

TUMKUR UNIVERSITY

Undergraduate Biochemistry Syllabus (3 Major system) -2024

Syllabus- Theory and Practical

SEP-2024 Curriculum and credit frame work

UG Programme (Biochemistry)

3 subject with practical

Title of the paper	Contact hrs/week	Exam hours	IA	Marks	Total marks	Credits
First Semester						
Biochemistry-I 1BCDSCT-01 Chemical Foundations of Biological Chemistry-1	4	3	20	80	100	4
Biochemistry Practical- I 1BCDSCP-01 Chemical Foundations of Biological Chemistry-1	4	3	10	40	50	2
Second Semester						
Biochemistry-II 2BCDSCT-02 Chemical Foundations of Biological Chemistry-2	4	3	20	80	100	4
Biochemistry Practical– II 2BCDSCP-02 Chemical Foundations of Biological Chemistry-2	4	3	10	40	50	2
Third Semester						
Biochemistry-III 3BCDSCT-03 Biomolecules and Analytical Techniques-3	4	3	20	80	100	4
Biochemistry Practical– III 3BCDSCP-03 Biomolecules and Analytical Techniques -3	4	3	10	40	50	2
Fourth Semester						
Biochemistry-IV 4BCDSCT-04 Proteins and Enzymology-4	4	3	20	80	100	4
Biochemistry Practical–IV 4BCDSCP-04 Proteins and Enzymology-4	4	3	10	40	50	2
Fifth Semester						
Biochemistry-V 5BCDSCT-5.1 Cell Biology and Endocrinology-5.1	4	3	20	80	100	3
Biochemistry-V 5BCDSCT-5.2 Bioenergetics and Metabolism -5.2	4	3	20	80	100	3
Biochemistry-V 5BCDSCP-5.1 Cell Biology and Metabolism -5.1	4	3	10	40	50	2
Biochemistry Skill 5BCSEC-5 Clinical Biochemistry	2	1.5	10	40	50	1
Sixth Semester						
Biochemistry-VI 6BCDSCT-6.1 Immunology and Cancer Biology -6.1	4	3	20	80	100	3
Biochemistry-VI 6BCDSCT-6.2 Molecular Biology and Genetic Engineering -6.2	4	3	20	80	100	3
Biochemistry-VI 6BCDSCP-6.1 Immunology and Molecular Biology -6.1	4	3	10	40	50	2
Biochemistry Skill -6BCSEC-6 Food Analysis techniques/Dissertation/Field visit	2	1.5	10	40	50	1

B.Sc., Biochemistry Semester-V

Course Code: 5BCDSCT-5.1

Course Title: Cell biology and Endocrinology-5.1 (Theory)

COURSE TITLE	Cell biology and Endocrinology -5.1
COURSE CREDITS	03
TOTAL CONTACT HOURS	48
DURATION OF EXAM	3 Hrs
FORMATIVE ASSESSMENT MARKS	20
SUMMATIVE ASSESSMENT MARKS	80

Course outcomes: By the end of this course, students will be able to explain the structure and functions of cell membranes, analyse key cellular processes, and understand the mechanisms of hormone action and regulation. They will develop an integrated understanding of the relationship between cell biology and endocrine physiology, enabling them to appreciate its significance in maintaining health and understanding disease processes.

Unit-I: Cell, Membrane Transportation and Cell communication

16 hours

Structure of prokaryotic cell and eukaryotic cells- Overview of plant and animal cells, Composition, structure and functions of cell wall and cell membrane, Structure and functions cell organelles. Membrane transport (active and passive), membrane channels, carriers, and transporter. Cell communication- basic concept of anchoring junctions, tight junctions and communication junctions (gap junctions and plasmodesmata); ECM components – proteins, polysaccharides and adhesion proteins. Cell signalling- Types, signal molecules, signal amplification, receptor types and sensing. Cell Cycle -An overview of cell cycle; Components of cell cycle, restriction point, and checkpoints. Mitosis: Prophase, prometaphase, metaphase, anaphase, telophase, and cytokinesis. Meiosis: Phases of meiosis I and meiosis II. Motor proteins- actin and myosin. Intracellular and extra-cellular control of cell division. Types of cell death: Senescence, apoptosis and necrosis.

Unit-II: Introduction to Endocrinology

16 hours

Hormones Introduction- Endocrine systems. Functions of hormones and their regulation. Chemical signalling- endocrine, paracrine, autocrine, intracrine and neuroendocrine mechanisms. Pituitary hormones- functions and targets. Chemical classification of hormones, transport of hormones in the circulation and their half-lives. Hormone mediated signalling. Hormone receptors- extracellular and intracellular. Receptor- hormone binding, Scatchard analysis. G protein coupled receptors, G proteins, second messengers- cAMP, cGMP, IP3, DAG, Ca²⁺, NO. General mechanism of hormone action.

Unit-III: Endocrine Hormones and their Biological Functions

16 hours

Hypothalamic - Study the physiological and biochemical actions of hypothalamic hormones, pituitary hormones- GH, prolactin, TSH, LH, FSH, and POMC. Peptide hormone family- oxytocin and vasopressin.

