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	SEC	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	SEC	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	SEC	SEC-3	2	2
BS 502	Generic Elective	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	SEC	SEC- 4	2	2
BS 602	Generic Elective	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

DSC – 1A

Semester – I: Paper-BS 104 (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, buffers,
5. Biological Buffers
6. Henderson- Hasselbalch equation (Simple numerical problems)
7. Stereo chemistry with reference to carbohydrates & amino acids.

Credit - II: Carbohydrates

1. Classification of carbohydrates
2. Mono saccharide straight chain and ring structures
3. Reactions of monosaccharides, mutarotation
4. Amino sugars and glycosides
5. Disaccharides, oligosaccharides& polysaccharides
6. Storage and structural polysaccharides, glycosaminoglycan's and
7. Bacterial cell wall polysaccharides.

Credit - III: Lipids

1. Classification of lipids
2. Essential fatty acids
3. Reactions & properties of lipids
4. General properties and structures of neutral fats, waxes, phospholipids, sphingolipids, cholesterol, glycolipids.
5. Prostaglandins and lipoproteins.
6. Bio membranes, behavior of amphipathic lipids in water, formation of micelles, bilayers, vesicles
7. Membrane composition and fluid mosaic model.

Credit – IV: 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, encephalin.
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.

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: Paper-BS 104 (practical): Qualitative Analysis of Biomolecules

(1 Credits; 2 Hr/week)

1. Laboratory general safety procedures
2. Preparation of standard solutions
3. Determination of pKa values of amino acids by titration
4. Preparation of 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

Model paper: Theory

Duration 3 hours Max. Marks 80

Section - A (Short Answer Type)

Answer all Questions 8 x 4 = 32 Marks

1.

2.

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4.

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8.

Section - B (Essay Answer Type)

Answer all Questions 4 x 12 = 48 Marks

9. (A).

(OR)

(B)

10. (A)

(OR)

(B)

11. (A)

(OR)

(B)

12. (A)

(OR)

(B)

Model Paper Practicals (end of semester)

Duration 3 hours **Max. Marks 25**

1. Write the Principles for the following experiments 5 Marks
2. Major Experiment 10 Marks
3. Minor Experiment 5 Marks
4. Viva-Voce and Record 5 Marks

DSC – 1B

Semester – II: Paper-BS 204 (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. Hyper chromic 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 spectra
4. Visible spectra
5. Molar extinction coefficient.
6. Principle of fluorimetry
7. Principle and applications of Centrifugation technique in biology

Credit – IV: Chromatography techniques

1. Principle in chromatographic technique.
2. Application of chromatographic technique in paper chromatography
3. TLC
4. Gel filtration (molecular sieve)
5. Ion exchange Chromatography
6. Affinity chromatography.

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-BS 204 (practical): Quantitative Analysis of Biomolecules

(1 Credits; 2 Hr/week)

1. Amino acid Estimation by Ninhydrin method
2. Protein Estimation by Folin`s Method
3. Total Sugar Estimation by Anthrone Method
4. Total Reducing Sugar Estimation by Dinitrosalicylate
5. Estimation of Keto sugar by Roe`s resorcinol Method

References

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

Model paper: Theory

Duration 3 hours Max. Marks 80

Section - A (Short Answer Type)

Answer all Questions 8 x 4 = 32 Marks

1.

2.

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4.

5.

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8.

Section - B (Essay Answer Type)

Answer all Questions 4 x 12 = 48 Marks

9. (A).

(OR)

(B)

10. (A)

(OR)

(B)

11. (A)

(OR)

(B)

12. (A)

(OR)

(B)

Model Paper Practicals (end of semester)

Duration 3 hours **Max. Marks 25**

1. Write the Principles for the following experiments 5 Marks
2. Major Experiment 10 Marks
3. Minor Experiment 5 Marks
4. Viva-Voce and Record 5 Marks

DSC – 1C

Semester – III: Paper-BS 304 (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_o, ε'_o). Standard reduction potential (ε'_o) 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_o 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, *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 cooperatitvity, 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. 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.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 - BS 304 (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 *p*H for phosphatase
8. Effect of Substrate concentration of amylase activity

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.l., IRL Press.
4. Biochemical Methods- Sadasivam,S and Manickyam,A. New Age International Publishers.

