కేంద్రీయ గిరిజన విశ్వవిద్యాలయం ఆంధ్ర ప్రదేశ్

केन्द्रीय जनजाति विश्व विद्यालय आंध्र प्रदेश

CENTRAL TRIBAL UNIVERSITY OF ANDHRA PRADESH

CURRICULUM AND SYLLABUS

(For 2025 -2026 admitted batch onwards)

Department of Biotechnology
School of Sciences

M.Sc. Biotechnology

REGULATIONS

(W.e.f 2025-26 admitted batch onwards)

ADMISSIONS

Admissions into the M.Sc. Biotechnology program shall be made through CUET (PG) conducted by the National Testing Agency (NTA) and entrance conducted by university for vacant seats.

ELIGIBILITY CRITERIA

Bachelor's degree in Biochemistry/ Bioinformatics/ Biotechnology/ Botany/ Microbiology/ Zoology/ Genetics or equivalent from any recognized University with at least 50% marks in aggregate for General, EWS and OBC categories or its equivalent on grading scale of respective University (45% marks or its equivalent on grading scale of respective University for SC/ST/PwD candidates).

STRUCTURE OF THE PROGRAM

The program consists of:

- Core courses
- Discipline centric electives
- Practicum courses

Each course is assigned a certain number of credits depending upon the number of contact hours (lectures/tutorials/practical) per week.

In general, credits are assigned to the courses based on the following contact hours per week per semester.

- One credit for each lecture / tutorial hour.
- One credit for two hours of practicum.
- Twenty credits for Research Project & Dissertation.

The curriculum of four semesters M.Sc. Biotechnology program is designed to have a total of 83. credits for the award of M.Sc. degree.

MEDIUM OF INSTRUCTION

The medium of instruction shall be in English

ATTENDANCE REQUIREMENTS

- A student whose attendance is less than 75% in all the courses put together in any semester will not be permitted to attend the end-semester examination, and he/she will not be allowed to register for the subsequent semester of study. He/ She will have to repeat the semester along with his/her juniors.
- However, the Vice-Chancellor on the recommendation of the Head of the Department and Dean of the School, may consider the shortage of attendance for students whose attendance is between 65% and 74% on genuine medical grounds.
- Other rules and regulations according to university examination section.

EVALUATION

The assessment of the student's performance in a theory course shall be based on two components: Continuous Evaluation (30 marks) and Semester-end examination (70 marks)

Program Structure for 2-Years M.Sc. Biotechnology Program

(From 2025-2026 admitted batch onwards)

	Course Level	Course Code	Title of the course	Lectures	Tutorial	Practicum	Credits	Marks
Semester-I	500	BIT 501	Cell Biology	3	0	0	3	100
	500	BIT 502	Basic Biochemistry	3	0	0	3	100
	500	BIT 503	Genetics and Molecular biology	3	0	0	3	100
	500	BIT 504	Ecology and Evolutionary Biology	3	0	0	3	100
	500	BIT 505	Bio-analytical techniques	3	0	0	3	100
	500	BIT 511	Cell Biology and Genetics and molecular biology Practicum	0	0	6	3	100
	500	BIT 512	Basic Biochemistry and Bio-analytical tools and techniques Practicum	0	0	6	3	100
	Total						**21**	
Semester-II	500	BIT 551	Microbiology & immunology	3	0	0	3	100
	500	BIT 552	Genetic engineering	3	0	0	3	100
	500	BIT 553	Plant Physiology and biotechnology	3	0	0	3	100
	500	BIT 554	Animal Physiology and biotechnology	3	0	0	3	100
	500	BIT555	Plant and Animal Tissue culture	3	0	0	3	100
	500	BIT 561	Microbiology and immunology Practicum	0	0	6	3	100
	500	BIT 562	Genetic engineering Practicum	0	0	6	3	100
	Total						**21**	
Semester-III	600	BIT 601	Biostatistics and Bioinformatics	3	0	0	3	100
	600	BIT 602	Fermentation & Industrial biotechnology	3	0	0	3	100
	600	BIT 603	Biosafety, IPR, and Entrepreneurship	3	0	0	3	100
	600	BIT 604	Research Methodology	3	0	0	3	100

