

B.Sc., Biotechnology Semester-III

Course code: **BTDSC - 03**

Course Title: **Biomolecules and Bioanalytical Techniques (Theory)**

COURSE TITLE	Biomolecules and Bioanalytical Techniques
COURSE CREDITS	04
TOTAL CONTACT HOURS	60
DURATION OF EXAM	3 Hrs
FORMATIVE ASSESSMENT MARKS	20
SUMMATIVE ASSESSMENT MARKS	80

Course Outcome:

This course introduces students to the fundamental concepts of biomolecules and their metabolism, laying the groundwork for understanding key biochemical processes essential to life. It provides a strong foundation in the structure, classification, and functions of carbohydrates, lipids, proteins, nucleic acids, enzymes, hormones, vitamins, and minerals. Emphasis is placed on metabolic pathways, enzyme kinetics, and the biochemical roles of essential nutrients. Additionally, the course equips students with theoretical and practical knowledge of bioanalytical techniques, enhancing their ability to analyze and interpret biochemical data. By the end of the course, students will have a well-rounded understanding of biochemical principles and laboratory methods relevant to research and clinical applications.

BTDSC – 03: Biomolecules and Bioanalytical Techniques (Theory)

Unit I: Carbohydrates and Lipids

15 Hrs

Carbohydrates: Introduction, sources, classification of carbohydrates. Structure, function and properties of carbohydrates. Monosaccharides – Isomerism and ring structure, Sugar derivatives– amino sugars. Disaccharides – Maltose, Lactose and Sucrose. Polysaccharides – Classification as homo and heteropolysaccharides, Homopolysaccharides -storage polysaccharides (starch and glycogen- structure, reaction, properties), structural polysaccharides (cellulose and chitin-structure, properties), Heteropolysaccharides -glycoproteins and proteoglycans.

Carbohydrate Metabolism- Glycolysis, TCA cycle, gluconeogenesis, and HMP shunt pathway. ETC- oxidative phosphorylation.

Lipids: Classification and function of lipids, properties (saponification value, acid value, iodine number, rancidity), Hydrogenation of fats and oils, Saturated and unsaturated fatty acids. General structure and biological functions of -phospholipids, sphingolipids, glycolipids, lipoproteins, prostaglandins, cholesterol, ergosterol.

Lipid Metabolism: Beta oxidation of fatty acids, Fatty acid biosynthesis, and cholesterol biosynthesis.

Unit II: Proteins and Enzymes

15 Hrs

Amino Acids, Peptides and Proteins: Introduction, classification and structure of amino acids; Zwitterion, isoelectric point, pK values. Essential and nonessential amino acids. Peptide bond and biological significance of peptides (Glutathione, Endorphins, Vasopressin, and Oxytocin). Structural organization of proteins - primary, secondary (α helix, β -sheets) tertiary and quaternary. Fibrous and globular proteins, Denaturation and renaturation of proteins.

General aspects of amino acid metabolism: Transamination, deamination, decarboxylation and urea cycle

Enzymes: Introduction, nomenclature and classification of enzymes. Enzyme activity and specific activity. Factors influencing enzyme activity. Enzyme kinetics. Activation energy and transition state theory. metalloenzymes, Coenzymes and their functions (one reaction involving FMN, FAD, NAD). Enzyme inhibition- Irreversible and reversible (competitive, non-competitive and uncompetitive inhibition with an example each). Zymogens (trypsinogen, chymotrypsinogen and pepsinogen). Isozymes (LDH, Creatine kinase, Alkaline phosphatase) and their clinical significance).

Unit III: Nucleic acids, Hormones, Vitamins and Minerals

15 Hrs

Nucleic acids: Structure, functions, Physical & chemical properties of Nucleic acids. Nucleotides in DNA and RNA. Structure and functions of DNA and RNA, Watson and Crick model of DNA and other forms of DNA (A and Z). Types of RNA (rRNA, tRNA, mRNA, snRNA, hnRNA, miRNA), ribozymes. **Nucleic acid Metabolism-** Overview of biosynthesis and degradation of purine and pyrimidine, salvage pathway.