Feedback regulation cycle. Endocrine disorders- gigantism, acromegaly, dwarfs, pigmies and diabetes insipidus. Thyroid hormone -types and biochemical actions of thyroid hormones and its regulations. Iodine requirement and deficiency of thyroid hormones. Pancreatic and GI tract hormones- insulin, glucagon, gastrin, secretin, CCK, GIP, adipolectin, leptin and ghrelin. Adrenal and gonads hormones- Aldosterone, renin angiotensin system, cortisol, epinephrine and norepinephrine (physiological and biochemical actions and their deficiencies). Stress response. Gonads- types and functions of male and female steroid hormones.

References

1. Lehninger: Principles of Biochemistry (2013) 6th ed., Nelson, D.L. and Cox, M.M. W.H. Freeman & Company (New York), ISBN: 13: 978-1-4641-0962-1 / ISBN: 10-14641-0962- 1.
2. Vander's Human Physiology (2008) 11th ed., Widmaier, E.P., Raff, H. and Strang, K.T. McGraw Hill International Publications, ISBN: 978-0-07-128366-3.
3. Endocrinology (2007) 6th ed., Hadley, M.C. and Levine, J.E. Pearson Education (New Delhi), Inc. ISBN: 978-81-317-2610-5.
4. The Cell: A Molecular Approach (2009) 5th Ed. Cooper, G.M. and Hausman, R.E. ASM Press &
5. Sunderland, (Washington DC), Sinauer Associates. (MA). ISBN: 978-0-87893- 300-6.
6. Human Physiology by C. C. Chatterjee.
7. Biochemistry by Debajyoti Das.
8. Medical Physiology by Guyton and Hall.

FORMATIVE ASSESSMENT	
ASSESSMENT	WEIGHTAGE IN MARKS
CLASS TEST (2 CLASS TEST)	15
ASSIGNMENT/ OPEN DISCUSSION	5
TOTAL	20

Course Code: 5BCDSCT-5.2

Course Title: Bioenergetics and Metabolism-5.2 (Theory)

COURSE TITLE	Bioenergetics and Metabolism-5.2
COURSE CREDITS	03
TOTAL CONTACT HOURS	48
DURATION OF EXAM	3 Hrs
FORMATIVE ASSESSMENT MARKS	20
SUMMATIVE ASSESSMENT MARKS	80

Course Outcome: At the end of the course, students will be able to understand the fundamental concepts of metabolism, the characteristics of metabolic pathways, and the experimental strategies used to study them; describe the major catabolic and anabolic pathways and their regulation; explain the biosynthesis and degradation of amino acids and nucleotides in humans and relate these processes to nutrition and disease; evaluate the significance of inhibitors of nucleotide metabolism as chemotherapeutic agents; and integrate amino acid and nucleotide metabolism with carbohydrate and lipid metabolism to gain a comprehensive understanding of metabolic regulation and homeostasis in health and disease.

Unit–I: Carbohydrate and Lipid Metabolism

(16 Hrs)

Introduction to metabolism: Catabolism, anabolism, and amphibolic pathways. Carbohydrate metabolism: Glycolysis and its regulation, Tricarboxylic acid (TCA) cycle and its regulation, amphibolic and anaplerotic reactions, gluconeogenesis and its regulation, glycogenolysis and its regulation, pentose phosphate pathway (HMP shunt) and its regulation. Fates of pyruvate: conversion of pyruvate to lactate, alcohol, and acetyl-CoA. Cori cycle. Lipid metabolism: Biosynthesis of triacylglycerols. Fatty acid biosynthesis: Acetyl-CoA carboxylase reaction, fatty acid synthase complex, energetics, and regulation of fatty acid biosynthesis. Biosynthesis and regulation of cholesterol. Fatty acid oxidation: Transport of fatty acids, β -oxidation, and energetics. Ketone bodies: Formation during starvation and diabetes, utilization, and significance. Atherosclerosis.

Unit–II: Amino Acid and Nucleic Acid Metabolism

(16 Hrs)

Amino acid metabolism: Deamination, transamination, decarboxylation, urea cycle and its regulation, biosynthesis of amino acids, glycogenic and ketogenic amino acids, biologically active amines, and disorders of amino acid metabolism including phenylketonuria and alkaptonuria. Nucleic acid metabolism: Purine and pyrimidine nucleotide metabolism, recycling of purine and pyrimidine nucleotides through salvage pathways, and disorders of nucleotide metabolism including Lesch–Nyhan syndrome and gout.

Unit–III: Bioenergetics, Cellular Respiration and Photosynthesis

(16 Hrs)

Bioenergetics: First law of thermodynamics, second law of thermodynamics, energy transformations in living systems, concepts of enthalpy, entropy, and free energy. Gibbs free energy, endergonic and exergonic reactions. Standard free energy changes (ΔG , ΔG° and $\Delta G'^\circ$), relationship between equilibrium constant and $\Delta G'^\circ$, feasibility of biochemical reactions, and simple numerical problems. ATP: Structure, properties, and ATP as the energy currency of the cell. High-energy compounds and coupled reactions. Cellular respiration: Electron transport chain, oxidative phosphorylation, P/O ratio and ATP production, outline of

Mitchell's chemiosmotic hypothesis, substrate-level phosphorylation with examples, balance sheet of glucose oxidation, and oxidative stress. Uncouplers and inhibitors of respiration including rotenone, antimycin A, cyanide, and 2,4-dinitrophenol (DNP). Photosynthesis: Light reactions, dark reactions (Calvin cycle), and the C4 pathway of carbon fixation.