	600	BIT 621 - 625	Elective-I	2	0	0	3	100
	600	BIT 611	Biostatistics and Bioinformatics practicum	0	0	6	3	100
	600	BIT 612	Diagnostic tools &techniques practicum	0	0	6	3	100
	Total						**21**	
Sem - IV	600	BIT 692	Research Project & Dissertation	0	0	40	20	300
	Total						**20**	

[Candidates are encouraged to choose the appropriate course either from the following list or from UGC- MOOCs/NPTEL with prior permission from Head of the Department]

ELECTIVE-I

Course Code	Title of the Course
BIT 621	Immuno-technology
BIT 622	Aquaculture
BIT623	Organic Farming
BIT624	Scientific writing
BIT625	Dairy and Food Processing Technology
BIT626	Fundamentals of public health

SEMESTER-I			
COURSE CODE	**TITLE OF THE COURSE**	**CREDITS**	**SEMESTER**
BIT501	**CELL BIOLOGY**	**3**	**I**

Course Objectives: Gain a comprehensive understanding of key biological concepts such as cell theory, evolution, and the characteristics of life. Delve into the structure and function of eukaryotic cells, including the plasma membrane, organelles, and nucleus, and understand their roles in cellular processes. Investigate the fundamental processes of cell metabolism, including anabolism and catabolism, and understand the role of enzymes in catalyzing biochemical reactions. Integrate knowledge of cellular structure and function with broader biological concepts such as biodiversity, ecological interactions, and evolution. Apply theoretical knowledge to practical contexts, including experimental design, data analysis, and scientific communication.

UNIT-I

Cell types: Evolution of different cell types and their importance in tissue organization and function. Historical overview of cell theory and its significance, protoplasm theory and organismal theory. Comparison and ultrastructure of prokaryote and eukaryote cells, viruses

UNIT-II

Cell Structure and Function: Overview of cell components: plasma membrane, cytoplasm, cytoskeletal structures, Detailed study of cell membrane structure, fluid mosaic model, membrane fluidity, ion channels, active transport, membrane pumps, mechanism of sorting and regulation of intracellular transport, electrical properties of membranes organelles: mitochondria, chloroplast endoplasmic reticulum, Golgi apparatus, lysosomes, centrioles, nucleus and its components

UNIT-III

Cellular Processes and Energy Flow: Cell metabolism: anabolism and catabolism, Enzymes and their role in cellular reactions, Cellular respiration and energy production: electron transport system and oxidative phosphorylation, Photosynthesis and its significance in energy capture, Cell cycle and cell division: mitosis and meiosis. Cell signaling: Hormones and their receptors, cell surface and intracellular receptors, GPCRs, Tyrosine Kinase Receptors, RTKs and cytokine receptors bacterial chemotaxis and quorum sensing.

UNIT-IV

Methodology to assess cell function: principles and applications of different research techniques used in cell biology like microscopy, FRAP, Flow cytometry

References

1. "Molecular Biology of the Cell" by Bruce Alberts, Alexander Johnson, Julian Lewis, David Morgan, Martin Raff, Keith Roberts, and Peter Walter, published in 2019.
2. "Biology: The Unity and Diversity of Life" by Cecie Starr, Ralph Taggart, Christine Evers, and Lisa Starr, published in 2019.
3. "Essential Cell Biology" by Bruce Alberts, Dennis Bray, Karen Hopkin, Alexander D. Johnson, Julian Lewis, Martin Raff, Keith Roberts, and Peter Walter, published in 2019.

COURSE CODE	TITLE OF THE COURSE	CREDITS	SEMESTER
BIT502	BASIC BIOCHEMISTRY	3	I

Course Objectives: Understand the definition and classification of biomolecules, including carbohydrates, lipids, proteins, and nucleic acids, and their significance in biological processes. Describe the structure and functions of carbohydrates, emphasizing their role in energy storage and cellular recognition, and explain the significance of lipids in cell membranes and energy storage. Explore the structure, classification, and properties of amino acids, and understand the diverse functions of proteins, including enzymatic catalysis, structural support, and signaling. Analyze the structure of DNA and RNA, and explain their roles in genetic information storage, replication, transcription, and translation, and explore key metabolic pathways, including glycolysis, the citric acid cycle, and oxidative phosphorylation.