Hormones- Classification of hormones based on chemical nature and mechanism of action. Chemical structure and functions of the following hormones: Glucagon, Cortisone, Epinephrine, Testosterone and Estradiol.

Vitamins-Water and fat soluble vitamins. Dietary source and biological role of vitamins Deficiency manifestation of vitamin A, B, C, D, E and K.

Minerals: Major minerals (Calcium, Phosphorus and Iron) and trace minerals (Iodine, Selenium, and Cobalt)- biological functions, sources, and deficiency issues.

Unit IV: Bioanalytical Techniques

15 Hrs

Chromatography: Principle, procedure and applications of - paper chromatography, thin layer chromatography, adsorption chromatography, ion exchange chromatography, gel filtration

chromatography, affinity chromatography, gas liquid chromatography and high performance liquid chromatography.

Centrifugation: Principles of sedimentation, types of centrifugation (preparative and analytical), and their applications.

Electrophoresis: Principle, procedure and applications of electrophoresis (gel electrophoresis - PAGE, SDS- PAGE & agarose electrophoresis) and isoelectric focusing.

Spectroscopy: Colorimetry, UV-Vis spectrophotometry, Spectrofluorimetry, atomic absorption spectroscopy, mass spectroscopy

Radioisotope techniques: Radioisotopes, half-life, GM counter, scintillating counting

References

1. Principles of Biochemistry (2012) by Voet D, Voet JG and Pratt CW. 4th Edition, John Wiley and Sons Inc, ISBN-10. 9781118092446.
2. Lehninger- Principles of Biochemistry (2013) by Nelson DL and Cox MM. 6th Edition. Macmillan Publications. ISBN-10. 1464109621.
3. Biochemistry-The chemical reactions of living cells (2003) by David E Metzler. 2nd Edition, Elsevier Academic Press. ISBN- 978-0124925403.
4. Fundamentals of Biochemistry (2005) by J.L. Jain, 6th Edition, published by S. Chand. ISBN- 81-219-2453-7. Biochemistry (2010) by Berg JM, Tymoczko JL and Stryer L, 7th Edition, Freeman and company. ISBN- 9781429229364
5. Harper's Illustrated Biochemistry (2018) by Weitz M and Boyle PJ. 31st Edition, McGraw-Hill Education ISBN- 978-1-259-83793-7.
6. Wilson and Walker's Principles and Techniques of Biochemistry and Molecular Biology (2018). 8th Edition, Cambridge University Press. ISBN- 9781108716987
7. 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: BTDSC- 03P

Course Title: Biomolecules and Bioanalytical Techniques (Practical)

COURSE TITLE	PRACTICAL COURSE ON Biomolecules and Bioanalytical Techniques
COURSE CREDITS	02
CONTACT HOURS	4 Hr/Week
DURATION OF EXAM	03 Hrs
FORMATIVE ASSESSMENT MARKS	10
SUMMATIVE ASSESSMENT MARKS	40

1. Preparation of buffers (Phosphate and citrate) & solutions (normal, molar, ppm, %)
2. Qualitative tests for carbohydrates, lipids, proteins and nucleic acids
3. Principle and working of a colorimeter and spectrophotometer
4. Estimation of reducing sugar - DNS method
5. Estimation of protein – Lowry’s method
6. Titration curve of any one amino acid
7. Determination of peroxide value of oil
8. Separation of amino acids by paper chromatography, TLC
9. Separation of plasma using centrifuge.
10. SDS-PAGE of plasma proteins
11. Estimation of amino acid by Ninhydrin method
12. Determination of amylase activity
13. Estimation of protein by biuret method
14. Protein precipitation by salting out method

REFERENCES

1. Nelson, D. L. & Cox, M.M. (2000), Lehninger’s Principles of Biochemistry (3rd Edition), Worth Publishers, New York, USA.
2. Stryer, L. (1995). Biochemistry, W.H. Freeman and Co., New York, USA.
3. Jain, J. L (1999), Fundamentals of Biochemistry, S.Chand and Company, New Delhi.
4. Murray, R.K, Granner, D.K, Mayes, P.A. & Rodwell, V.W. (2003), Harper’s Illustrated Biochemistry, McGraw-Hill Companies.
5. Sadasivam, S. And Manickam, A. (1996), Biochemical Methods, New Age International (P) Limited
6. Jayaraman, J. (1971), Laboratory Manual in Biochemistry, John Wiley & Sons, Limited.

