(Notified by Registrar, AUS on _____)

Assam University, Silchar

Four Year Undergraduate Programme

Implemented under NEP 2020

Effective from the Academic Year 2023-24

Syllabus of Biotechnology

Approved in the __th meeting of the Academic Council on____vide Resolution No ___

Bachelor in Biotechnology with Honours/Honours and Research

Programme Specific Objective

The objective of the Biotechnology program is to provide students with a comprehensive understanding of the principles, techniques, and applications of biotechnology. The program aims to equip students with the necessary knowledge and skills to pursue careers in various sectors of biotechnology, including research, academia, industry, and healthcare. The program also focuses on fostering critical thinking, problem-solving abilities, and effective communication skills among students.

Programme Specific Outcomes

Upon completion of the Biotechnology program, students will be able to:

1. Demonstrate a comprehensive understanding of the principles and concepts of biotechnology, including the fundamentals of cell biology, genetics, immunology, microbiology and molecular biology.
2. Apply theoretical knowledge and practical skills in various areas of biotechnology, such as cell culture, genetic engineering, recombinant DNA technology and bioinformatics.
3. Analyze and interpret data from experiments, research studies, and scientific literature in the field of biotechnology.
4. Apply ethical principles and practices in biotechnology research, considering the social, legal, and environmental implications of biotechnological advancements.
5. Communicate scientific concepts and research findings clearly and effectively through oral presentations, scientific reports, and written documentation.

Table 1: Semester-wise list of Biotechnology DSC Courses

Semester	Course Code	Title of Courses	Credits
I	BTC DSC101T	Cell Biology	3
	BTC DSC102T	Environmental Biotechnology	3
II	BTC DSC151T	Biochemistry	3
	BTC DSC152P	Cell Biology, Environmental Biotechnology and Biochemistry	3
III	BTC DSC201T	Genetics	4
	BTC DSC202T	Immunology	4
IV	BTC DSC251T	Animal Cell Culture	4
	BTC DSC252T	Bioprocess Technology	4
	BTC DSC253P	Immunology, Genetics and Bioprocess Technology	4
V	BTC DSC301T	Plant Biotechnology	4
	BTC DSC302T	Animal Biotechnology	4
	BTC DSC303P	Plant Biotechnology and Animal Biotechnology	4
VI	BTC DSC351T	Recombinant DNA Technology	4
	BTC DSC352T	Genomics and Proteomics	4
	BTC DSC353T	Molecular Diagnostics	4
	BTC DSC354P	Recombinant DNA Technology and Molecular Diagnostics	4
VII	BTC DSC401T	Animal Cell Culture	4
	BTC DSC402T	Bioinformatics	4
	BTC DSC403T	Biostatistics	4
	BTC DSC404P	Animal Cell Culture, Bioinformatics and Biostatistics	4
VIII	BTC DSC451T	Research Methodology/	4
	BTC DSC452T	Industrial Biotechnology	4
	BTC DSC453(A)T	Medical Biotechnology	4
	BTC DSC454(B)T	Bioethics and Biosafety	4
	BTC DSC455T	Research Project/Dissertation	4

Table 2: Semester-wise list of Biotechnology DSM Courses

Semester	Course Code	Title of Courses	Credits
I	BTC DSM101T	Cell Biology and Biochemistry	3
II	BTC DSM151T	Cell Biology and Biochemistry	3
III	BTC DSM201T	Microbiology and Immunology	3
IV	BTC DSM251P	Cell Biology, Biochemistry, Microbiology and Immunology	3
	BTC DSM252T	Microbiology and Immunology	3
V	BTC DSM301T	Genetics and Molecular Biology	3
	BTC DSM302T	Genetics and Molecular Biology	3
VI	BTC DSM351P	Molecular Biology	3
VII	BTC DSM401T	Recombinant DNA Technology	3
VIII	BTC DSM451T	Recombinant DNA Technology	3

Table 3: Semester-wise list of Biotechnology SEC Courses

Semester	Course Code	Title of Courses	Credits
I	BTC SEC101	Microbiology	3
II	BTC SEC151	Immunology	3
III	BTC SEC201	Molecular Biology	3

Table 4: Semester-wise list of Biotechnology IDC Courses

Semester	Course Code	Title of Courses	Credits
I	BTC IDC101T	Biotechnology in Human Welfare	3
II	BTC IDC151T	Human Physiology	3
III	BTC IDC201T	Basics of Forensic Science	3

SYLLABI OF BIOTECHNOLOGY DSC PAPERS

SEMESTER-I

BTC DSC 101T
CELL BIOLOGY

Contact Hours: 45
Full Marks = 100 [ESE (70) CCA (30)]