UNIT-I

Basic Concepts of Biochemistry: Importance of biochemistry in understanding life processes, Overview of chemical bonding: Vân der Waals, electrostatic, hydrogen bonding, hydrophobic interaction, & covalent bonds, pH, pk_a, acids, bases, buffers, chirality, stearic hindrance, stereoisomers &geometric isomers, principles of thermodynamics

UNIT-II

Carbohydrates and Lipids: Structure, functions and properties of carbohydrates, classification: monosaccharides, disaccharides, polysaccharides, epimers and anomers, glycosidic linkage, Role of carbohydrates in energy storage and cellular recognition, Structure and properties of lipids: fatty acids, triglycerides, phospholipids, micelles, liposomes, bilayers and vesicles, steroids, Significance of lipids in cell membranes and energy storage.

UNIT-III

Proteins and Enzymes: Amino acids: structure, classification, and properties: zwitter ion, isoelectric point, pk_a value, peptide bond formation Protein structure levels: primary, secondary, tertiary, quaternary, globular and fibrous protein, Ramachandran plot, protein denaturation& folding, oxygen binding protein: Hemoglobin &Myoglobin. Enzymes classification, cofactor, prosthetic group apoenzyme &holoenzyme, Enzymes: catalysis, specificity, enzyme kinetics, regulation.

UNIT-IV

Nucleic Acids and Metabolism: DNA and RNA structure: nucleotides, base pairing, double helix, different forms of DNA: A, B, Z, euchromatin &heterochromatin, Overview of metabolism: anabolism and catabolism, Energy carriers: ATP, NADH, FADH2, Metabolism of carbohydrates, lipids, amino acids nucleotides and vitamins.

References

1. Lehninger Principles of Biochemistry by David L. Nelson and Michael M. Cox
2. Biochemistry by Jeremy M. Berg, John L. Tymoczko, and LubertStryer
3. Biochemistry: Concepts and Connections by Dean R. Appling, Spencer J. Anthony-Cahill, and Christopher K. Mathews

COURSE CODE	TITLE OF THE COURSE	CREDITS	SEMESTER
BIT503	GENETICS AND MOLECULAR BIOLOGY	3	I

Course objectives: Gain an understanding of genetics and its significance in biological processes, including the historical development of genetics as a scientific discipline and the basic principles of inheritance outlined by Mendel's laws. Explore non-Mendelian inheritance patterns, including incomplete dominance, codominance, and sex-linked inheritance, and understand how these patterns contribute to genetic diversity and inheritance of traits in populations. Examine the molecular structure of DNA, including nucleotides, base pairing, and the double helix, and understand the process of DNA replication, including semiconservative replication and the enzymes involved. Investigate the processes of transcription and translation, including RNA synthesis, the role of RNA polymerase, ribosomes, tRNA, and codons, understand the mechanisms of gene regulation, including transcription factors, operons, and epigenetic modifications.

UNIT-I

Introduction to Genetics and Molecular Biology -Mendel's laws of inheritance: Law of Dominance, segregation &independent assortment, Monohybrid and dihybrid crosses: Punnett squares and phenotype predictions, types of genetic material, Griffith, Avery, Macleod & McCarty, Hershey and Chase, Meselson Stahl experiments, Central dogma

UNIT-II

Mendelian Genetics and Inheritance Patterns: Non-Mendelian inheritance: incomplete dominance, codominance, multiple alleles, epistasis, lethal genes, complementary genes Sex-linked inheritance, and pedigree analysis, Linkage and crossing over, gene mapping, recombination frequency Cytoplasmic and mitochondrial inheritance, Human genetics and diseases. Sex determination and dosage compensation.

UNIT-III

DNA Structure and Replication: Molecular structure of DNA: nucleotides, base pairing, double helix, DNA replication in prokaryotes &eukaryote, Repair mechanisms: mismatch repair, base excision repair, NER, direct repair

UNIT-IV

Gene Expression and Regulation: Transcription: RNA synthesis, RNA polymerase, promoters, enhancers, post-transcriptional modifications: alternative splicing, RNA editing. Translation: ribosomes, structure of tRNA, genetic code & wobble hypothesis, initiation, elongation, termination of translation in prokaryotes &eukaryotes Regulation of gene expression: operons (lac, trp, arabinose,) epigenetic modifications.

References

1. Principles of Genetics by D. Peter Snustad and Michael J. Simmons
2. Genetics: A Conceptual Approach by Benjamin A. Pierce
3. Molecular Biology of the Cell by Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, and Peter Walter.