7. Plummer, D.T. (1993). An Introduction to Practical Biochemistry, Sixth Reprint. Tata McGraw-Hill Publishing Company Limited, New Delhi.
8. Harvey, R.A. & Ferrier, D.R. (2011). Lippincott's Illustrated Reviews, Biochemistry Fifth Edition, Lippincott Williams and W Wilkins

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

Course code: **BTOEC - 3.1**

Course Title: **Nutrition and Diet- 3.1** (Elective-Theory)

COURSE TITLE	Nutritional Biochemistry- 3.1
COURSE CREDITS	03
TOTAL CONTACT HOURS	45
DURATION OF EXAM	3 Hrs
FORMATIVE ASSESSMENT MARKS	20
SUMMATIVE ASSESSMENT MARKS	80

Course Outcome:

This course introduces students to the fundamentals of nutrition, covering its role in health maintenance and disease prevention. It includes the classification of foods and diets, functions of basic food groups, and application of dietary guidelines such as food pyramid models and MyPlate. Students will explore functional foods, bioactive compounds, prebiotics, and probiotics, along with their health benefits. The course also emphasizes the sources, functions, requirements, and deficiencies of macro- and micronutrients, and the use of nutritional assessment tools such as RDA, BMI, and BMR. By the end, learners will be able to apply nutritional principles in promoting health and managing diet-related disorders.

BTOEC - 3.1: Nutrition and Diet (Elective)

Unit-I Nutrition and Diet

15hrs

Concept of Nutrition and Health- Relationship between nutrition, health, and disease prevention. Understanding nutritional status and malnutrition (undernutrition and overnutrition). Food: sources, components, and classification. Diet: definition, types (therapeutic and cultural) and significance. Food Groups and Classification– Overview of basic food groups: cereals, pulses, fruits, vegetables, dairy, meat/fish, fats/oils, and sugars. Functions of Food– An overview on the Physiological functions: energy provision, tissue building, metabolic regulation.

Unit-II Food pyramid and Functional Foods and Bioactive Compounds

15hrs

Food Pyramid and MyPlate Guidelines- Introduction to food pyramid models (Indian, USDA, WHO). MyPlate dietary guidelines for healthy eating. Functional Foods-Definition and classification of functional foods. Role of functional foods in health promotion and disease prevention (e.g., heart disease, diabetes, cancer). Bioactive compounds-Introduction to phytochemicals and their health benefits (soy, oats, flaxseed, berries, turmeric, garlic, and green tea). Prebiotics and Probiotics- Definitions, differences, and Sources of prebiotics (e.g., inulin, oligosaccharides) and probiotics (e.g., Lactobacillus, Bifidobacterium). Health benefits on gut health, immunity, and metabolic disorders.

Unit-III Nutrients

15hrs

Introduction to Nutrients, Classification of nutrients- Macronutrients and Micronutrients. Importance of nutrients in human growth, development, and health maintenance. Macronutrients- Carbohydrates, Proteins and fats- sources, types, functions and caloric value and daily requirement Micronutrients: Minerals- sources, functions and deficiency of Calcium, Iron and Iodine. Vitamins- sources, functions and deficiency of fat soluble (A,D,E & K) and water soluble vitamins (B1, B2, B3 and B6). Nutritional Assessment and Guidelines- concept of RDA, Body Mass Index (BMI) and Basal Metabolic Rate (BMR). Factors affecting BMR.