Course Objective: *The objective of the course in Cell Biology is to provide students with a comprehensive understanding of the fundamental principles and concepts related to the structure, function, and behavior of cells. The course aims to introduce students to the various components of cells, including organelles, cytoskeletons, and cell membranes, and to explore their roles in cell biology. Additionally, the course aims to familiarize students with key processes such as the cell cycle, nucleic acid structure, cell adhesion, extracellular matrix, and the development and progression of cancer.*

UNIT 1 *(9 Lectures)*

Introduction to cell biology: cell theory; ultrastructure of prokaryotic and eukaryotic cells; cytosol and cytoplasm. **Structure and function of motile cells**: amoeboid, ciliary and flagellar. **Cytoskeletons:** microfilaments, intermediate filaments, and microtubules.

UNIT 2 *(8 Lectures)*

Structure and function of cell organelles: endoplasmic reticulum, golgi complex, mitochondria, chloroplast, ribosomes, lysosomes, peroxisomes and vacuole.

UNIT 3 *(9 Lectures)*

Nucleus: structure and function**. Cell Membrane:** components of biological membranes; fluid mosaic model; cell recognition and membrane transport.

UNIT 4 *(9 Lectures)*

Cell cycle: regulation of cell cycle; mitosis and meiosis; cell cycle check point; cell senescence; programmed cell death. **Nucleic acids:** nucleosides and nucleotides; purines and pyrimidines; physical and chemical properties of nucleic acids; double helical model of DNA.

UNIT 5 *(10 Lectures)*

Cell adhesion molecules: cadherins and integrins. **Extracellular Matrix:** composition and function. **Cancer**: carcinogenesis; agents promoting carcinogenesis; oncogenes; characteristics and molecular basis of cancer; treatment and prevention of cancer.

Course Outcomes: *The Cell Biology course provides a comprehensive understanding of cell structure, organelles, membrane function, cell cycle regulation, nucleic acids, cell adhesion, and cancer. Students will gain knowledge and insights into fundamental cellular processes and their implications in biological systems.*

SUGGESTED READING

1. Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments. 6th Edition. John Wiley & Sons. Inc.
2. De Robertis, E.D.P. and De Robertis, E.M.F. 2006. Cell and Molecular Biology. 8th edition.Lippincott Williams and Wilkins, Philadelphia.
3. Cooper, G.M. and Hausman, R.E. 2009. The Cell: A Molecular Approach. 5th edition. ASMPress & Sunderland, Washington, D.C.; Sinauer Associates, MA.
4. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. 2009. The World of the Cell. 7th edition. Pearson Benjamin Cummings Publishing, San Francisco.

BTC DSC 102T

ENVIRONMENTAL BIOTECHNOLOGY

Contact Hours: 45

Full Marks = 100 [ESE (70) CCA (30)]

Course Objective: *The objective of the course in Environmental Biotechnology is to provide students with an understanding of the principles and applications of biotechnology in addressing environmental challenges. The course aims to introduce students to various topics such as conventional and modern fuels, sewage and waste treatment, bioremediation techniques, biofertilizers, biocontrol agents, bioleaching, nanotechnology, and environmental monitoring. Through theoretical knowledge and practical examples, the course intends to equip students with the necessary skills to develop sustainable solutions for environmental issues using biotechnological approaches.*

UNIT I *(10 Lectures)*

Conventional fuels and their environmental impact: firewood, plant, animal, water, coal and gas. **Modern fuels and their environmental impact**: methanogenic bacteria, biogas; microbial hydrogen production; conversion of sugar to alcohol.

UNIT 2 *(8 Lectures)*

Sewage/Waste treatment: composition of sewage; treatment of municipal waste and industrial effluents. **Waste management and energy production:** composting; vermicomposting; biogas production.

UNIT 3 *(9 Lectures)*

Bioremediation techniques: bioremediation of soil & water contaminated with oil spills, heavy metals and detergents; degradation of cellulose using microbes; degradation of pesticides by microorganisms; phytoremediation and mycoremediation; biostimulation and bioaugmentation. .

UNIT 4 *(8 Lectures)*

Biofertilizers: nitrogen fixers, mycorrhiza, VAM. **Biocontrol agents**: biological control of pests and diseases. **Biopesticides.**

UNIT 5 *(10 Lectures)*

Bioleaching: microbial enrichment of ores (gold, copper and uranium) **Nanotechnology:** principle and applications. **Environmental Monitoring:** use of biosensors, remote sensing and GIS for environmental analysis. .