COURSE CODE	TITLE OF THE COURSE	CREDITS	SEMESTER
BIT504	ECOLOGY AND EVOLUTIONARY BIOLOGY	3	I

Course objectives: Students will acquire a comprehensive understanding of ecology, encompassing the definition, scope, and hierarchical levels of ecological organization. They will develop analytical skills to investigate energy flow and nutrient cycling within ecosystems. Additionally, they will gain proficiency in utilizing population growth models to forecast changes in population dynamics, identifying key factors influencing population size, and critically evaluating the ecological impacts of human activities. Moreover, learners will delve into the intricate genetic mechanisms that drive embryonic development, exploring the pivotal roles of homeobox genes, pattern formation, and cell signaling in differentiation and morphogenesis.

UNIT-I

Introduction to Ecology and Ecosystems: Definition and scope of ecology: study of interactions between organisms and their environment, biotic and abiotic interactions Habitat and Niche, niche overlap &types resource partitioning; character displacement, Dynamics and types ecosystem: energy, primary &secondary production, food chain, food web, tropic levels, ecological pyramids, energy flow.

UNIT-II

Population Dynamics and Community Ecology: Population growth models: exponential and logistic growth, r and K selection, Factors influencing population size: birth rates, death rates, immigration, emigration, Species Interactions: Competition, Neutralism, predation, parasitism, ammenselism, commensalism, mutualism Succession: primary and secondary succession, climax communities, Biogeochemical cycles: carbon, nitrogen, phosphorus cycles.

UNIT-III

Developmental biology: Introduction to developmental biology: gametogenesis, fertilization, cleavage, gastrulation &embryonic development, Potency, commitment, specification (autonomous, conditional, syncytial) induction, competence, determination and differentiation; morphogenetic gradients, cell fate and cell lineages, stem cells.

UNIT-IV

Evolution and Population genetics: Lamarck; Darwin–concepts of variation, adaptation, struggle, fitness and natural selection; Mendelism; Spontaneity of mutations; The evolutionary synthesis. Populations, Gene pool, Gene frequency; Hardy-Weinberg Law; concepts and rate of change in gene frequency through natural selection, migration and random genetic drift; Adaptive radiation, Isolating mechanisms; Speciation, Allopatric, Sympatric, parapetric, peripatric; Convergent evolution; Sexual selection; Co-evolution.

References

1. Ecology: Concepts and Applications by Manuel C. Molles Jr.
2. Developmental Biology by Scott F. Gilbert
3. Ecology: The Economy of Nature by Robert E. Ricklefs and Rick Relyea
4. Principles of Development by Lewis Wolpert, Cheryll Tickle, and Alfonso Martinez Arias

COURSE CODE	TITLE OF THE COURSE	CREDITS	SEMESTER
BIT505	BIO-ANALYTICAL TOOLS AND TECHNIQUES	3	I

Course objectives: students will embark on a comprehensive journey encompassing various facets of biological applications and technological advancements. They will delve into the expansive scope of applied biology understanding how instrumentation plays a pivotal role in driving research and practical applications forward. Through exploration of medical instrumentation and diagnostics, learners will gain insights into cutting-edge techniques such as MRI, CT, PCR, and DNA sequencing, while recognizing the importance of biomarkers in disease diagnosis. Furthermore, they will delve into the principles of genetic engineering and biotechnology, honing their skills in recombinant DNA technology and bioinformatics tools. Through this integrated approach, students will emerge prepared to contribute meaningfully to the intersection of biology and technology in addressing real-world challenges and advancements.

UNIT-I

Introduction to Applied and Instrumentation Biology: Isolation of nucleic acid, Electrophoresis: polyacrylamide, agarose gel electrophoresis, PAGE, 2D PAGE, Isoelectric focusing gels, Molecular analysis using UV/visible, fluorescence, circular dichroism, NMR and ESR, Mass spectroscopy, X-ray diffraction and NMR

UNIT-II

Medical Instrumentation and Diagnostics: Molecular diagnostics: PCR, ELISA, DNA sequencing, immunoprecipitation, flowcytometry, FISH and GISH, Biomarkers and their role in disease diagnosis and monitoring.

