in snails, Leber's hereditary optic neuropathy (LHON)).
5. Polygenic inheritance (Introduction to quantitative traits).
6. Sex linked inheritance. X-linked recessive inheritance (colour blindness & Hemophilia). Concept of Autosomal recessive and dominant inheritance
7. Linkage and recombination

Credit – III: Mutations and Mutagens

1. Mutations (spontaneous / induced, somatic / germinal, forward / reverse, transition / transversions)
2. Mutations (Silent, missense, nonsense, and frame shift mutations, conditional, leaky)
3. Detection, selection & isolation of microbial mutants
4. Estimation of mutation rates
5. Reversion and suppression of mutations
6. Mutagens – physical, chemical
7. Transposon mutagenesis, site-directed mutagenesis

Credit – IV : Microbiology

1. Introduction to brief history of microbiology. Classification of microorganisms, Mycoplasma.
2. Motility and sporulation
3. Isolation and cultivation of bacteria. Selective media and enriched media. Gram's staining
4. Bacterial growth curve and kinetics of growth. Batch, continuous and synchronous cultures.
5. Industrial uses of *Aspergillus niger*, yeast and Spirulina.
6. Structure and composition of viruses. One-step growth and determination of plaque forming units (PFU).

7. Viral life cycles – T4 (Lytic), λ phage (lytic and lysogenic), TMV, Retro viruses- HIV.

References

1. Principles of Genetics by Eldon John Gardner, Michael J. Simmons, D. Peter Snustad; John Wiley
2. Modern Genetic Analysis Anthony JF Griffiths, William M Gilbert, Jeffrey H Miller, and Richard C Lewontin. Pub. W. H. Freeman
3. Lewin B. (Ed)(1996) Genes, VII edition, John Wiley and Sons, New York.
4. Cell and Molecular Biology, De Robertis and De Robertis, Lippincott & Wilkins
5. Cell Biology by C. B. Pawar
6. Principles of Genetics by R.H. TamarinMcGrawhill
7. Theory & problems in Genetics by Stansfield, Schaum out line series McGrawhill
8. Textbook of Microbiology – Ananthanarayan, R and JayaramPaniker, C.K., Orient Longman.
9. Microbiology – Prescott.L.M.,Harley.J.P. &Klein.D.A, McGraw-Hill.
10. Microbiology – PelczarJr,.M.J., Chan.E.C.S. and Krieg.N.R., Tata McGraw-Hill.
11. Textbook of Microbiology- Dubey, R. C. and Maheshwari, D. K. S. Chand & Co.

DSE – 1 E

Semester – V: Paper-BS 504 B (Practicals): Cell Biology, Genetics and Microbiology

(1 Credits; 2Hr/week)

1. Preparation of different stages of Mitosis and Meiosis
2. Problems on Monohybrid cross, Problems on dihybrid ratio in *Drosophila*/maize, Linkage and Recombination, Sex linked inheritance and X-linked recessive inheritance
3. Sterilization methods and preparation of culture media, Isolation of pure cultures: (i) Streak plate method (ii) Serial dilution method.
4. Gram staining.
5. Motility of bacteria by hanging drop method.
6. Bacterial growth curve.
7. Antibiotic sensitivity by paper disc method.

References

1. Essential practical handbook of Cell Biology & Genetics, Biometry and Microbiology: A Laboratory Manual by Debarati Das, Academic Publishers
2. Microbiology – A Laboratory manual by Cappuccino and Sherman, Pearson Publications LPE.
3. Experiments in Microbiology, Plant Pathology and Biotechnology by Aneja A. R., New Age Publications

Semester – VI

DSE – 1 F

Semester – VI: Paper-BS 603 A (Theory): Molecular Biology and Immunology
(4 Credits; 4Hr/week)

Credit- I : DNA Replication

1. Experimental evidences to prove DNA as genetic material.
2. Nature and structure of the gene.
3. DNA replication- models of replication, Meselson-Stahl's experimental proof for semi-conservative model.
4. Replication in prokaryotes - DNA polymerases I, II and III of *E.coli*, helicase, topoisomerases, primase, ligase.
5. Bidirectional replication model. Okazaki fragments, leading and lagging strands of DNA synthesis.
6. Replication in Eukaryotes
7. Inhibitors of DNA replication.