Course Outcomes: *The Environmental Biotechnology course equips students with a deep understanding of the environmental impact of fuels, sewage composition, waste management techniques, bioremediation methods, biofertilizers, biological control agents, bioleaching, nanotechnology applications, and environmental monitoring tools. By the end of the course, students will have the knowledge and skills to address environmental challenges, contribute to sustainable practices, and make informed decisions in the field of biotechnology and environmental science.*

SUGGESTED READING

1. Odum EP, Barrett GW (2004) Fundamentals of Ecology (5th ed.). Brooks/ Cole Publishers
2. Evans G, Furlong JC (2010) Environmental biotechnology: Theory and application. Oxford: Wiley-Blackwell
3. Fulekar MH (2010) Environmental biotechnology. Science Publishers
4. Jordening HJ, Winter J (2005) Environmental biotechnology: Concepts and applications. Wiley-VCH
5. Rittmann BE, McCarty PL (2001) Environmental biotechnology: Principles and applications. McGraw-Hill
6. Scragg AH (2005) Environmental biotechnology. Oxford University Press
7. Vallero D (2010) Environmental Biotechnology: A Biosystems Approach. Elsevier

SEMESTER-II

BTC DSC 151T
BIOCHEMISTRY

Contact Hours: 45
Full Marks = 100 [ESE (70) CCA (30)]

Course Objective: *The objective of the course in Biochemistry is to provide students with a comprehensive understanding of the fundamental principles and concepts in biochemistry. The course aims to introduce students to the structure, properties, and functions of biomolecules such as amino acids, proteins, carbohydrates, lipids, and nucleic acids. It also covers topics related to protein purification techniques, enzymology, and carbohydrate metabolism. The course intends to equip students with a solid foundation in biochemistry, enabling them to comprehend the intricate biochemical processes and their significance in cellular functions.*

UNIT 1 *(10 Lectures)*

Amino acids and proteins: structure and properties of amino acids; physical and chemical properties of proteins; different level of structural organization of proteins; forces stabilizing protein structure and shape; fibrous and globular proteins. **Protein purification techniques**: protein extraction and fractionation techniques.

UNIT 2 *(8 Lectures)*

Carbohydrate: structure; properties and function of monosaccharides, disaccharides and polysaccharides. homo and hetero polysaccharides; mucopolysaccharides; glycoproteins and their biological functions.

UNIT 3 *(10 Lectures)*

Lipids: classification and properties of fatty acids; essential fatty acids; phospholipids, glycolipids and steroids. **Nucleic acids:** nucleosides and nucleotides; purines and pyrimidines; physical and chemical properties of nucleic acids; double helical model of DNA; types of DNA.

UNIT 4 *(9 Lectures)*

Enzymes: nomenclature and classification of enzymes; enzyme specificity; lock-and-key model and induced-fit model; active site; factors affecting enzyme activity; activation energy; enzyme inhibition- reversible and irreversible; cofactors; prosthetic groups.

UNIT 5 *(8 Lectures)*

Carbohydrate metabolism: glycolysis; fate of pyruvate under aerobic and anaerobic conditions; pentose phosphate pathway; gluconeogenesis; glycogenolysis TCA cycle; electron transport chain.

Course Outcomes: *The Biochemistry course aims to provide students with a comprehensive understanding of the molecular foundations of life. By the end of the course, students will be able to describe the structure and properties of biomolecules. They will develop an understanding of enzyme nomenclature and classification, along with factors influencing enzyme activity. Furthermore, students will have a comprehensive understanding of the major pathways of carbohydrate metabolism, including glycolysis and the TCA cycle. Through these outcomes, students will be well-equipped to comprehend the intricate molecular processes that underlie biological systems and apply their knowledge to various fields within biotechnology.*

SUGGESTED READING

1. Berg, J. M., Tymoczko, J. L. and Stryer, L. (2006). Biochemistry. VI Edition. W.H Freeman and Co.
2. Buchanan, B., Gruissem, W. and Jones, R. (2000) Biochemistry and Molecular Biology of Plants. American Society of Plant Biologists.
3. Nelson, D.L., Cox, M.M. (2004) Lehninger: Principles of Biochemistry, 4th Edition, WH Freeman and Company, New York, USA.
4. Hopkins, W.G. and Huner, P.A. (2008) Introduction to Plant Physiology. John Wiley and Sons.
5. Salisbury, F.B. and Ross, C.W. (1991) Plant Physiology, Wadsworth Publishing Co. Ltd.