UNIT-III

Biotechnology and Instrumentation: Principles of genetic engineering and biotechnology, Tools and techniques in recombinant DNA technology: gene cloning, gene expression analysis, Protein purification and analysis methods, blotting techniques

UNIT-IV

Environmental Monitoring and Instrumentation: Importance of environmental monitoring and conservation, Instruments for assessing air quality, water quality, soil health, and biodiversity, Remote sensing and Geographic Information Systems (GIS) applications in environmental studies.

References

1. Principles of Instrumental Analysis by Douglas A. Skoog, F. James Holler, and Stanley R. Crouch
2. Biotechnology by David P. Clark and Nanette J. Pazdernik
3. Molecular Biology Techniques: An Intensive Laboratory Course by Susan J. Karcher
4. Environmental Instrumentation and Analysis Handbook by C. Baral, R. S. Chakraborty, and A. Sengupta

COURSE CODE	TITLE OF THE COURSE	CREDITS	SEMESTER
BIT511	CELL BIOLOGY AND GENETICS AND MOLECULAR BIOLOGY PRACTICUM	3	I

Course objectives: In the laboratory, students will delve into the realm of life forms and cellular organization using microscopy techniques. They will gain practical experience in understanding different cell structure, its organelles and multiplication gaining insights into intricate cellular structures. Through hands-on activities, they will analyze blood cells, refining their ability to identify different cell types. They should learn the laws of heredity with practical emphasis on inheritance and will be able to identify and outline the structure of a eukaryotic cell at different magnification, measure the cell length and breadth using micrometry, differentiate stages of Mitosis and meiosis. They should be able to isolate the DNA, identify and distinguish different blood cells, to solve simple genetic problems and analyze Human karyotype and pedigree.

Experiments

1. Principle and utility of microscopy
2. Observation of distinguishing features of different eukaryotic cells
3. Staining to differentiate plant and animal cells
4. Preparation of blood smear and differential staining of blood cells
5. Identification of Blood groups
6. Study of divisional stages in Mitosis.
7. Study of divisional stages in Meiosis.
8. Isolation of plant cellular DNA.
9. Simple genetic problems solving
10. Human Karyotype analysis
11. Simple Mendelian traits in humans and pedigree analysis

Reference Books

1. Microscopy: A Very Short Introduction by Terence Allen and Graham W. Gooday., 2015
2. Essential Cell Biology by Bruce Alberts, Dennis Bray, Karen Hopkin, Alexander D. Johnson, Julian Lewis, Martin Raff, Keith Roberts, and Peter Walter., 2019
3. Cell Biology by the Numbers by Ron Milo and Rob Phillips., 2015

COURSE CODE	TITLE OF THE COURSE	CREDITS	SEMESTER
BIT512	BASIC BIOCHEMISTRY AND BIOANALYTICAL TECHNIQUES PRACTICUM	3	I

Course objectives: In the Biochemistry and Instrumentation lab, students will conduct various experiments and utilize essential equipment to explore biochemical concepts. They will estimate carbohydrates and proteins through methods like Fehling's test, Iodine test, Biuret Method, and Lowry's method. Additionally, they will prepare buffers, measure pH, and investigate salivary amylase activity. Students will also work with advanced instruments including agarose gel electrophoresis units, SDS Page units, PCR machines, spectrophotometers, autoclaves, and laminar air flows, gaining practical skills crucial for biochemical research and analysis.

Experiments

1. Buffer preparation and operation of a pH meter
2. Spectroscopy – determine absorption maxima of protein and prove Beer-Lambert's law
3. Carbohydrate estimation by Fehling's test and Iodine test
4. Estimation of proteins by Biuret Method and Lowry's method.
5. Agarose gel electrophoresis of isolated nucleic acids
6. SDS PAGE for the isolated proteins
7. Polymerase chain reaction
8. Microtomes
9. Lyophilization (freeze-drying)
10. Chromatography

Reference Books

1. Practical Skills in Biomolecular Sciences by Rob Reed 2011
2. Practical Spectroscopy: The Rapid Interpretation of Spectral Data for McMurry's Organic Chemistry by James W. Zubrick., 2013
3. Practical Biochemistry by Wilson & Walker., 2008
4. Practical Protein Bioinformatics by Ingvar Eidhammer, Ida Norholm, Kristian Flick., 2019
5. Molecular Cloning: A Laboratory Manual by Michael R. Green, Joseph Sambrook., 2012