References

1. Lehninger- Principles of Biochemistry (2013) by Nelson DL and Cox MM. 6th Edition. Macmillan Publications. ISBN-10. 1464109621.
2. Biochemistry-The chemical reactions of living cells (2003) by David E Metzler. 2nd Edition, Elsevier Academic Press. ISBN-978-0124925403.
3. Principles of Biochemistry (2012) by Voet D, Voet JG and Pratt CW. 4th Edition, John Wiley and Sons Inc, ISBN-10. 9781118092446.
4. Fundamentals of Biochemistry (2005) by J.L. Jain, 6th Edition, published by S. Chand. ISBN-81-219-2453-7.
5. Biochemistry (2010) by Berg JM, Tymoczko JL and Stryer L, 7th Edition, Freeman and company. ISBN-9781429229364
6. Harper's Illustrated Biochemistry (2018) by Weitz M and Boyle PJ. 31st Edition, McGraw-Hill Education ISBN- 978-1-259-83793-7.
7. Wilson and Walker's Principles and Techniques of Biochemistry and Molecular Biology (2018). 8th Edition, Cambridge University Press. ISBN-9781108716987
8. Analytical techniques in Biochemistry and Molecular Biology (2011) by Rajan K. 1st Edition, Springer New York, NY. ISBN- 978-1-4419-9784-5.

FORMATIVE ASSESSMENT	
ASSESSMENT	WEIGHTAGE IN MARKS
CLASS TEST (2 CLASS TEST)	15
ASSIGNMENT/ OPEN DISCUSSION	5
TOTAL	20

Course code: 5BCDSCP-5.1

Course Title: Cell Biology and Metabolism-5.1 (Practical)

COURSE TITLE	Biochemistry particals-5
COURSE CREDITS	02
CONTACT HOURS	4 HOURS/WEEK
DURATION OF EXAM	03
FORMATIVE ASSESSMENT MARKS	10
SUMMATIVE ASSESSMENT MARKS	40

Course Outcome: Upon successful completion of this practical course, students will be able to perform and interpret biochemical, cellular, and endocrine experiments; understand the principles and analysis of major biomolecules; develop skills in laboratory techniques, experimental design, data interpretation, and instrument handling; and apply this knowledge to biochemical research, diagnostics, and the understanding of disease mechanisms.

Cell Biology and Metabolism practical

1. Observation of prokaryotic and eukaryotic cells under a compound microscope.
2. Staining techniques: Gram staining, methylene blue staining of cheek cells.
3. Study of mitosis in onion root tips using squash preparation.
4. Observation of meiosis in grasshopper testis or flower anthers.
5. Demonstration of osmosis using potato osmometer.
6. Demonstration of catalase activity in plant tissues.
7. Estimation of blood glucose levels (glucose oxidase method).
8. **Histology**-Microscopic study of organs (Permanent slides).
9. Estimation of Blood glucose by DNS method.
10. Estimation of Urea by DAMO method.
11. Estimation of Uric acid.
12. Estimation of creatinine by Jaffe's method.
13. Estimation of cholesterol by Zak's method.
14. Estimation of inorganic phosphate by Fiske Subbarow method.
15. Estimation of protein by Lowry's method.
16. Estimation of protein by Biuret method.
17. Estimation of amino acids by ninhydrin method.
18. Isolation of casein from milk.
19. Isolation of lecithin from Egg's yolk.

References:

1. Practical Biochemistry (2011) by Geetha Damodaran, Jaypee publishers, ISBN- 9789350251416.
2. Biochemical Methods (2007) by Sadasivam S and Manickam A. 3rd Edition, New Age International Pvt. Ltd. ISBN-81-224-0976-8.
3. An Introduction to Practical Biochemistry (2017) by David T Plummer. 3rd Edition, McGraw Hill Education, ISBN- 978-0070994874.
4. Analytical techniques in Biochemistry and Molecular Biology (2011) by Rajan K. 1st Edition, Springer New York, NY. ISBN- 978-1-4419-9784-5.
5. Wilson and Walker's Principles and Techniques of Biochemistry and Molecular Biology (2018). 8th Edition, Cambridge University Press. ISBN- 9781108716987.
6. Laboratory Manual in Biochemistry (2011) by Jayaraman J. 1st Edition, John Wiley and Sons Ltd, ISBN- 9780852264287.
7. General Chemistry experiment – Anil J Elias (University press).
8. Vogel textbook of quantitative chemical analysis G.H. Jeffery, J. Basset.
9. Advanced Experimental Chemistry. Vol-I J.N.Gurtu and R Kapoor, S.Chand and Co.
10. Svehla, G. Vogel's Qualitative Inorganic Analysis, Pearson Education, 2012.
11. Practical Biochemistry, Geetha Damodaran, Jaypee, 2011
12. Biochemical methods, S. Sadasivam, A. Manickam, 3rd Ed, New Age Int Pvt Ltd, 2007
13. An Introduction to Practical Biochemistry, David T. Plummer, 3rd edition 2017
14. Laboratory manual in Biochemistry, J. Jayaraman 2011.