BTC DSC 152P

CELL BIOLOGY, ENVIRONMENTAL BIOTECHNOLOGY AND BIOCHEMISTRY

Contact Hours: 60
Full Marks = 100

Course Objective: *The objective of this combined course is to provide students with a comprehensive understanding of the fundamental principles and practical techniques. The course aims to introduce students to cell biology, environmental biotechnology, and biochemistry. The course intends to equip students with practical skills in these areas, enabling them to understand cellular processes, environmental analysis, and biochemical reactions.*

Two Experiments are to be performed – one from each part

Part A: Cell Biology

1. Preparation of solutions and buffers.
2. Handling and working principle of simple and compound microscope.
3. Study of mitosis in onion root tips.
4. Study of structure of prokaryotic and eukaryotic cell.

Part B: Environmental Biotechnology

1. Determination of moisture content, pH, particle size, water holding capacity and organic matter content of soil samples.
2. Determination of pH, conductivity and TDS content of water samples.
3. Isolation of microorganisms from soil, air and water.

Part C: Biochemistry

1. To study the effect of pH and temperature on the activity of salivary amylase.
2. Estimation of blood glucose by glucose oxidase method.
3. Estimation of protein by Lowry's method.
4. Separation of amino acids by paper chromatography.

Course Outcomes: *The practical course aims to provide students with a comprehensive understanding of fundamental principles and practical techniques in the areas of Cell Biology, Environmental Biotechnology and Biochemistry. By the end of the course, students will be able to prepare solutions and buffers, handle and operate microscopes, study cell division and cell structure, perform tests on soil and water samples, investigate the effects of pH and temperature on enzyme activity, conduct blood glucose and protein estimations and separate amino acids using paper chromatography.*

SUGGESTED READING

1. Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments. 6th Edition. John Wiley & Sons. Inc.
2. Berg, J. M., Tymoczko, J. L. and Stryer, L. (2006). Biochemistry. VI Edition. W.H Freeman and Co.
3. Gupta, R & Makhija, S and Toteja R. (2018). Cell Biology : Practical Manual. Prestige Publishers.
4. Patra, J. K., Das, G., Das, S. K., & Thatoi, H. (2020). A Practical Guide to Environmental Biotechnology. Springer.

SYLLABI OF BIOTECHNOLOGY DSM PAPERS

SEMESTER-I

BTC DSM 101T
CELL BIOLOGY AND BIOCHEMISTRY

Contact Hours: 45
Full Marks = 100 [ESE (70) CCA (30)]

Course Objective: *The objective of the course in Cell Biology and Biochemistry is to provide students with a comprehensive understanding of the principles and concepts related to the structure, function, and behavior of cells, as well as the fundamental aspects of biochemistry. The course aims to introduce students to the organization and components of cells, including organelles and cell membranes. It also covers essential topics in biochemistry, such as nucleic acids, proteins, carbohydrates, enzymes, and metabolic pathways.*

UNIT 1 *(8 Lectures)*

Introduction to cell biology: cell theory; ultrastructure of prokaryotic and eukaryotic cells. **Cell Membrane:** components of biological membranes, fluid mosaic model; cell recognition and membrane transport.

UNIT 2 *(8 Lectures)*

Structure and function of cell organelles: cytosol; endoplasmic reticulum; golgi complex; mitochondria; chloroplast; ribosomes; lysosomes; peroxisomes; nucleus; nucleolus; vacuole; cytoskeleton.

UNIT 3 *(10 Lectures)*

Nucleic acids: nucleosides and nucleotides; purines and pyrimidines; physical and chemical properties of nucleic acids; double helical model of DNA. **Cell cycle:** regulation of cell cycle; mitosis and meiosis; cell cycle check point; programmed cell death. **Cancer**: carcinogenesis; agents promoting carcinogenesis; oncogenes; characteristics and molecular basis of cancer; treatment and prevention of cancer.

UNIT 4 *(10 Lectures)*

Amino acids and proteins: structure and properties of amino acids; different level of structural organization of proteins; physical and chemical properties of proteins; forces stabilizing protein structure. **Carbohydrate:** structure; properties and function of monosaccharides, disaccharides and polysaccharides.

UNIT 5 *(9 Lectures)*

Enzymes: nomenclature and classification of enzymes; factors affecting enzyme activity; activation energy; enzyme inhibition- reversible and irreversible; cofactors; prosthetic groups.
Carbohydrate metabolism: glycolysis; TCA cycle; electron transport chain.