REFERENCES

- Rosemary Stanton's Complete Book of Food & Nutrition, 2007, Simon & Schuster Publishers, Australia, ISBN 10: 0731812999
- Food Science and Nutrition, 2018, Roday S. Oxford University Press Publishers, ISBN: 9780199489084/0199489084.
- Clinical Dietetics and Nutrition, 2002, Antia FP and Abraham P. Oxford University Press; 4th Edition. ISBN-10: 9780195664157.
- Krause's Food, Nutrition and Diet therapy, 2003, Mahan KL and Escott-Stump S. Elsevier, ISBN: 9780721697840.
- Oxford Handbook of Nutrition and Dietetics, 2011, Webster-Gandy J, Madden A and Holdsworth M. Oxford University Press, Print ISBN-13: 9780199585823.
- Food, Nutrition and Health. Tapsell L. Oxford University Press (2010).
- Food Science, 2007, Srilakshmi S. New Age International (P) Limited Publishers, ISBN: 9788122420227/ 8122420222.

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

Course code: **BTOEC - 3.2**

Course Title: **Intellectual Property Rights - 3.2** (Elective-Theory)

COURSE TITLE	Intellectual Property Rights - 3.2
COURSE CREDITS	03
TOTAL CONTACT HOURS	45
DURATION OF EXAM	3 Hrs
FORMATIVE ASSESSMENT MARKS	20
SUMMATIVE ASSESSMENT MARKS	80

Course Outcome:

This course provides an overview of Intellectual Property Rights (IPR), including patents, trademarks, copyrights, designs, trade secrets, geographical indications, and plant variety protection, along with the role of national and international bodies such as WIPO, WTO, TRIPS, and GATT. Students will learn the fundamentals of patenting, types of patents, the Indian Patent Act and its amendments, patent application procedures, prior art, patent databases, and infringement issues, supported by case studies. The course also covers the principles, registration processes, and legal protection of trademarks, copyrights, and industrial designs. By the end, learners will be able to understand, identify, and apply IPR concepts in protecting innovations and creative works.

BTOEC - 3.2: Intellectual Property Rights - 3.2 (Elective)

Unit I Introduction to Intellectual Property Rights (IPR)

15hrs

Genesis and scope of Intellectual Property Rights. Types of IPR: patents, trademarks, copyrights, designs, trade secrets, geographical indications, and plant variety protection. Overview of national and international agencies: World Intellectual Property Organization (WIPO), World Trade Organization (WTO), Trade-Related Aspects of Intellectual Property Rights (TRIPS), and General Agreement on Tariffs and Trade (GATT).

Unit-II Patenting, Process, and Infringement

15 hrs

Basics of patents. Types of patents: patentable and non-patentable inventions. Process and product patents. Indian Patent Act, 1970 – recent amendments. Patent Cooperation Treaty (PCT) and its implications. Process of patenting. Types of patent applications: provisional and complete specifications. Concept of "prior art" and use of patent databases (USPTO, EPO, India). Financial assistance, schemes, and grants available for patenting. Patent infringement and related issues. Case studies on patents: Basmati rice, turmeric, neem.

Unit-III Trademarks, Copyrights, and Industrial Designs

15 hrs

Trademarks-Types, purpose, and functions of trademarks; trademark registration process; protection and enforcement of trademarks.

Copyright- Fundamentals of copyright law; concept of originality; rights of reproduction and distribution.

Industrial Designs- Introduction to design protection; types of industrial designs; kinds of protection offered under design law.

References

- Maskus, K. E. (2000). Intellectual Property Rights in the Global Economy. Washington, DC: Institute for International Economics.
- Ganguli, P. (2001). Intellectual Property Rights: Unleashing the Knowledge Economy. New Delhi: Tata McGraw-Hill.
- Ahuja, V. K. (2023). Law Relating to Intellectual Property Rights (7th ed.). Gurgaon: LexisNexis.
- Bouchoux, D. E. (2012). Intellectual Property: The Law of Trademarks, Copyrights, Patents, and Trade Secrets (4th ed.). Boston: Cengage Learning.
- Miller, A. R., & Davis, M. H. (2012). Intellectual Property: Patents, Trademarks and Copyright in a Nutshell (5th ed.). St. Paul, MN: West Academic Publishing.
- Pandey, N., & Dharni, K. (2014). Intellectual Property Rights: Text and Cases. New Delhi: PHI Learning Pvt. Ltd.
- Sople, V. V. (2016). Managing Intellectual Property: The Strategic Imperative (2nd ed.). New Delhi: PHI Learning Pvt. Ltd.
- Narayanan, P. (2017). Intellectual Property Law (4th ed.). Kolkata: Eastern Law House.
- Radha Krishnan, R., & Balasubramanian, S. (2008). Intellectual Property Rights: A Management Perspective. New Delhi: Excel Books.