SEMESTER-II			
COURSE CODE	**TITLE OF THE COURSE**	**CREDITS**	**SEMESTER**
BIT551	**MICROBIOLOGY AND IMMUNOLOGY**	**3**	**II**

Course Objectives: Students will explore microbiology's history and scope, covering microbial morphology, taxonomy, and classification criteria. They'll learn about various microorganisms, including bacteria, archaea, algae, fungi, protozoa, extremophiles, and un-culturable microbes. Additionally, they'll study methods for controlling microorganisms such as sterilization, disinfection, and antisepsis, alongside antibiotics, antiviral, and antifungal drugs. The curriculum delves into viruses, bacteriophages, host-pathogen interactions, and microbial communication systems. Furthermore, learners will focus on innate and acquired immunity, including components like phagocytosis, complement, inflammatory responses, and immunological organs. Finally, they'll be introduced to advanced immunological techniques such as RIA, ELISA, Western blotting, and flow cytometry, alongside topics like immune reactions, cytokines, apoptosis, gene knockout techniques, microarray analysis, transgenic mice, and biosensor assays.

UNIT-I

Introduction to microbiology and microbes: history & scope of microbiology. Microbial taxonomy and evolution of diversity, Types of microorganisms, general characteristics of main groups of microorganisms, Criteria used in the classification of microorganisms, cytology, genetics, host specialization, serology.

UNIT-II

Aseptic techniques and properties of microbes: Sterilization, disinfection and antisepsis: physical and chemical methods, antibiotics, antiviral and antifungal drugs, biological control of microorganisms. Virus and bacteriophages: general properties & classification, structure, taxonomy of virus, viral replication, sub-viral particles – viroids and prions., PPLO Host-pathogen interaction, ecological impact of microbes, symbiosis (Nitrogen fixation and ruminant symbiosis), microbes and nutrient cycles, microbial communication system, bacterial quorum sensing, microbial fuel cells, prebiotics and probiotics.

UNIT-III

Concepts of immunology: Components of innate and acquired immunity, phagocytosis, complement and inflammatory responses, pathogen recognition receptors (PRR) and pathogen associated molecular pattern (PAMP), antigenicity & immunogenicity(haptens & adjuvants)Major Histocompatibility Complex: antigen processing and presentation- endogenous antigens, exogenous antigens, activation and differentiation of B and T cells, B and T cell receptors, humoral and cell mediated immune responses, Organs of immune system, primary and secondary lymphoid organs, Immunoglobulins - basic structure, classes & subclasses of immunoglobulins, hypersensitivity and autoimmunity, vaccines, cytokines: properties, receptors and therapeutic uses.

UNIT-IV
Immunology techniques: Precipitation, agglutination and complement mediated immune reactions. Advanced immunological techniques: RIA, ELISA, Western blotting, ELISPOT assay, immunofluorescence microscopy, flow cytometry and immunoelectron microscopy, surface plasmon resonance, biosensor assays for assessing ligand – receptor interaction, cell cytotoxicity assays, microarrays, transgenic mice, gene knock outs.
Reference Books
1. Pelczar, M. J., Reid, R. D., & Chan, E. C. (2001). Microbiology (5th ed.). New York: McGraw-Hill. 2. Willey, J. M., Sherwood, L., Woolverton, C. J., Prescott, L. M., & Willey, J. M. (2011).
2. Prescott's Microbiology. New York: McGraw-Hill. 3. Matthai, W., Berg, C. Y., & Black, J. G. (2005).
3. Microbiology, Principles and Explorations. Boston, MA: John Wiley &SonsRecommended Textbooks and References:
4. Kindt, T. J., Goldsby, R. A., Osborne, B. A., &Kuby, J. (2006). Kuby Immunology. New York: W.H. Freeman. 2. Brostoff, J., Seaddin, J. K., Male, D., &Roitt, I. M. (2002).
5. Clinical Immunology. London: Gower Medical Pub. 3. Murphy, K., Travers, P., Walport, M., &Janeway, C. (2012). Janeway'sImmunobiology. New York: Garland Science. 4. Paul, W. E. (2012). Fundamental Immunology. New York: Raven Press. 5. Goding, J. W. (1996). Monoclonal Antibodies: Principles and Practice: Production and Application of Monoclonal Antibodies in Cell Biology, Biochemistry, and Immunology. London: Academic Press. 6. Parham, P. (2005). The Immune System. New York: Garland Science.