Course Outcomes: *By the end of the course, students will have a comprehensive understanding of cell biology, including the ultrastructure of prokaryotic and eukaryotic cells, as well as the components of biological membranes and the structure and function of cell organelles. They will also acquire an understanding on nucleic acids, cell cycle and cancer. Additionally, students will be familiar with the structure, properties, and functions of proteins and carbohydrates. They will have a solid understanding of the major metabolic pathways involved in carbohydrate metabolism, including glycolysis, the TCA cycle, and the electron transport chain.*

SUGGESTED READING

1. Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments. 6th Edition. John Wiley & Sons. Inc.
2. De Robertis, E.D.P. and De Robertis, E.M.F. 2006. Cell and Molecular Biology. 8th edition.Lippincott Williams and Wilkins, Philadelphia.
3. Cooper, G.M. and Hausman, R.E. 2009. The Cell: A Molecular Approach. 5th edition. ASMPress & Sunderland, Washington, D.C.; Sinauer Associates, MA.
4. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. 2009. The World of the Cell. 7th edition. Pearson Benjamin Cummings Publishing, San Francisco.
5. Berg, J. M., Tymoczko, J. L. and Stryer, L. (2006). Biochemistry. VI Edition. W.H Freeman and Co.
6. Buchanan, B., Gruissem, W. and Jones, R. (2000) Biochemistry and Molecular Biology of Plants.American Society of Plant Biologists.
7. Nelson, D.L., Cox, M.M. (2004) Lehninger Principles of Biochemistry, 4th Edition, WH Freeman and Company, New York, USA.

SEMESTER-II

BTC DSM 151T
CELL BIOLOGY AND BIOCHEMISTRY

Contact Hours: 45
Full Marks = 100 [ESE (70) CCA (30)]

Course Objective: *The objective of the course in Cell Biology and Biochemistry is to provide students with a comprehensive understanding of the principles and concepts related to the structure, function, and behavior of cells, as well as the fundamental aspects of biochemistry. The course aims to introduce students to the organization and components of cells, including organelles and cell membranes. It also covers essential topics in biochemistry, such as nucleic acids, proteins, carbohydrates, enzymes, and metabolic pathways.*

UNIT 1 *(8 Lectures)*

Introduction to cell biology: cell theory; ultrastructure of prokaryotic and eukaryotic cells. **Cell Membrane:** components of biological membranes, fluid mosaic model; cell recognition and membrane transport.

UNIT 2 *(8 Lectures)*

Structure and function of cell organelles: cytosol; endoplasmic reticulum; golgi complex; mitochondria; chloroplast; ribosomes; lysosomes; peroxisomes; nucleus; nucleolus; vacuole; cytoskeleton.

UNIT 3 *(10 Lectures)*

Nucleic acids: nucleosides and nucleotides; purines and pyrimidines; physical and chemical properties of nucleic acids; double helical model of DNA. **Cell cycle:** regulation of cell cycle; mitosis and meiosis; cell cycle check point; programmed cell death. **Cancer**: carcinogenesis; agents promoting carcinogenesis; oncogenes; characteristics and molecular basis of cancer; treatment and prevention of cancer.

UNIT 4 *(10 Lectures)*

Amino acids and proteins: structure and properties of amino acids; different level of structural organization of proteins; physical and chemical properties of proteins; forces stabilizing protein structure. **Carbohydrate:** structure; properties and function of monosaccharides, disaccharides and polysaccharides.

UNIT 5 *(9 Lectures)*

Enzymes: nomenclature and classification of enzymes; factors affecting enzyme activity; activation energy; enzyme inhibition- reversible and irreversible; cofactors; prosthetic groups. **Carbohydrate metabolism:** glycolysis; TCA cycle; electron transport chain.

Course Outcomes: *By the end of the course, students will have a comprehensive understanding of cell biology, including the ultrastructure of prokaryotic and eukaryotic cells, as well as the components of biological membranes and the structure and function of cell organelles. They will also acquire an understanding on nucleic acids, cell cycle and cancer. Additionally, students will be familiar with the structure, properties, and functions of proteins and carbohydrates. They will have a solid understanding of the major metabolic pathways involved in carbohydrate metabolism, including glycolysis, the TCA cycle, and the electron transport chain.*

SUGGESTED READING

1. Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments. 6th Edition. John Wiley & Sons. Inc.
2. De Robertis, E.D.P. and De Robertis, E.M.F. 2006. Cell and Molecular Biology. 8th edition.Lippincott Williams and Wilkins, Philadelphia.
3. Cooper, G.M. and Hausman, R.E. 2009. The Cell: A Molecular Approach. 5th edition. ASMPress & Sunderland, Washington, D.C.; Sinauer Associates, MA.
4. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. 2009. The World of the Cell. 7th edition. Pearson Benjamin Cummings Publishing, San Francisco.
5. Berg, J. M., Tymoczko, J. L. and Stryer, L. (2006). Biochemistry. VI Edition. W.H Freeman and Co.
6. Buchanan, B., Gruissem, W. and Jones, R. (2000) Biochemistry and Molecular Biology of Plants.American Society of Plant Biologists.
7. Nelson, D.L., Cox, M.M. (2004) Lehninger Principles of Biochemistry, 4th Edition, WH Freeman and Company, New York, USA.