Credit- II : Transcription and Translation

1. Transcription - RNA synthesis, RNA polymerases of prokaryotes and eukaryotes
2. Initiation, Elongation and Termination- rho dependent and rho independent.
3. Post-transcriptional modifications and Inhibitors of RNA synthesis.
4. Genetic code, Deciphering of genetic code, Nirenberg's and Khorana's experiments, wobble hypothesis, degeneracy of genetic code.
5. Protein synthesis- structure of t-RNA activation of amino acids (aminoacyl t-RNA synthetases), Ribosome structure
6. Initiation, elongation and termination of protein synthesis. Post- translational modifications and Inhibitors of protein synthesis.
7. Regulation of prokaryotic gene expression- induction and repression. Lac operon

Credit – III: Immunology

1. Organization of immune system.
2. Organs and cells of immune system.
3. Innate and acquired immunity.
4. Cell mediated and humoral immunity (T- and B- cells).
5. Classification of immunoglobulins, structure of IgG. Theories of antibody formation- clonal selection theory.
6. Epitopes / antigenic determinants. Concept of haptens. Adjuvants.
7. Monoclonal antibodies and their applications

Credit – IV: Immunotechnology

1. Antigen-antibody reactions- agglutination, immunoprecipitation, immunodiffusion.
2. Blood group antigens.
3. Immunodiagnostics-RIA, ELISA.

4. Vaccines and their classification, Traditional vaccines
5. Modern vaccines- recombinant and peptide vaccines.
6. Outlines of hypersensitivity reactions.
7. Fundamentals of graft rejection and MHC proteins.

References

1. Molecular Biology of Cell- Alberts, B. Bray, D. Lewis, J. Raff, M. Roberts, K. and Watson, J. D.Garland Publishing.
2. Recombinant DNA and Biotechnology: A Guide for teachers- Helen and Massey. ASM Press.
3. Genes VIII – Lewin. B, Oxford University Press .
4. Molecular Biology- Freifelder. D. Naroasa Pub. House
5. Molecular Biology of the Gene- Watson. J.D., Baker, T.A, Bell, S.P.,Gann.A, Levine, M and Losick.R, Pearson Education.
6. Molecular Biotechnology- Glick, B. R. and Pasternak, J. J. ASM Press
7. Principles of Gene Manipulation: An Introduction to GE- Old, R. V. and Primrose, S. B. Blackwell Sci. Pub.
8. Molecular Cell Biology- Lodish, H., Berk, A., Matsudaira, P., Kaiser, C. A., Krieger, M. Scott M P., Zipursky, S. L. and Darnell, J. Freeman & Co.
9. Immunology. Tizard, I. R. Thomson Press.
10. Kuby Immunology – Kindt.T.J., Goldsby.R.A. and Osborne.B.A., Freeman & Co.
11. Roitt's Essential Immunology – Roitt.I.M. and Delves.P.J., Blackwell Science.