Model paper: Theory

Duration 3 hours Max. Marks 80

Section - A (Short Answer Type)

Answer all Questions 8 x 4 = 32 Marks

1.

2.

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8.

Section - B (Essay Answer Type)

Answer all Questions 4 x 12 = 48 Marks

9. (A).

(OR)

(B)

10. (A)

(OR)

(B)

11. (A)

(OR)

(B)

12. (A)

(OR)

(B)

Model Paper Practicals (end of semester)

Duration 3 hours **Max. Marks 25**

1. Write the Principles for the following experiments 5 Marks
2. Major Experiment 10 Marks
3. Minor Experiment 5 Marks
4. Viva-Voce and Record 5 Marks

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. Photosytnthesis- Light and Dark reactions, Calvin cycle and C_4 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-BS 404 (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 Vijay Deshpande.
2. Laboratory Manual in Biochemistry- Jayaraman, J. Wiley Eastern

Model paper: Theory

Duration 3 hours Max. Marks 80

Section - A (Short Answer Type)

Answer all Questions 8 x 4 = 32 Marks

1.

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8.

Section - B (Essay Answer Type)

Answer all Questions 4 x 12 = 48 Marks

9. (A).

(OR)

(B)

10. (A)

(OR)

(B)

11. (A)

(OR)

(B)

12. (A)

(OR)

(B)

Model Paper Practicals (end of semester)

Duration 3 hours **Max. Marks 25**

1. Write the Principles for the following experiments 5 Marks
2. Major Experiment 10 Marks
3. Minor Experiment 5 Marks
4. Viva-Voce and Record 5 Marks

DSC – 1 E

Semester – V: Paper-BS 503 (Theory) : Physiology and Clinical Biochemistry

(3 Credits; 3 Hr/week)

Credit-1: 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
5. Cardiac cycle, cardiac factors controlling blood pressure.
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-2: Endocrinology

1. Endocrinology- organization of endocrine system. Classification of hormones.
2. Mechanism of hormonal action- signal transduction pathways for 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. Introduction of gastrointestinal hormones.

Credit-3: Organs and Organ Function tests

1. Structure and functions of the liver.
2. 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.
3. Kidneys-structure of nephron and Mechanism of urine formation
4. Normal and abnormal constituents of urine.
5. Biological buffers. Role of kidneys in maintaining acid-base and electrolyte balance in the body.
6. Renal function tests- creatinine and urea clearance tests, phenol red test.
7. Biochemical tests for the diagnosis of heart diseases- HDL/LDL cholesterol, SGOT, LDH, CK, C-reactive protein, cardiac troponins.

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, Pralhad Rao and Reddy V. Oxford & IBH Publishers.
8. Foods: Facts & Principle- Shakuntala and Shadaksharaswamy. 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

DSC – 1E

Semester – V: Paper - BS 503 (Practicals): Physiology and Clinical Biochemistry

(1 Credits; 2 Hr/week)

1. Estimation of hemoglobin in blood.
2. Total count - RBC and WBC. Differential count.
3. Urine analysis for albumin, sugars and ketone bodies.
4. Estimation of urinary creatinine.
5. Estimation of blood urea.
6. Estimation of serum total cholesterol.
7. Determination of serum alkaline phosphatase activity.
8. Determination of SGOT and SGPT activity

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 E
Semester – V: Paper-BS 506 A (Theory): Molecular Biology
(3 Credits; 3 Hr/week)

Credit- I : DNA Replication

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

Credit- II : Transcription

1. Transcription - RNA synthesis, RNA polymerases of prokaryotes.
2. Promoters, Initiation- sigma factors and their recognition sites.
3. Elongation- role of core enzyme.
4. Termination- rho dependent and rho independent. RNA polymerase I, II and III of eukaryotes.
5. Transcriptional events in eukaryotic m-RNA synthesis
6. Post-transcriptional modifications of eukaryotic m-RNA. I
7. Inhibitors of RNA synthesis.