SYLLABI OF BIOTECHNOLOGY SEC PAPERS

SEMESTER-I

BTC SEC 101
MICROBIOLOGY

Marks = 100 [ESE (50) IT (20) LAB (30)]

Course Objective: *The objective of the course in Microbiology is to provide students with a comprehensive understanding of the field of microbiology, including the history, classification, morphology and cell structure of microorganisms. The course aims to explain the basic concepts of microbial growth, culture techniques and sterilization methods. It also covers various applications of microbiology in environmental, industrial, agricultural, food, and fermented food sectors.*

PART-A: Theory
Contact hours: 30

UNIT 1 *(6 Lectures)*

History of microbiology: major discoveries and contributors to the field. **Microbial classification**: criteria for grouping microorganisms and major taxonomic groups. **Overview of microorganisms:** cell structure of major groups of microorganisms - bacteria, algae, fungi and protozoa; unique features of viruses.

UNIT 2 *(6 Lectures)*

Microbial growth: growth curve; generation time; factors affecting growth of bacteria; nutritional categories of micro-organisms **Genetic exchange in bacteria:** conjugation transformation and transduction.

UNIT 3 *(5 Lectures)*

Microbial culture techniques: preparation of culture media; inoculation; pure culture techniques. **Sterilization techniques:** Physical and chemical methods for sterilization.

UNIT 4 *(7 Lectures)*

Environmental microbiology: nutrient cycling and biogeochemical processes – e.g. carbon, nitrogen and phosphorous. **Industrial microbiology:** microbial production of antibiotics and enzymes. **Agricultural microbiology:** plant growth promoting bacteria; plant-microbe interactions – e.g. legume-rhizobia interaction; biocontrol agents.

UNIT 5 *(6 Lectures)*

Food Microbiology: important microorganisms in food microbiology; major food born infections; preservation of various types of foods. **Fermented Foods:** Introduction to fermented foods; importance of fermented foods; probiotics and their potential health benefits.

PART-B: Practical /Project/Field work
Contact hours: 30

The following is the list of practicals:

1. Preparation of media & sterilization methods
2. Serial dilution technique
3. Isolation of bacteria from air
4. Isolation of bacteria from water
5. Isolation of bacteria from soil
6. Grams staining and biochemical characterization of bacteria
7. Antibiotic sensitivity test

Course Outcomes: *By the end of the course, students will be familiar with the morphology and cell structure of various microorganisms, including bacteria, algae, fungi, protozoa, and viruses. Students will understand microbial growth and the mechanisms of genetic exchange in bacteria, including conjugation, transformation, and transduction. They will develop proficiency in microbial culture techniques, and attain knowledge on physical and chemical methods of sterilization in microbiological practices. Students will gain knowledge about the role of microorganisms in nutrient cycling and biogeochemical processes. Additionally, students will learn the diverse role of industrial microbiology, agricultural microbiology and food microbiology.*

SUGGESTED READING

1. Alexopoulos CJ, Mims CW, and Blackwell M. (1996). Introductory Mycology. 4 th edition. John and Sons, Inc.
2. Jay JM, Loessner MJ and Golden DA. (2005). *Modern Food Microbiology*. 7thedition, CBS Publishers and Distributors, Delhi, India.
3. Kumar HD. (1990). Introductory Phycology. 2nd edition. Affiliated East Western Press.
4. Madigan MT, Martinko JM and Parker J. (2009). Brock Biology of Microorganisms. 12th edition. Pearson/Benjamin Cummings.
5. Pelczar MJ, Chan ECS and Krieg NR. (1993). Microbiology. 5th edition. McGraw Hill Book Company.
6. Stanier RY, Ingraham JL, Wheelis ML, and Painter PR. (2005). General Microbiology. 5th edition. McMillan.
7. Tortora GJ, Funke BR, and Case CL. (2008). Microbiology: An Introduction. 9 th edition. Pearson Education.
8. Willey JM, Sherwood LM, and Woolverton CJ. (2008). Prescott, Harley and Klein's Microbiology. 7th edition. McGraw Hill Higher Education.