COURSE CODE	TITLE OF THE COURSE	CREDITS	SEMESTER
BIT552	GENETIC ENGINEERING	3	II

Course Objectives: Throughout the course, students will delve into fundamental cloning techniques, understanding the enzymes involved such as nucleases, polymerases, ligases, and topoisomerases, as well as exploring a variety of vectors used in cloning and expression, including plasmids, phages, phagemids, cosmids, and artificial chromosome vectors. They will also learn about transformation methods for bacteria, plants, and animal cells, as well as screening techniques for transformants using selection markers and reporter genes.

UNIT-I

Concepts of cloning: Basic cloning techniques, Enzymes used in cloning (Nucleases including restriction endonucleases, Polymerases, methylases, ligases, phosphatases, kinases) Vectors used in cloning and expression-Cloning vectors: Plasmids and Phage (Lambda and M13 derived) Vectors, phagemids, cosmids, artificial chromosome vectors (YAC, BAC), Animal virus derived vectors - SV40 and retroviral vectors and transposons. Basic cloning techniques

UNIT-II

Techniques of Genetic engineering: Transformation and related techniques: Competent cell preparation methods, Transformation methods for bacteria, plant and animal cells, electroporation, transfection, Screening of transformants- selection markers (antibiotic resistance and genes of essential metabolism), alpha complementation for recombinant selection, reporter genes (GUS assay, luciferase), strategies for heterologous expression of genes and guiding principles.

UNIT-III

Concepts of gene expression: Principles of PCR: primer design; fidelity of thermostable enzymes; Taq polymerases; types of PCR and applications-touch-down/ hot start and gradient PCR, Anchored-PCR, Inverse-PCR, Multiplex-PCR, Reverse Transcription-PCR, and Real Time-PCR. Construction of libraries, screening and sequencing: Construction of gene libraries: genomic DNA, sub-genomic DNA, EST and cDNA libraries. Methods of library screening: Types of probes and their construction methods

UNIT-IV

Advanced Genetic engineering concepts: DNA sequencing methods: Conventional and Next Generation sequencing approaches. Maxum Gilbert chemical degradation method, Sanger's dideoxy chain termination method, Nanopore sequencing, pyrosequencing, Ion torrent method. Applications of genetic engineering: Gene downregulation-using antisense RNA, dsRNA and co-suppression, CRISPR- cas 9. Site directed mutagenesis (PCR based methods) transgenic animals (knockout mice) and plants (Flavrsavr tomato), production of recombinant pharmaceuticals (insulin and somatostatin), DNase foot printing, gene therapy (*in vitro* and *in vivo* methods).

Reference Books

1. Genetic Engineering: Principles and Methods by Jane K. Setlow
2. Principles of Gene Manipulation and Genomics by Sandy B. Primrose and Richard M. Twyman
3. Genetic Engineering by Desmond S. T. Nicholl
4. Genentech: The Beginnings of Biotech by Sally Smith Hughes

COURSE CODE	TITLE OF THE COURSE	CREDITS	SEMESTER
BIT553	PLANT PHYSIOLOGY AND BIOTECHNOLOGY	3	II

Course Objectives: In the study of Plant Physiology Fundamentals, students will gain insight into essential processes underlying plant growth and development, including the structure and function of plant cells, mechanisms of water and mineral uptake, and pathways of photosynthesis. Moving on to Plant Growth and Development, learners will explore the role of hormones in regulating growth stages such as seed germination, flowering, and fruit development. Subsequently, the unit on Plant Responses to Environmental Factors will elucidate how plants adapt to biotic and abiotic stresses, including interactions with light, water availability, and defense mechanisms against pathogens.

UNIT-I

Fundamentals of plant physiology: Overview of plant physiology and its significance in agriculture and ecology, Plant cell structure and function, Water and mineral uptake, transport &translocation mechanism (apoplast, symplast), transpiration, mechanisms of loading and unloading of photo assimilates. Photosynthesis: light dependent and light independent reactions, factors influencing, photosynthesis. light harvesting complexes; mechanisms of electron transport; photoprotective mechanisms; CO_2 fixation-C3, C4 and CAM pathways. Citric acid cycle; plant mitochondrial electron transport and ATP synthesis; alternate oxidase; photorespiratory pathway

UNIT-II

Plant Growth and Development: Hormones of plant growth and development: Biosynthesis, storage, breakdown and transport; physiological effects and mechanisms of action. Seed germination and dormancy, Flowering: photoperiodism and vernalization, Fruit and seed development.