FORMATIVE ASSESSMENT	
ASSESSMENT	WEIGHTAGE IN MARKS
RECORD/ VIVA VOCE	5
CONTINUOUS EVALUATION AND CLASS TEST	5
TOTAL	10

Course Code: **5BCSEC-5**

Skill Enhancement Course with Practical Clinical Biochemistry (SEC-Theory)

COURSE TITLE	Clinical Biochemistry- 5.1
COURSE CREDITS	02
TOTAL CONTACT HOURS	15
DURATION OF EXAM	1.5 Hrs
FORMATIVE ASSESSMENT MARKS	10
SUMMATIVE ASSESSMENT MARKS	40

Unit-I: Clinical Biochemistry

15 hours

Normal composition of urine- Volume, pH, color and specific gravity. Chemical analysis and normal values of the constituents-urea, uric acid, creatinine, pigment and their clinical significance. **Abnormal constituents of urine-** glucose, albumin, ketone bodies and bile pigments and their pathological significance. **Blood:** Normal constituents of blood and their variation in pathological conditions- urea, uric acid, creatinine, glucose, bilirubin, total protein, albumin/globulin ratio. Lipid profile- cholesterol, Triglycerides, lipoproteins-HDL and LDL. **Clinical enzymology:** Alkaline phosphatase, SGOT and SGPT. CPK and LDH. **Liver diseases:** Cirrhosis, hepatitis, fatty liver and Jaundice. **Inborn errors of Metabolism:** Phenylketonuria, Alkaptonuria, Albinism, Lesch–Nyhan Syndrome, and Niemann–Pick Disease. **Lifestyle diseases:** Causes, prevention and markers of Cancer, Diabetes mellitus, and Atherosclerosis.

Clinical Biochemistry (Practical)

1. Estimation of bilirubin by Malloy and Evelyn method
2. Estimation of haemoglobin iron by ammonium thiocyanate method.
3. Estimation of serum chloride by Van-Slyke method
4. Separation of serum and plasma from blood.
5. Estimation of serum calcium
6. Qualitative analysis of abnormal constituents of urine.
7. Qualitative analysis of normal (organic and inorganic) constituents of urine.
8. Estimation of antibodies present in serum by Biuret/ Lowry's method.
9. Study of case reports (Visiting diagnostic labs)

References

1. Clinical Dietetics and Nutrition, 2002, Antia FP and Abraham P. Oxford University Press; 4th Edition. ISBN-10: 9780195664157.
2. Oxford Handbook of Nutrition and Dietetics, 2011, Webster-Gandy J, Madden A and Holds worth M. Oxford University Press, Print ISBN-13: 9780199585823.
3. Krause's Food, Nutrition and Diet therapy, 2003, Mahan KL and Escott-Stump S. Elsevier, ISBN: 9780721697840.
4. Human Nutrition and Dietetics. 1986, Passmore R. and Davidson S. Churchill Livingstone Publications, ISBN-10: 0443024863.
5. Rosemary Stanton's Complete Book of Food & Nutrition, 2007, Simon & Schuster Publishers, Australia, ISBN 10: 0731812999
6. Food Science and Nutrition, 2018, Roday S. Oxford University Press Publishers, ISBN: 9780199489084/0199489084.

7. Food Science, 2007, Srilakshmi S. New Age International (P) Limited Publishers, ISBN: 9788122420227/ 8122420222.
8. Human Nutrition and Dietetics. J.S. Garrow, W. Philip T. James, Alan Ralph. Churchill Livingstone Publisher.
9. Modern Nutrition in Health and Disease. Michael G. Wohl, Robert S. Goodhart, Maurice E. Shils. Lea &Febiger Publisher, U.S.A.
10. Mechanism and Theory in Food Chemistry. DWS Wong. Springer Cham Publishers.
11. Advanced Text Book on Food and Nutrition, Vol. I & II. Swaminathan M. The Bangalore Press.
12. Food, Nutrition and Health. Tapsell L. Oxford University Press (2010).
13. Modern Nutrition in Health and Disease. Maurice E. Shils, Moshe Shike. Lippincott Williams & Wilkins, Philadelphia.
14. Practical Biochemistry (2011) by Geetha Damodaran, Jaypee publishers, ISBN- 9789350251416.
15. Biochemical Methods (2007) by Sadasivam S and Manickam A. 3rd Edition, New Age International Pvt Ltd. ISBN-81-224-0976-8.
16. An Introduction to Practical Biochemistry (2017) by David T Plummer. 3rd Edition, McGraw Hill Education, ISBN- 978-0070994874.
17. Analytical techniques in Biochemistry and Molecular Biology (2011) by Rajan K. 1st Edition, Springer New York, NY. ISBN- 978-1-4419-9784-5.
18. Wilson and Walker's Principles and Techniques of Biochemistry and Molecular Biology (2018). 8th Edition, Cambridge University Press. ISBN- 9781108716987.
19. Laboratory Manual in Biochemistry (2011) by Jayaraman J. 1st Edition, John Wiley and Sons Ltd, ISBN- 9780852264287.