SEMESTER-II

BTC SEC 151
IMMUNOLOGY
Marks = 100 [ESE (50) IT (20) LAB (30)]

Course Objective: *The objective of the course in Immunology is to provide students with a comprehensive understanding of the immune system and its components. The course aims to introduce students to the concepts of immunity and the structure and function of immune cells such as B lymphocytes and T lymphocytes. It covers topics such as antibody production, immunoglobulin gene expression, antigen recognition and processing, autoimmune diseases, immunodeficiency, vaccines and vaccination, and immunodiagnostics. The course intends to equip students with a solid foundation in immunology, enabling them to understand the mechanisms of immune responses and their applications in healthcare and diagnostics.*

PART-A: Theory
Contact hours: 30

UNIT 1 *(7 Lectures)*

Overview of the immune system: innate and adaptive immunity; humoral and cellular immune responses. **Immune components:** B lymphocytes and T lymphocytes; structure of immunoglobulins; T cell receptors. **B-cell activation:** antibody production; class switching and affinity maturation; heavy chain gene transcription.

UNIT 2 *(7 Lectures)*

Regulation of immunoglobulin gene expression: clonal selection theory; allotypes and idiotypes; allelic exclusion; immunologic memory, heavy chain gene transcription, genetic basis of antibody diversity. **Antigen and allergen:** properties and types of antigens - self-antigens, foreign antigens, and allergens; immunogenicity.

UNIT 3 *(5 Lectures)*

Antigen recognition and processing: class I and class II MHC molecules, antigen processing and presentation by MHC molecule.

UNIT 4 *(5 Lectures)*

Autoimmune diseases: examples of organ-specific (Hashimoto's disease, myasthenia gravis) and systemic (systemic lupus erythematosus, rheumatoid arthritis) autoimmune diseases. **Immunodeficiency**: HIV and AIDS.

UNIT 5 *(6 Lectures)*

Vaccines and vaccination: adjuvants; cytokines; types of vaccines (bacterial, viral, recombinant, DNA vaccines); passive and active immunization. **Introduction to immunodiagnostics**: ELISA; RIA; immune-electrophoresis.

PART-B: Practical /Project/Field work
Contact hours: 30

The following is the list of practicals:

1. Perform total count of red blood cells (RBCs) in a blood sample
2. Determination of total leukocyte count (TLC) in a blood sample
3. Determination of differential leukocyte count (DLC) in a blood sample
4. Analyze antigen-antibody reactions using the Ouchterlony double immunodiffusion technique.
5. Perform ELISA to detect specific antigen or antibody in a sample.

Course Outcomes: *By the end of the course, students will have a solid understanding of immunology. They will be able to explain the components of the immune system, and will have knowledge of immunoglobulin gene expression regulation, clonal selection theory, and the genetic basis of antibody diversity. Students will be able to understand the concept of antigen recognition and processing. Students will gain knowledge about autoimmune diseases as well as immunodeficiency diseases. Additionally, students will be attain the concept of vaccines, and able to describe the immunodiagnostics techniques such as ELISA, RIA, and immune-electrophoresis.*

SUGGESTED READING

1. Abbas AK, Lichtman AH, Pillai S. (2007). Cellular and Molecular Immunology. 6 th edition Saunders Publication, Philadelphia.
2. Delves P, Martin S, Burton D, Roitt IM. (2006). Roitt's Essential Immunology. 11th edition Wiley-Blackwell Scientific Publication, Oxford.
3. Goldsby RA, Kindt TJ, Osborne BA. (2007). Kuby's Immunology. 6th edition W.H. Freeman and Company, New York.
4. Murphy K, Travers P, Walport M. (2008). Janeway's Immunobiology. 7th edition Garland Science Publishers, New York.
5. Peakman M, and Vergani D. (2009). Basic and Clinical Immunology. 2nd edition Churchill Livingstone Publishers, Edinberg.
6. Richard C and Geiffrey S. (2009). Immunology. 6th edition. Wiley Blackwell Publication

SYLLABI OF BIOTECHNOLOGY IDC PAPERS

SEMESTER-I

BTC IDC 101T
BIOTECHNOLOGY IN HUMAN WELFARE

Contact Hours: 45
Full Marks = 100 [ESE (70) CCA (30)]

Course Objective: *The objective of the course is to provide students with a comprehensive understanding of the applications of biotechnology in various aspects of human welfare, including medicine, healthcare, agriculture, environment, and industry. The course aims to introduce students to the principles and techniques of genetic engineering, production of therapeutic products, gene therapy, forensic science, plant biotechnology, environmental biotechnology, and industrial biotechnology. It also aims to highlight the potential benefits and challenges associated with the use of biotechnology in improving human well-being.*

UNIT 1 *(7 Lectures)*
Biotechnology: definition and scope; major milestones; applications in healthcare; agriculture, and industry; overview of genetically modified organisms (GMOs).