DSE – 1 F

Semester – VI: Paper - BS 603 A (Practicals) : Molecular Biology and Immunology

(1 Credits; 2Hr/week)

1. Isolation of DNA from onion/Plasmids
2. Determination of purity of nucleic acids by UV-spectrophotometric method.
3. Estimation of DNA by diphenylamine method.
4. Estimation of RNA by orcinol method.
5. Electrophoresis of nucleic acids and visualization by ethidium bromide staining.
6. Agglutination: A, B, AB and O blood groups and Rh
7. ODD and Sandwich ELISA

References

1. Experimental Biochemistry-A student companion-Beedu Sashidhar Rao and Vijay Deshpande.
2. Laboratory Manual in Biochemistry- Jayaraman, J. Wiley Eastern
3. Biochemical Methods- Sadasivam,S and Manickyam,A. New Age International Publishers

DSE – 1 F
Semester – VI: Paper-BS 603 B (Theory): r-DNA technology and Biotechnology
(4 Credits; 4Hr/week)

Credit – I: r-DNA technology I

1. Cloning strategies.
2. Tools of r-DNA technology: Enzymes- Restriction endonucleases and ligases
3. Restriction mapping.
4. Polymerase chain reaction- principle and applications
5. Outlines of blotting techniques-Southern, Northern and Western
6. Molecular markers–RFLP,AFLP and RAPD
7. DNA sequencing- Maxam Gilbert and Sanger's methods

Credit – II: r-DNA technology II

1. Construction of c-DNA libraries.
2. Cloning vectors- Plasmids, Cosmids, and λ phages
3. Hosts- *E.coli*
4. Applications of gene cloning- production of insulin
5. Production of human growth hormone
6. Production of *Bt* cotton
7. Edible vaccines.

Credit – III: Plant and Animal Biotechnology

1. Plant tissue culture and its applications
2. Plants as bioreactors and valuable chemical factories (production of bioactive compounds)
3. Transgenic plants, Crop improvement, Production of herbicide and insect resistant plants
4. Genetically modified crops – Arabidopsis, Golden rice, soybeans, Bt cotton, tobacco, potato, papaya, jatropha,
5. Animal cell cultures and its applications.
6. Animal cells as bioreactors. Molecular pharming; Production of vaccines, pharmaceutical proteins, recombinant hemoglobin and blood substituents
7. Transgenic animals

Credit – IV: Microbial and Environmental Biotechnology

1. Microbes as biocontrol agents, Microbial insecticides (Baculoviruses, *Bacillus thurinigiensis* and *Bacillus sphaericus*)
2. Bioremediation, Biodegradation of cellulose and lignocellulose, bio-surfactants and bio-emulsifiers
3. Microbial ore leaching and production of microbial fuels (hydrogen, methane)
4. Renewable and Non-renewable energy sources
5. Strategies involved in Municipal solid waste treatment, Treatment of industrial and domestic effluent (aerobic and anaerobic)
6. Biomaterials as an alternative to non-degradable materials. Heavy Metal Accumulation. Biosorption.
7. Heavy metal tolerance (including mechanism) and its impact on environment

References

1. Principles of Gene Manipulation: An introduction to GE – Old, R. and Primrose, S.B. Blackwell Sci. Pub
2. Molecular Biotechnology Glick, BR and Paternak, JJ. Publish ASM Press
3. Introduction to Biotechnology, William J. Thieman, Michael A. Palladino, Benjamin Cummings Publ
4. Biotechnology- Arora, Himalaya pub. House
5. Introduction to Environmental Biotechnology by A. K. Chatterji, PHI Learning Pvt. Ltd.
6. Animal Cells as Bioreactors - By Terence Gartoright, Cambridge Univ Press
7. Text Book of Biotechnology - By H.K. Das (Wiley Publications)
8. Introduction to Plant Tissue Culture - By M.K. Razdan (Oxford and IBH Publishing Company, New Delhi)
9. Industrial Microbiology by L.E. Casida

DSE – 1 F

Semester – VI: Paper-BS 603 B (Practicals): r-DNA technology and Biotechnology
(1 Credits; 2Hr/week)

1. Restriction mapping: λ-DNA with any two restriction enzymes; strategies of Gene cloning
2. Preparation and transformation of competent cells
3. Preparation of MS medium and initiation of callus, Micropropagation of plants
4. Isolation of microbes from environment (Any source : soil, water, skin, bread, milk)
5. Efficacy testing for bio-fertilizers (nodulation test for rhizobia) and Efficacy testing for bio-pesticides
6. Microbial degradation of organic matter, Municipal solid waste treatment and Waste water treatment
7. Production of hydrogen and methane