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

B.Sc., Biotechnology Semester - IV

Course code: BTDSC - 04

Course Title: Molecular Biology - 4 (Theory)

COURSE TITLE	Molecular Biology-4
COURSE CREDITS	04
TOTAL CONTACT HOURS	60
DURATION OF EXAM	3 Hrs
FORMATIVE ASSESSMENT MARKS	20
SUMMATIVE ASSESSMENT MARKS	80

Course Outcome:

This course introduces students to the central dogma of molecular biology and highlights its significance in understanding the chemical and molecular processes occurring within and between cells. It provides a strong foundation on the structure and functions of nucleic acids and proteins, emphasizing their interactions that drive cell growth, division, and development. Students gain insight into the structural organization of genes and the overall organization of genomes. The course also enables students to understand the concept and features of the genetic code. By the end of the course, students will have developed a comprehensive understanding of the mechanisms of DNA replication in both prokaryotic and eukaryotic systems.

BTDSC - 04: Molecular Biology

Unit I: Replication

15 Hrs

Central dogma of molecular biology, DNA as genetic material, structure of DNA, types and properties of DNA. Replication of DNA in prokaryotes and eukaryotes: semi-conservative nature of DNA replication, bi-directional replication, DNA polymerases, proteins and enzymes involved in replication. The replication complex: pre-priming proteins, primosome, replisome. Rolling circle replication. Unique aspects of eukaryotic chromosome replication. Fidelity of replication.

Unit II: Transcription

15 Hrs

Mechanism of transcription in prokaryotes and eukaryotes: initiation, elongation, and termination processes; promoter structure and function, role of transcription factors, enhancers, and silencers. Enzymes and proteins involved in transcription, including RNA polymerases (I, II, and III in eukaryotes), sigma factors in prokaryotes, general transcription factors. Post-transcriptional modifications in eukaryotes: 5' capping, 3' polyadenylation, splicing of introns, and RNA editing. Inhibitors of transcription and their relevance in research and therapeutics.

Unit III: Genetic Code and Translation

15 Hrs

Genetic code– characteristics and properties: universality, degeneracy and non-overlapping nature. Wobble hypothesis and its role in codon-anticodon recognition. Protein biosynthesis in prokaryotes and eukaryotes– steps of translation including initiation, elongation, and termination; structure and function of ribosomes, initiation factors, elongation and release factors. Differences in translational mechanisms between prokaryotes and eukaryotes. Post-translational modifications: phosphorylation, glycosylation, acetylation, and methylation. Inhibitors of protein synthesis–chloramphenicol, tetracycline, erythromycin, puromycin, and cycloheximide.

Unit IV: Regulation of Gene Expression

15 Hrs

Overview of gene regulation in prokaryotes and eukaryotes. Clustered genes and the operon concept. Detailed study of the lac operon: negative and positive control mechanisms. trp operon: repressible operon and attenuation. Comparison of inducible and repressible systems. Polycistronic and monocistronic mRNAs: structure and significance. Introduction to regulatory RNAs (miRNA, siRNA) and basic chromatin-level regulation in eukaryotes.