Credit- III : Translation and Regulation of Gene Expression

1. Introduction to protein synthesis- Genetic code, structure of t-RNA
2. Deciphering of genetic code, Nirenberg's and Khorana's experiments, wobble hypothesis, degeneracy of genetic code.
3. Protein synthesis- activation of amino acids (aminoacyl t-RNA synthetases).
4. Ribosome structure. Initiation, elongation and termination of protein synthesis.
5. Post- translational modifications- signal hypothesis.
6. Inhibitors of protein synthesis.
7. Regulation of prokaryotic gene expression- induction and repression. Lac operon, catabolite repression. Tryptophan operon and attenuation.

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.

DSE – 1 E

Semester – V: Paper - BS 506 A (Practicals) : Molecular Biology

(1 Credits; 2 Hr/week)

1. Isolation of DNA from onion/liver/coconut endosperm.
2. Isolation of plasmids
3. Isolation of RNA
4. Determination of purity of nucleic acids by UV-spectrophotometric method.
5. Estimation of DNA by diphenylamine method.
6. Estimation of RNA by orcinol method.
7. Electrophoresis of nucleic acids and visualization by methylene blue staining.
8. Restriction mapping: λ- DNA with any two restriction enzymes.

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 E

Semester – V: Paper-BS 506 B (Theory): Cell Biology and Genetics

(3 Credits; 3 Hr/week)

Credit – I: Cell Biology

1. Cells as basic units of living organisms
2. Composition & functions of cell organelles
3. Cytoskeleton- Microfilaments, Microtubules & Intermediate filaments
4. Ultra structure of prokaryotic cell and eukaryotic cells
5. Chromosome organization in Prokaryotes and Eukaryotes and structure of chromosomes (Polytene and Lamp Brush)
6. Mitosis and meiosis Significance of mitosis and meiosis
7. Cell Cycle and cell death

Credit – II: Genetics

1. Basic concepts of Mendel's experiments – Law of segregation and Law of Independent assortment
2. Partial or incomplete dominance and Co-dominance
3. Non-Mendelian inheritance: Extra chromosomal inheritance (paramecium & drosophila).
4. Maternal inheritance (Coiling in snails, Laber's hereditary optic neuropathy).
5. Linkage and recombination
6. Polygenic inheritance (Introduction to quantitative traits).
7. Sex linked inheritance. X-linked recessive inheritance (colour blindness & Hemophilia)

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

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. Tamarin McGrawhill
7. Theory & problems in Genetics by Stansfield, Schaum out line series McGrawhill

DSE – 1 E

Semester – V: Paper-BS 506 B (Practicals) : Cell Biology and Genetics

(1 Credits; 2 Hr/week)

1. Preparation of different stages of Mitosis
2. Preparation of different stages of Meiosis
3. Types of chromosomes
4. Karyotyping
5. Problems on Monohybrid cross
6. Problems on dihybrid ratio in *Drosophila*/maize
7. Problems on Linkage and Recombination
8. Studies on Sex linked inheritance and X-linked recessive inheritance

References

1. Essential practical handbook of Cell Biology & Genetics, Biometry and Microbiology: A Laboratory Manual by Debarati Das, Academic Publishers

Model paper: Theory

Duration 3 hours Max. Marks 75

Section - A (Short Answer Type)

Answer all Questions 6 x 5 = 30 Marks

1.

2.

3.

4.

5.

6.

Section - B (Essay Answer Type)

Answer all Questions 3 x 15 = 45 Marks

7. (A).