UNIT 2 *(10 Lectures)*
Medicine and healthcare biotechnology: introduction to genetic engineering; production of therapeutic products – e.g. insulin and growth hormone; gene therapy and its potential for treating genetic diseases. **Forensic science:** solving violent crimes such as murder and rape; solving claims of paternity; introduction to DNA finger printing – PCR and RFLP.

UNIT 3 *(10 Lectures)*
Plant Biotechnology: basic techniques of plant tissue culture; somaclonal variation – principle, application and limitations; somatic hybridization; biopesticides and biofertilizers – principles and applications; production of transgenic plants – BT cotton and golden rice.

UNIT 4 *(9 Lectures)*
Environmental Biotechnology: introduction to bioremediation and its role in cleaning up pollutants; treatment of municipal waste and industrial effluents; biogas production; use of biosensors for environmental analysis.

UNIT 5 *(9 Lectures)*
Industrial Biotechnology: introduction to bioprocess technology; principles of upstream processing- media preparation and sterilization; design of bioprocess vessels; introduction to downstream processing, product recovery and purification.

Course Outcome: *Students will gain a comprehensive understanding of biotechnology and its applications in healthcare, agriculture, industry, and the environment. They will learn about genetic engineering, plant tissue culture, environmental biotechnology, and industrial biotechnology. By the end of the course, students will be equipped with the knowledge and abilities to contribute to the field of biotechnology across various sectors.*

SUGGESTED READING

1. Sateesh MK (2010) Bioethics and Biosafety, I. K. International Pvt Ltd.
2. Sree Krishna V (2007) Bioethics and Biosafety in Biotechnology, New age international publishers
3. Ratledge, C., & Kristiansen, B. (Eds.). (2001). Basic biotechnology. Cambridge University Press.
4. Wang, L. K., Ivanov, V., Tay, J. H., & Hung, Y. T. (Eds.). (2010). Environmental biotechnology (Vol. 10). Springer Science & Business Media.

SEMESTER-II

BTC IDC 151T
HUMAN PHYSIOLOGY

Contact Hours: 45
Full Marks = 100 [ESE (70) CCA (30)]

Course Objective: *The objective of the course in Human Physiology is to provide students with a comprehensive understanding of the physiological processes and systems in the human body. It covers topics such as the human digestive system, respiratory system, circulatory system, skeletal system, excretory system, and the nervous and endocrine systems. The course intends to equip students with knowledge of the structure, function, and coordination of these systems, enabling them to understand the complexities of human physiology.*

UNIT I *(8 Lectures)*

Digestion: definition of digestion; human digestive system; digestion in buccal cavity, stomach and intestine; basic composition of bile, saliva, pancreatic juice and intestinal juice; role of liver, gall bladder and pancreas in digestion.

UNIT II *(9 Lectures)*

Respiration: definition of respiration; aerobic and anaerobic respiration; human respiratory system; structure of lungs; inspiration and expiration; transport of O_2; transport of CO_2; exchange of gases; chloride shift.

UNIT III *(9 Lectures)*

Circulation: composition of blood; mechanism of blood coagulation; single and double circulation; structure of human heart; mechanism of blood circulation through human heart; cardiac cycle; ECG; pacemaker.

UNIT IV *(9 Lectures)*

Locomotion: cardiac, smooth and skeletal muscles; actin and myosin; bone and cartilage; axial skeleton; appendicular skeleton; disorders of skeletal system. **Excretion:** definition of excretion; structure of kidney; structure of nephron; urea cycle; composition of human urine; sweat and sebum.

UNIT V *(10 Lectures)*

Neural and chemical co-ordination: types of nervous system; structure of human brain; cerebrum and cerebellum; structure of neuron; reflex action; definition of hormones; functions of hormones; pituitary; pineal gland; thyroid; thymus; pancreas as endocrine gland; testis; ovary.

Course Outcomes: *By the end of the course, students will have a comprehensive understanding of human physiology. They will be able to describe the digestive system, respiratory system, cardiovascular system, musculoskeletal system, excretory system, nervous system and endocrine system. Students will be able to explain the functions and interactions of various organs and systems in the human body. They will also gain knowledge of common disorders related to the skeletal system. Students will develop a strong foundation in human physiology and its importance in maintaining overall health.*

SUGGESTED READING

1. Guyton, A.C. & Hall, J.E. (2006). Textbook of Medical Physiology. XI Edition. Hercourt Asia PTE Ltd. /W.B. Saunders Company.
2. Tortora, G.J. & Grabowski, S. (2006). Principles of Anatomy & Physiology. XI Edition. John wiley & sons,Inc.
3. VanPutte, C. L., Regan, J. L., & Russo, A. F. (2021). Seeley's essentials of anatomy & physiology. McGraw-Hill.