References:

1. Cell and Molecular Biology (1980) by Eduardo D. P. De Robertis and Eduardo M. F. de Robertis. 8th Edition published by Lea and Febiger.
2. Cell and Molecular Biology (2017) by De Robertis E.D.P. 8th Edition published by Blaze Publishers & Distributors Pvt. Ltd., ISBN- 978-8184734508
3. The Cell: A Molecular Approach Paperback (2009) by Hausman M. Cooper and Robert E. Geoffrey. 5th Edition published by Sinauer Associates, Inc. ISBN- 978-0878933976.
4. The World of the Cell (2009) by Wayne MB, Lewis JK, Bertoni HJ, and Paul G. 7th Edition published by Pearson Benjamin Cummings Publishing, San Francisco, ISBN: 9780805393934.
5. Molecular Biology of the Gene (2013) by Watson JD, Baker TA, Bell SP, Gann A and Levine M. 7th Edition published by Benjamin-Cummings Pub Co, ISBN-978-0321762436.
6. Wilson and Walkers Principles and Techniques of Biochemistry and Molecular Biology (2023). 8th Edition published by Cambridge University Press, ISBN- 978-1107606227

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

Course code: BTDSC - 04P
Course Title: Molecular Biology-4 (Practical)

COURSE TITLE	PRACTICAL COURSE ON Biomolecules and Analytical Techniques-4
COURSE CREDITS	02
CONTACT HOURS	4 Hr/Week
DURATION OF EXAM	03 Hrs
FORMATIVE ASSESSMENT MARKS	10
SUMMATIVE ASSESSMENT MARKS	40

Course Outcome:

Upon completion of the program, students will have a thorough understanding of the functional significance of DNA technology and its role in modern biology. They will acquire essential laboratory skills needed to perform, interpret, and analyze commonly used molecular biology techniques. The program equips students with the ability to apply these techniques in research settings, fostering critical thinking and problem-solving skills. Additionally, students gain hands-on experience with molecular biology tools and technologies, preparing them for advanced studies, research, or careers in biotechnology, molecular diagnostics, and related fields.

MOLECULAR BIOLOGY PRACTICALS

1. DNA isolation from prokaryotes- *E. coli*
2. DNA isolation from eukaryotes- *Saccharomyces cerevisiae*
3. Determination of absorption maxima of DNA, RNA and protein.
4. Separation of DNA by Agarose Gel Electrophoresis
5. Quantitative estimation of DNA by DPA method
6. Quantitative estimation of DNA by orcinol method
7. Melting curve analysis of DNA
8. Demonstration of PCR
9. Extraction and estimation of protein (Plant / Animal source by salt precipitation and organic solvent method)
10. Preparation of charts and models

References

1. Cell and Molecular Biology Lab Manual (2011) by David Thompson. CreateSpace Independent Publishing Platform, ISBN-1463530080/ 9781463530082.

2. Cell and Molecular Biology (1980) by Eduardo D. P. De Robertis and Eduardo M. F. de Robertis. 8th Edition published by Lea and Febiger.
3. Cell and Molecular Biology (2017) by De Robertis E.D.P. 8th Edition published by Blaze Publishers & Distributors Pvt. Ltd., ISBN- 978-8184734508
4. The Cell: A Molecular Approach Paperback (2009) by Hausman M. Cooper and Robert E. Geoffrey. 5th Edition published by Sinauer Associates, Inc. ISBN- 978-0878933976.
5. The World of the Cell (2009) by Wayne MB, Lewis JK, Bertoni HJ, and Paul G. 7th Edition published by Pearson Benjamin Cummings Publishing, San Francisco, ISBN: 9780805393934.
6. Wilson and Walkers Principles and Techniques of Biochemistry and Molecular Biology (2023). 8th Edition published by Cambridge University Press, ISBN- 978-1107606227

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

Course code: **BTOEC - 4.1**

Course Title: **Enzymes in Food, Biomedical, and Industrial Biotechnology- 4.1** (Elective-Theory)

COURSE TITLE	Enzymes in Food, Biomedical, and Industrial Biotechnology- 4.1
COURSE CREDITS	03
TOTAL CONTACT HOURS	45
DURATION OF EXAM	3 Hrs
FORMATIVE ASSESSMENT MARKS	20
SUMMATIVE ASSESSMENT MARKS	80

Course Outcome:

This course covers the principles and applications of enzymes in food processing, biosensor development, and enzyme engineering, including industrial bioconversions, biomedical and environmental diagnostics, immobilization techniques, recombinant enzyme production, and strategies for optimizing enzyme performance in various bioprocesses.