FORMATIVE ASSESSMENT	
ASSESSMENT	WEIGHTAGE IN MARKS
CLASS TEST (1 CLASS TEST)	5
ASSIGNMENT/ OPEN DISCUSSION	5
TOTAL	10

B.Sc., Biochemistry Semester-VI

Course Code: 6BCDSCT-6.1

Course Title: Immunology and Cancer Biology-6.1 (Theory)

COURSE TITLE	Immunology and Cancer Biology-6.1
COURSE CREDITS	03
TOTAL CONTACT HOURS	48
DURATION OF EXAM	3 Hrs
FORMATIVE ASSESSMENT MARKS	20
SUMMATIVE ASSESSMENT MARKS	80

Course Outcome: At the end of the course, students will be able to understand the organization and functions of the immune system, including the roles of immune cells, antigens, antibodies, and mechanisms of innate and adaptive immunity; explain the principles underlying immunological tolerance, hypersensitivity, autoimmunity, immunodeficiency disorders, and vaccination; apply knowledge of immunological techniques for the detection, diagnosis, and analysis of biological molecules and immune responses; describe the molecular and cellular basis of cancer, including oncogenes, tumor suppressor genes, carcinogenesis, apoptosis, angiogenesis, and metastasis; evaluate current and emerging strategies for cancer diagnosis, prevention, and treatment; and integrate concepts of immunology and cancer biology to understand disease pathogenesis, therapeutic interventions, and recent advances in biomedical research and personalized medicine.

UNIT -I: Immune System and Immune Cells

16 hours

Organs of the immune system: Anatomy and functions of lymphoid organs and tissues. Haematopoiesis. Cellular components of the immune system- granulocytes- neutrophil, eosinophil, basophil and mast cell. Mononuclear cells- Lymphocytes, Monocytes, Macrophages, NK cells and Dendritic cells. Innate and adaptive immunity, Cellular mediated and humoral immunity. Immunogen (antigen): Concept of epitope (antigenic determinants), and immunogens, factors that influence immunogenicity. Classes of antigen- Epitopes, Haptens. Antibody: Molecular Structure- general features, light and heavy chains, Hyper variable and constant regions. Different isotypes and subtypes of immunoglobulins, Allotypes and idiotypes. Structure, selection, maturation and functions of B and T cells and their types.

UNIT -II: Immunization and Immunological Techniques

16 hours

Tolerance, autoimmunity and hypersensitivity: Organ specific and systemic autoimmune diseases (SCID). Gell and Coombs classification, IgE mediated (Type I) hypersensitivity, antibody mediated cytotoxic (Type II) hypersensitivity, immune complex mediated (type III) hypersensitivity and delayed type (Type IV) hypersensitivity. Immunodeficiency disorder (AIDS). Immunological techniques: Immunogen-immunoglobulin interactions- Precipitin reactions, agglutinin reactions. Precipitin reactions in aqueous solutions, Precipitin reactions in semi-solid medium- single diffusion, double diffusion (Ouchterloney). Immunoelectrophoresis, Radio-immuno assay, fluorescence Immuno assay, ELISA, western blotting,

Hybridoma technology and their application. Immunization: Historical aspects of vaccine development and vaccination. Structure and characteristics of Vaccine. Types of vaccines. Vaccination -Vaccines and their preparations, primary and secondary Response after immunization.

Unit -III: Basic and Applied Cancer Biology

16 hours

Introduction to Cancer- Definition, characteristics of cancer cells, Benign vs malignant tumors, Hallmarks of cancer. Cell Cycle- Checkpoints and their significance. Oncogenes and Tumor Suppressor Genes- Proto-oncogenes and their activation, Examples: Ras, Myc, and Src. Tumor suppressors: p53, Rb, BRCA (any two). Molecular Basis of Carcinogenesis-Mutations, chromosomal abnormalities, Epigenetic changes in cancer. Apoptosis and Cancer- Pathways of programmed cell death, Angiogenesis and Metastasis-angiogenesis (VEGF or HIF). Steps in metastasis: invasion, migration, colonization. Cancer Diagnosis-Histopathology, biomarkers and cytology. Cancer Treatment Strategies-Chemotherapy, radiotherapy, surgery, Targeted therapy (tyrosine kinase inhibitors, monoclonal antibodies). Emerging cancer therapies-CAR-T cells and checkpoint inhibitors. Cancer prevention and control- Lifestyle and dietary factors. Screening programs (Pap smear, mammography, colonoscopy), and Vaccines (HPV, HBV). Recent Advances in Cancer Biology and its applications (Example-genomics, personalized medicine, CRISPR and Liquid biopsy).