(OR)

(B)

8. (A)

(OR)

(B)

9. (A)

(OR)

(B)

Model Paper Practicals (end of semester)

Duration 3 hours **Max. Marks 25**

1. Write the Principles for the following experiments 5 Marks
2. Major Experiment 10 Marks
3. Minor Experiment 5 Marks
4. Viva-Voce and Record 5 Marks

DSC – 1 F

Semester – VI: Paper-BS 603 (Theory): Nutrition and Immunology

(3 Credits; 3 Hr/week)

Credit – I: 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 – II: 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 – III: Immunotechnology

1. Antigen-antibody reactions- agglutination, immunoprecipitation, immunodiffusion.
2. Blood group antigens.
3. Immunodiagnostics-RIA, ELISA.
4. Vaccines and their classification. Traditional vaccines-live and attenuated, toxoids.
5. Modern vaccines- recombinant and peptide vaccines.
6. Outlines of hypersensitivity reactions.
7. Fundamentals of graft rejection and MHC proteins.

References

1. Essentials of Food and Nutrition –Swaminathan M. Bangalore Press
2. Immunology. Tizard, I. R. Thomson Press.
3. Kuby Immunology – Kindt.T.J., Goldsby.R.A. and Osborne.B.A., Freeman & Co.
4. Roitt's Essential Immunology – Roitt.I.M. and Delves.P.J., Blackwell Science.

DSC – 1 F

Semester – VI: Paper-BS 603 (Practicals): Nutrition and Immunology

(1 Credits; 2 Hr/week)

1. Estimation of calcium by titrimetry
2. Estimation of iron in apple juice by phenanthroline method.
3. Estimation of vitamin C by 2, 6 -dichlorophenol indophenol method.
4. Isolation of total lipids by gravimetric method.
5. Determination of iodine value of an oil.
6. Determination of acid value of an oil.
7. Agglutination: ABO and D Ag typing
8. ODD and ELISA - 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 606 A (Theory): Microbiology and r-DNA Technology

(3 Credits; 3 Hr/week)

Credit – I : Microbiology

1. Introduction to brief history of microbiology. Classification of microorganisms- prokaryotic and eukaryotic microorganisms.
2. Isolation and cultivation of bacteria. Selective media and enriched media.
3. Bacterial growth curve and kinetics of growth. Batch, continuous and synchronous cultures.
4. Gram's staining- Gram positive and Gram negative bacteria, motility and sporulation.
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. Isolation and cultivation of bacterial plaques. Lytic and lysogenic life cycle of λ phage. TMV, Retro viruses- HIV. Prions and Mycoplasma.

Credit – II: r-DNA technology I

1. Outlines of cloning strategies.
2. DNA sequencing- Maxam Gilbert and Sanger's methods.
3. Tools of r-DNA technology: Enzymes- Restriction endonucleases and ligases
4. Restriction mapping.
5. Cloning vectors- Plasmids, Cosmids, and λ phages
6. Hosts- *E.coli*
7. Molecular markers – RFLP, AFLP and RAPD

Credit – III: r-DNA technology II

1. Construction of c-DNA libraries.
2. Polymerase chain reaction- principle and applications.
3. Outlines of blotting techniques-Southern, Northern and Western.
4. Applications of gene cloning- production of insulin
5. Production of human growth hormone
6. Production of Bt cotton
7. Edible vaccines.

References

1. Textbook of Microbiology – Ananthanarayan, R and Jayaram Paniker, C.K., Orient Longman.
2. Microbiology – Prescott.L.M.,Harley.J.P. & Klein.D.A, McGraw-Hill.
3. Microbiology – Pelczar Jr,.M.J., Chan.E.C.S. and Krieg.N.R., Tata McGraw-Hill.
4. Textbook of Microbiology- Dubey, R. C. and Maheshwari, D. K. S. Chand & Co.
5. Principles of Gene Manipulation: An introduction to GE – Old, R. and Primrose, S.B. Blackwell Sci. Pub
6. Molecular Biotechnology Glick, BR and Paternak, JJ. Publish ASM Press

DSE – 1 F

Semester – VI: Paper-BS 606 A (Practicals): Microbiology and r-DNA Technology

(3 Credits; 3 Hr/week)

1. Preparation of culture media and sterilization methods.
2. Isolation of pure cultures: (i) Streak plate method (ii) Serial dilution method.
3. Gram staining.
4. Motility of bacteria by hanging drop method.
5. Bacterial growth curve.
6. Antibiotic sensitivity by paper disc method.
7. Gene cloning (Demonstration only)
8. Preparation and transformation of competent cells