BTOEC - 4.1: Enzymes in Food, Biomedical, and Industrial Biotechnology (Elective)

Unit-I Applications of Enzymes in Food Processing

15 hrs

Introduction to enzyme function and kinetics relevant to food processing. Enzymatic bioconversions in industry: starch hydrolysis, sugar inversion, and glucose-fructose isomerization. High-fructose corn syrup production, interesterified fats, and hydrolyzed proteins. Use of enzymes in baking (e.g., amylases), brewing (glucose oxidase for desugaring and deoxygenation), and beer production (mashing and chill proofing). Cheese production using proteases. Other food applications of lipases, cellulases, and pectinases. Stability, immobilization, and optimization of enzyme function in industrial food systems.

Unit-II Enzyme Biosensors and Biomedical Applications

15hrs

Introduction to enzyme-based biosensors- principle, components, and classification. Applications in biomedical diagnostics- glucose sensors, cholesterol sensors, and urea biosensors. Role of biosensors in environmental monitoring- detection of pollutants, heavy metals, and pesticide residues. Hybrid enzymes – structure and function of ribozymes (RNAzymes) and catalytic antibodies (Abzymes). Emerging trends in biosensor development, including wearable biosensors and nanomaterial-based biosensing platforms.

Enzyme Engineering: Introduction to enzyme engineering, Recombinant enzyme production and expression systems. Enzyme Immobilization- Principles and need for immobilization. Techniques of immobilization- Adsorption, Entrapment, Covalent binding and Encapsulation. Carriers and supports used for immobilization (natural and synthetic). Applications and Limitations- Advantages and disadvantages of immobilized enzymes, Industrial applications of immobilized enzymes

References

- Trevan, M. D. (1987). Immobilized Enzymes: An Introduction and Applications in Biotechnology. Wiley-Blackwell. – A foundational book covering enzyme immobilization techniques and their industrial use.
- Whitaker, J. R., Voragen, A. G. J., & Wong, D. W. S. (2003). Handbook of Food Enzymology. CRC Press. – Comprehensive guide on enzyme roles and processing in food technology.
- Palmer, T., & Bonner, P. L. (2007). Enzymes: Biochemistry, Biotechnology, Clinical Chemistry (2nd ed.). Woodhead Publishing. – Covers enzyme structure, function, applications, and clinical uses.
- Chaplin, M. F., & Bucke, C. (1990). Enzyme Technology. Cambridge University Press. – A clear and concise book on enzyme applications, including immobilization and industrial processes.
- Bamforth, C. W. (2005). Food, Fermentation and Micro-organisms. Wiley-Blackwell. – Discusses enzymatic processes in food and beverage production.
- Bhattacharya, B. K. (2004). Industrial Microbiology (2nd ed.). Oxford & IBH Publishing. – Includes applications of microbial and enzyme technologies in various industries.
- Davis, J., & Higson, S. (2002). Bio-sensors for Rapid Detection of Foodborne Pathogens. Elsevier. – Focused on biosensors using enzymes in food and biomedical sectors.
- Aehle, W. (2007). Enzymes in Industry: Production and Applications (3rd ed.). Wiley-VCH. – Detailed coverage of industrial enzyme production and usage.

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

Course code: **BTOEC - 4.2**

Course Title: **Human Physiology - 4.2** (Elective-Theory)

COURSE TITLE	Human Physiology- 4.2
COURSE CREDITS	03
TOTAL CONTACT HOURS	45
DURATION OF EXAM	3 Hrs
FORMATIVE ASSESSMENT MARKS	20
SUMMATIVE ASSESSMENT MARKS	80

Course Outcome:

This course provides an understanding of the structure and function of major human physiological systems, including digestive, respiratory, circulatory, nervous, muscular, and endocrine systems. Students will learn the processes of digestion, absorption, and nutrient transport, mechanisms of respiration and gas exchange, blood composition and coagulation, cardiac function, neural conduction, and muscle physiology. The course also covers the structure, function, and hormonal regulation of endocrine glands, along with disorders arising from hormonal imbalances. By the end, learners will be able to explain the physiological mechanisms that maintain homeostasis and relate them to health and disease conditions.