References:

1. Kuby Immunology (2007) 6th ed., Kindt, T.L., Goldsby, R.A. and Osborne, B.A., W.H Freeman and Company (New York), ISBN: 13: 978-0-7167-8590-3 / ISBN: 10:0-7617- 8590-0.
2. Immunology: A Short Course (2009) 6th ed., Coico, R and Sunshine, G., John Wiley& sons, Inc (New Jersey), ISBN: 978-0-470-08158-7.
3. Janeway's Immunobiology (2012) 8th ed., Murphy, K., Mowat, A., and Weaver, C.T., Garland Science (London & New York), ISBN: 978-0-8153-4243-4.
4. Kindt, T.J., Goldsby, R.A. and Osborne, B.A. (2007). Kuby Immunology, W.H. Freeman and Co, New York.
5. Lehninger: Principles of Biochemistry (2013) 6th ed., Nelson, D.L. and Cox, M.M. W.H. Freeman & Company (New York), ISBN: 13: 978-1-4641-0962-1 / ISBN: 10-14641-0962- 1.
6. Weinberg, Robert. A. *The Biology of Cancer* (2nd ed.). W. W. Norton & Company.
7. Alberts, Bruce, et al. *Molecular Biology of the Cell*. 7th ed., W. W. Norton & Company, 2022.
8. Lodish, Harvey, et al. *Molecular Cell Biology*. 9th ed., Macmillan Learning, 2021.

FORMATIVE ASSESSMENT	
ASSESSMENT	WEIGHTAGE IN MARKS
CLASS TEST (2 CLASS TEST)	15
ASSIGNMENT/ OPEN DISCUSSION	5
TOTAL	20

Course Code: 6BCDSCT-6.2

Course Title: Molecular Biology and Genetic Engineering-6.2 (Theory)

COURSE TITLE	Molecular Biology and Genetic Engineering-6.2
COURSE CREDITS	03
TOTAL CONTACT HOURS	48
DURATION OF EXAM	3 Hrs
FORMATIVE ASSESSMENT MARKS	20
SUMMATIVE ASSESSMENT MARKS	80

Course Outcome: At the end of the course, students will be able to explain the molecular mechanisms of DNA replication, transcription, translation, and DNA repair in prokaryotic and eukaryotic systems; interpret the structure and organization of genes and genomes, the properties of the genetic code, and the regulation of gene expression in both prokaryotes and eukaryotes; describe the principles and methodologies of recombinant DNA technology, including gene cloning, vector systems, and gene transfer techniques; apply knowledge of molecular biology tools such as PCR and its variants for genetic analysis and manipulation; and evaluate the applications of genetic engineering in basic research, biotechnology, agriculture, medicine, and industry.

Unit-I: Replication and Transcription

16 Hrs

DNA Replication: Replication in prokaryotes and eukaryotes - Enzymes in DNA replication and mechanism of replication. Models of replication (Theta, rolling circle and semiconservative models). Differences between prokaryotic and eukaryotic replication. DNA damage & Repair- Causes of damage and mechanisms of repair– photoreactivation, excision repair, mis-match repair and SOS repair.

Central dogma. Concept of Gene – functional unit, prokaryotic and eukaryotic gene (introns and exons), and Genome. Genetic code, its properties and Wobble hypothesis. Transcription & RNA Processing- Transcription in prokaryotes and eukaryotes– promoters, RNA polymerases, direction of transcription and mechanism of transcription. Post transcriptional processing of eukaryotic mRNA.

Unit-II: Translation and Gene Regulation

16 Hrs

Translation: Ribosome- prokaryote and eukaryote ribosome. Translation- in prokaryotes and eukaryotes Enzymes and factors involved in translation. Mechanism of translation– activation of amino acid, aminoacyl tRNA synthesis, initiation, elongation and termination of polypeptide chain. Post translational modifications of proteins. Inhibitors of translation and fidelity of translation. Regulation of Gene expression in Prokaryotes Operon concept, Lac operon and Tryptophan operon. Gene regulation in eukaryotes– Transcriptional activation and galactose metabolism in yeast. Gene organization and expression in Mitochondria and chloroplast.

Unit-III: Genetic Engineering

16 Hrs

Requirements and steps involved in gene cloning, Isolation of gene/DNA fragments- Purification of genes: Mechanical shearing, restriction digestion, cDNA synthesis, and chemical synthesis of gene. Enzymes

involved in gene cloning: ligases, nucleases: Restriction enzymes- Outlines of bacterial restriction and modification systems- Classification of restriction enzymes- Type II restriction enzyme: Nomenclature, Production of DNA fragments with cohesive ends and blunt ends and their significance.

Vectors -Plasmids, Bacteriophages, cosmids, BACs, YACs and vectors for construction of cDNA libraries. Site directed mutagenesis. Expression vectors (lac and tac). Introduction of cloned genes into host- Transformation, transduction, transfection, electroporation, particle bombardment, microinjection, liposome mediated DNA delivery.