References

1. Molecular Cloning (Lab manual) by Maniatis T, Fritsch EF, Sambrook J, Volume –I, CSH
2. Microbial Biotechnology – A Laboratory Manual for bacterial systems by Das, Surajit, Dash, HirakRanjan, Springer-Verlag
3. Plant Tissue Culture by Kalyan Kumar De
4. Biogas Technology by b.T. Nijaguna
5. Biotechnology procedures and experiments handbook by S. Harisha, Infinity Science Press LLC.

Semester IV: Optional Paper in place of Project (Theory)
Biochemistry in health and disease
(4 Credits: 4 hrs/week)

Credit I. Metabolic disorders

1. Amino acid metabolism
2. Phenyketonuria, Alkaptonuria
3. Carbohydrate Metabolism
4. Galactosemia, Pentosuria
5. Nucleic acid metabolism
6. Gout, Lesch-Nyhan syndrome
7. Lipid Metabolism
8. Gaucher's disease, Tay-sachs disease

Credit II. Genetic disorders

1. Introduction to genetic diseases
2. Chromosomal disorders- Down syndrome, Turner syndrome
3. Hemoglobinopathies- Sickle cell anaemia
4. Thalassemia
5. Genetic counselling
6. Pre-natal diagnosis
7. Gene therapy

Credit III. Endocrine disorders

1. Introduction to endocrine disorders
2. Endocrine organs-

a) Pituitary glands
b) Thyroid gland
c) Parathyroid gland
d) Pancreas
e) Ovaries, Testis
f) Adrenal glands

3. Diabetes – Type I & II
4. Thyroidism
5. Polycystic Ovaries
6. Endometriosis
7. Contraceptives
8. Addison's and Cushing syndrome

Credit IV. Molecular Basis of Cancer

1. Chemical Carcinogens
2. Fundamental features of carcinogenesis
3. Oncogenes, Tumor suppressor genes causing cancer
4. Tumor biomarkers in bodily fluids.
5. Mechanism of carcinogenesis
6. New therapies in cancer
7. Epigenetic mechanism in cancer.

References:

1. Voets Principles of Biochemistry V Edition-2016 for Unit I & II.
2. Tietz Fundamentals of Clinical Chemistry-2010 for Unit III.
3. Harpers illustrated Biochemistry for Unit IV.

B.Sc., CBCS for all Universities in Telangana (wef 2019-2020)
B.Sc., BIOCHEMISTRY

MODEL PAPER: THEORY

For I & II Semesters

Duration 3 hours **Max. Marks 80**

Section - A (Short Answer Type)
Answer any eight of the following questions **8 x 4 = 32 Marks**

1. Credit-I
2. ,,
3. ,,
4. Credit-II
5. ,,
6. ,,
7. Credit-III
8. ,,
9. ,,
10. Credit-IV
11. ,,
12. ,,

Section - B (Essay Answer Type)
Answer all Questions 4 x 12 = 48 Marks

9. (a) Credit-I
(OR)
(b) Credit-I

10. (a) Credit-II
(OR)
(b) Credit-II

11. (a) Credit-III
(OR)
(b) Credit-III

12. (a) Credit-IV
(OR)
(b) Credit-IV

B.Sc., CBCS for all Universities in Telangana (wef 2019-2020)
B.Sc., BIOCHEMISTRY

MODEL PAPER PRACTICALS

For I & II Semesters

Duration: 3 hours **Max. Marks 50**

1. Write the Principles for the following experiments (10 Marks)
2. Major Experiment (20 Marks)
3. Minor Experiment (10 Marks)
4. Viva-Voce and Record (10 Marks)

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Osmania University,
HYDERABAD-500 007.