BTOEC -4.2: Human Physiology (Elective)

UNIT I: Digestion and Respiration

15 hrs

Digestion: Overview of the human digestive system. Mechanical and chemical processes involved in the digestion of carbohydrates, proteins, and lipids. Site-specific enzymatic actions in the oral cavity, stomach, and small intestine. Absorption Mechanisms-Absorption of monosaccharides, amino acids, fatty acids, glycerol, and minerals in different segments of the small intestine. Transport mechanisms-active transport, passive diffusion, facilitated diffusion, endocytosis. Composition of bile, saliva, pancreatic, gastric, and intestinal juices.

Overview of respiratory system- anatomy and functions of the lungs, airways, and associated muscles. Exchange of gases, transport of O₂ and CO₂, oxygen dissociation curve, chloride shift.

Unit II Circulatory and nervous system

15 hrs

Composition of blood, separation of plasma and serum, plasma proteins and their role. Types and functions of blood cells, hematopoiesis. Mechanism of coagulation of blood.

Mechanism of working of the heart: Cardiac output, cardiac cycle, origin and conduction of heartbeat.

Structure of a neuron, resting membrane potential, Graded potential, Origin of action potential and its propagation in myelinated and non-myelinated nerve fibres,

Unit III Muscular and endocrine system

15 hrs

Ultrastructure of skeletal muscle, Molecular and chemical basis of muscle contraction. Muscle physiology and osmoregulation Structure of cardiac, smooth & skeletal muscle, threshold stimulus, All or None rule, single muscle twitch, muscle tone, isotonic and isometric contraction, Physical, chemical & electrical events of mechanism of muscle contraction.

Different endocrine glands– Hypothalamus, pituitary, pineal, thymus, thyroid, parathyroid and adrenals. Types of hormones and mechanism of action of hormones (insulin and steroids). Hypo and hyper-secretion of hormones.

References

- Guyton, A. C., & Hall, J. E. (2020). Textbook of medical physiology (14th ed.). Elsevier.
- Sherwood, L. (2015). Human physiology: From cells to systems (9th ed.). Cengage Learning.
- Tortora, G. J., & Derrickson, B. H. (2017). Principles of anatomy and physiology (15th ed.). Wiley.
- Khurana, I. (2018). Textbook of medical physiology (2nd ed.). Elsevier India.
- Goyal, R. K. (2013). Essentials of human physiology (4th ed.). CBS Publishers & Distributors.
- Vasudevan, D. M., Sreekumari, S., & Vaidyanathan, K. (2022). Textbook of biochemistry for medical students (9th ed.). Jaypee Brothers Medical Publishers.
- Satyanarayana, U., & Chakrapani, U. (2021). Biochemistry (5th ed.). Elsevier India.
- Martini, F. H., Nath, J. L., & Bartholomew, E. F. (2017). Fundamentals of anatomy and physiology (11th ed.). Pearson Education.

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

Scheme of B.Sc Biotechnology Theory and Practical Question Paper (Core and Elective)

B.Sc Degree Examinations (Revised NEP-SEP) Biotechnology 2024-25

Theory Paper

Duration: 3 Hours	The question paper shall consist of two parts: Part A, Part B and Part C	Max. Mark 80
PART-A	Answer any 10 out of 12 questions [Q 1 to Q 12] (three questions from each unit)	10×2=20
PART-B	Answer any 6 out of 8 questions [Q 13 to Q 20] (two questions from each unit)	6X5= 30
PART-C	Answer any 3 out of 5 questions [Q 21 to Q 25] (1 and half questions from each unit)	3X10= 30

- i) Equal weightage of marks shall be given to all the units in Part A, Part B and Part C.
- ii) In part C, each main question shall have only three sub-divisions (a), (b) and (c) with (4+4+2), (5+3+2) or (4+3+3) marks respectively.

Practical Paper

DURATION ;3 hours	Max. Marks; 40
Performance	30 marks Two experiments; one major and one minor
Viva-voce	5 marks
Record	5marks (minimum 8 experiment should be recorded)