PCR- Concept and technology- Properties of primers -Taq DNA polymerase and its significance Inverse, multiplex PCR, RAPD, RFLP, AFLP and its significance. Real time PCR. Applications of genetic engineering

References:

1. Molecular Biology-David Friefelder, Narosa Publication-house Pvt. Ltd. New Delhi, 2020
2. A Textbook of Biochemistry: Molecular and Clinical Aspects S. Nagini. 2nd edition. Sci Tech Publ., Chennai, 2007.
3. Molecular Biology and Biotechnology- Walker JM and Rapley R, 5th Ed, Royal Society of Chemistry, 2009
4. Molecular Biology: Genes to proteins- Tropp BE, 4th Ed, Jones & Bartlett Publishers, 2012
5. Essential of Molecular Biology- Malacinski GM, Jones & Bartlett Learning, 2005
6. Cell and Molecular Biology- Rasthogi SC, 2nd Ed, New Age International, 01-Jan-2006
7. Molecular Cell Biology-Lodish H, Berk A, Kaiser CA, Krieger M, Bretscher A, Ploegh H, Amon A, Scott MP, WH Freeman Publishers, 2012
8. The world of the Cell-Becker, Pearson Education India, 2007

FORMATIVE ASSESSMENT	
ASSESSMENT	WEIGHTAGE IN MARKS
CLASS TEST (2 CLASS TEST)	15
ASSIGNMENT/ OPEN DISCUSSION	5
TOTAL	20

Couse Code: 6BCDSCP-6.1

Course Title: Immunology and Molecular Biology-6.1 (Practical)

COURSE TITLE	Immunology and Cancer Biology (Practical)
COURSE CREDITS	02
CONTACT HOURS	4 HOURS/WEEK
DURATION OF EXAM	03
FORMATIVE ASSESSMENT MARKS	10
SUMMATIVE ASSESSMENT MARKS	40

Course outcome: Students completing this practical course will be able to connect immunological assays, cancer biology experiments, molecular biology techniques, and genetic engineering methods, thereby gaining a holistic understanding of how these disciplines integrate in biomedical research and diagnostics.

1. Preparation of plasma and serum from blood.
2. Agglutination reactions- Blood Group Determination (ABO & Rh typing)
3. Determination of Typhoid -WIDAL test.
4. Demonstration of Ouchterlony Double Diffusion Test.
5. Demonstration of ELISA test/assay.
6. Study of Cell Cycle Using Onion Root Tip.
7. Histopathology of Tumor Tissue (Demonstration and observation of permanent slides).
8. Isolation of DNA from banana/endosperm of coconut/ bacteria / any other source.
9. Estimation of DNA by diphenyl amine method.
10. Isolation of RNA from plant /animal/Microbial sources.
11. Estimation of RNA by orcinol method.
12. Spectrophotometric Analysis of DNA/RNA.
13. Demonstration of Agarose gel electrophoresis.
14. Polymerase Chain Reaction (PCR) Demonstration.
15. Isolation of plasmids.
16. Thermal denaturation of DNA.
17. Western blotting technique (Demonstration).
18. Visiting research labs.

REFERENCES:

1. General Chemistry experiment – Anil J Elias (University press).
2. Vogel textbook of quantitative chemical analysis G.H. Jeffery, J. Basset.
3. Advanced Experimental Chemistry. Vol-I J.N.Gurtu and R Kapoor, S.Chand and Co.
4. Svehla, G. Vogel's Qualitative Inorganic Analysis, Pearson Education, 2012.
5. Practical Biochemistry, Geetha Damodaran, Jaypee, 2011
6. Biochemical methods, S. Sadasivam, A. Manickam, 3rd Ed, New Age Int Pvt Ltd, 2007
7. An Introduction to Practical Biochemistry, David T. Plummer, 3rd edition 2017
8. Laboratory manual in Biochemistry, J. Jayaraman 2011.

FORMATIVE ASSESSMENT	
ASSESSMENT	WEIGHTAGE IN MARKS
RECORD/ VIVA VOCE	5
CONTINUOUS EVALUATION AND CLASS TEST	5
TOTAL	10

B.Sc., Biochemistry Semester-VI

Course Code: 6BCSEC-6

Biochemistry -Skill Enhancement Course with Practical Food Analysis Techniques/Dissertation/Field Visit

Note: Students are required to choose any one of the following options as their Skill Enhancement Course: Food Analysis Techniques (FAT), Dissertation, or Field Visit. These courses are designed to provide practical exposure, hands-on training, and experiential learning opportunities, enabling students to develop specialized skills relevant to biochemistry and allied disciplines based on their interests and career aspirations. The selected component will carry the prescribed credits and assessment as per the program regulations.

COURSE TITLE	Food Analysis Techniques/ Dissertation/Field Visit
COURSE CREDITS	02
CONTACT HOURS	3 HOURS/WEEK
DURATION OF EXAM	1.5 Hrs
FORMATIVE ASSESSMENT MARKS	10
SUMMATIVE ASSESSMENT MARKS	40

Course outcome: Students completing this course will be able to integrate theoretical knowledge and practical skills in food analysis to evaluate the nutritional composition, quality, and safety of food products, ensuring compliance with regulatory standards and developing competencies required for careers in food science, food technology, quality assurance, and the food industry.