References

1. Molecular Cloning (Lab manual) by Maniatis T, Fritsch EF, Sambrook J, Volume –I, CSH
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

DSE – 1 F
Semester – VI: Paper-BS 606 B (Theory): Biotechnology
(3 Credits; 3 Hr/week)

Credit – I: Plant Biotechnology

1. Plant tissue culture and its applications
2. Plants as bioreactors and valuable chemical factories (production of bioactive compounds)
3. Crop improvement, Production of herbicide and insect resistant plants
4. Plant metabolic engineering
5. Genetic engineering for quality improvement of Protein, lipids, carbohydrates, vitamins & mineral nutrients
6. Marker-assisted selection of qualitative and quantitative traits.
7. Genetically modified crops – Golden rice, soybeans, Bt cotton, tobacco, potato, papaya, jatropha, Arabidopsis

Credit – II: Animal and Microbial Biotechnology

1. Animal cell cultures as bioreactors
2. Usage of animal cell culture for *in vitro* drug testing
3. Molecular pharming; Production of vaccines, pharmaceutical proteins, recombinant hemoglobin and blood substituents
4. Microbes as biocontrol agents
5. Overview of Microbial insecticides (Baculoviruses, *Bacillus thurinigiensis* and *Bacillus sphaericus*)
6. Bioremediation, Biodegradation of cellulose and lignocellulose, biosurfactants and bioemulsifiers
7. Microbial ore leaching and production of microbial fuels (hydrogen, methane)

Credit – III: Environmental Biotechnology

1. Renewable and Non-renewable energy sources
2. Strategies involved in Municipal solid waste treatment
3. Treatment of industrial and domestic effluent,(aerobic and anaerobic)
4. Biomaterials as an alternative to non-degradable materials
5. Microorganisms for Heavy Metal Accumulation
6. Biosorption
7. Heavy metal tolerance (including mechanism) and its impact on environment

References:

1. Introduction to Biotechnology, William J. Thieman, Michael A. Palladino, Benjamin Cummings Publ
2. Biotechnology- Arora, Himalaya pub. House
3. Introduction to Environmental Biotechnology by A. K. Chatterji, PHI Learning Pvt. Ltd.
4. Animal Cells as Bioreactors - By Terence Gartoright, Cambridge Univ Press
5. Text Book of Biotechnology - By H.K. Das (Wiley Publications)
6. Introduction to Plant Tissue Culture - By M.K. Razdan (Oxford and IBH Publishing Company, New Delhi)
7. Industrial Microbiology by L.E. Casida

DSE – 1 F

Semester – VI: Paper-BS 606 B (Practicals): Biotechnology

(1 Credits; 2 Hr/week)

1. Preparation of MS medium and initiation of callus
2. Micropropagation of plants
3. Preparation of animal cell culture media, Cell disaggregation and cell counting
4. Isolation of microbes from environment (soil, water, skin bread, milk)
5. Microbial degradation of organic matter
6. Efficacy testing for biofertilizers (nodulation test for rhizobia) and biopesticides
7. Municipal solid waste treatment and Waste water treatment
8. Production of hydrogen and methane

References

1. Microbial Biotechnology – A Laboratory Manual for bacterial systems by Das, Surajit, Dash, Hirak Ranjan, Springer-Verlag
2. Plant Tissue Culture by Kalyan Kumar De
3. Biogas Technology by b.T. Nijaguna
4. Biotechnology procedures and experiments handbook by S. Harisha, Infinity Science Press LLC.

Model paper: Theory

Duration 3 hours Max. Marks 75

Section - A (Short Answer Type)

Answer all Questions 6 x 5 = 30 Marks

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Section - B (Essay Answer Type)

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(OR)

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Model Paper Practicals (end of semester)

Duration 3 hours **Max. Marks 25**

1. Write the Principles for the following experiments 5 Marks
2. Major Experiment 10 Marks
3. Minor Experiment 5 Marks
4. Viva-Voce and Record 5 Marks