Unit I: Food Analysis Techniques

15 hours

Introduction: Food regulations and standards, sampling methods, sample preparation for analysis. Statistical evaluation of analytical data- official methods of food analysis. Moisture in foods- determination by different methods - ash content of foods, titratable acidity in foods, determination of dietary fiber and crude fiber. Determination of total fat in foods by different methods- Analysis of oils and fats for physical and chemical parameters. Quality standards and adulterants- different methods of determination of protein and amino acids in foods; determination of total carbohydrates, starch, disaccharides and simple sugars in foods.

SEC-Practical-Food Analysis Techniques

1. Sampling & Preparation (Demonstration of food sampling methods and Preparation of food samples (drying, grinding, homogenization).
2. Determination of moisture by oven drying method
3. Determination of ash content by dry ashing and wet ashing.
4. Estimation of titratable acidity in fruit juices/milk.
5. Determination of crude fiber and dietary fiber (enzymatic-gravimetric method).
6. Determination of acid value, peroxide value, saponification value.
7. Determination of total nitrogen by Kjeldahl method
8. Estimation of total carbohydrates (Anthrone method).
9. Estimation of Starch by Iodine method.
10. Demonstration of food quality standards (ISI, FSSAI).
11. Detection of common adulterants in food (milk, sugar, oils, spices).

References

1. Srilakshmi, B. (2018). Food Science (7th ed.). New Delhi: New Age International. Chicago
2. Norman N. Potter, Joseph H. Hotchkiss. Food Science Text Series (FSTS).
3. Ranganna, S. (1991). *Handbook of analysis and quality control for fruit and vegetable products* (2nd ed.). Tata McGraw-Hill Publishing Company.
4. Frazier, W. C., & Westhoff, D. C. (1995). *Food microbiology* (4th ed.). Tata McGraw-Hill.
5. Food Safety and Standards Act, 2006 (Act No. 34 of 2006)
6. AOAC Official Methods of Analysis- Standard protocols for proximate composition (moisture, ash, fat, protein, carbohydrate).
7. Handbook of Analysis of Quality Control for Fruit and Vegetable Products– S. Ranganna.
8. Food Analysis- S. Suzanne Nielsen (covers modern instrumental techniques).
9. Laboratory Manual in Food Science and Technology- University level lab guides.

FORMATIVE ASSESSMENT	
ASSESSMENT	WEIGHTAGE IN MARKS
CLASS TEST (L+ P CLASS TEST)	5
RECORD/VIVA VOCE	5
TOTAL	10

Question Paper pattern for Skill Enhancement Course with Practical (SEC)

Duration of exam: 1.5 hours	The question shall consist of two parts: part a and part b	Maximum marks: 40
Part A (Theory)	Answer any 4 out of 5 questions (Q1 to Q5)	$4 \times 2 = 08$
	Answer any 4 out of 6 questions (Q5 to Q9)	$4 \times 3 = 12$
Part B (Practical)	Answer any 4 out of 5 questions (Q10 to Q13)	$4 \times 2 = 08$
	Answer any 1 out of 2 questions (Q14 to Q15)*	$1 \times 12 = 12$
*Q14 and Q15 question shall have only two sub-divisions (a) and (b) with (4+5)/ (3+6) marks respectively. In part B , questions from the experiments related to practical (principle, reactions, reaction mechanisms, structures, formulas, calculations and procedure shall be given).		
In case of Dissertation	Students opting for the Dissertation component shall submit a dissertation report and make an oral presentation of their work before the examiner(s). The dissertation will be evaluated based on the quality of the report, understanding of the subject, presentation skills, and performance during the viva voce examination. Marks shall be awarded accordingly as per the prescribed evaluation scheme.	
In case of field visit	Students opting for the Field Visit component shall participate in an approved visit to a research institution, industry, diagnostic laboratory, food processing unit, or other relevant facility. Each student shall submit a field visit report documenting the observations, learning outcomes, and relevance of the visit to the discipline. Students may also be required to make a presentation before the examiner(s). Evaluation shall be based on participation, quality of the report, presentation, and understanding of the concepts and practices observed during the visit.	

Fifth and Sixth Semester B.Sc Degree Examination, July 2026
(UG-SEP 2024)
BIOCHEMISTRY
Title of the Paper:

Time: 3 Hrs

Max. Marks: 80

Note to candidates: All the parts are compulsory.

PART-A

Answer any 10 of the following. Each carries TWO marks.

2X10= 20

- 1)
- 2)
- 3)
- 4)
- 5)
- 6)
- 7)
- 8)
- 9)
- 10)
- 11)
- 12)

PART-B

Answer any 6 of the following. Each carries FIVE marks.

6X5= 30

- 13)
- 14)
- 15)
- 16)
- 17)
- 18)
- 19)
- 20)

PART-C

Answer any 3 of the following. Each carries TEN marks.

3X10= 30

- 21) a.
b.
c.
- 22) a.
b.
c.
- 23) a.
b.
c.
- 24) a.
b.
c.
- 25) a.
b.
c.