UNIT-III

Plant Responses to Environmental Factors: Biotic and abiotic stress, Plant responses to light and photomorphogenesis, phytochromes, cryptochromes and phototropins, Physiological adaptations to water, heat and salinity, Plant defense mechanisms: secondary metabolites (Biosynthesis of terpenes, phenols and nitrogenous compounds and their roles), induced resistance.

UNIT-IV

Biotechnology in Plant Improvement: Genetic engineering techniques in plant biotechnology, Plant tissue culture: micropropagation, somatic embryogenesis, organogenesis, Marker-assisted selection and molecular breeding, Plant biotechnology applications: biofortification, transgenic crops.

Reference Books

1. Plant Physiology by Lincoln Taiz, Eduardo Zeiger, Ian Max Møller, and Angus Murphy
2. Plant Physiology and Development by Lincoln Taiz, Eduardo Zeiger, Ian Max Møller, and Angus Murphy
3. Plant Biotechnology: Principles and Applications by Malik Zainul Abdin, Jitendra Kumar

COURSE CODE	TITLE OF THE COURSE	CREDITS	SEMESTER
BIT554	ANIMAL PHYSIOLOGY AND BIOTECHNOLOGY	3	II

Course Objectives: In the exploration of Animal Physiology Fundamentals, students will delve into the core principles of animal physiology. This encompasses understanding the cellular structure and function within animal tissues, as well as the regulatory mechanisms of homeostasis controlled by the nervous and endocrine systems. Moving on to Animal Nutrition and Metabolism, learners will investigate the digestive system's role in nutrient absorption and delve into energy metabolism while also exploring metabolic adaptations.

UNIT-I

Animal Physiology & Fundamentals: Overview of animal physiology, Cell structure and function in animal tissues, Blood corpuscles, hemopoiesis and formed elements, plasma function, Homeostasis, Anatomy of heart, myogenic heart, ECG – its principle and significance, cardiac cycle, neural and chemical regulation of all above, Transport of gases, exchange of gases, waste elimination, neural and chemical regulation of respiration.

UNIT-II

Animal Digestion, Absorption &Excretion: Digestive system and nutrient absorption, energy balance, BMR, basic anatomy of kidney, urine formation, urine concentration, waste elimination, micturition, regulation of water balance, blood volume, blood pressure, RAAS mechanism, electrolyte balance, acid-base balance

UNIT-III

Reproduction and Endocrinology: Reproductive processes, gametogenesis, ovulation, neuroendocrine regulation, endocrine glands, basic mechanism of hormone action, hormones and diseases; sense organs, thermoregulation

UNIT-IV

Animal Health, Biotechnology, and Disease Management: Immune system: innate and adaptive immunity, Vaccines and immunotherapies in animal health, Molecular diagnostics and disease detection, Biotechnological interventions in disease prevention and treatment.

Reference Books

1. Animal Physiology by Richard W. Hill, Gordon A. Wyse, and Margaret Anderson
2. Principles of Animal Physiology by Christopher D. Moyes and Patricia M. Schulte
3. Animal Biotechnology: Models in Discovery and Translation by Ashish S. Verma and Anchal Singh
4. Veterinary Immunology: Principles and Practiceby Michael J. Day

COURSE CODE	TITLE OF THE COURSE	CREDITS	SEMESTER
BIT555	PLANT AND ANIMAL TISSUE CULTURE	3	II

Course Objectives: The course aims to provide a comprehensive understanding of plant and animal tissue culture, covering its definition, historical development, and significance in biomedicine and research. Unit-I focuses on introducing the fundamentals of Plant Tissue culture and basic concepts like cellular totipotency, morphogenesis (organogenesis & embryogenesis), regeneration Unit-II delves into callus culture, suspension cultures. Micropropagation strategies: axillary bud, meristem/shoot tip culture Units III& IV mirror the structure of Units I & II respectively,

UNIT-I

Concepts of Plant Tissue culture: Definitions, scope, and historical evolution of tissue culture in plants and animals. In vitro culture principles: cellular totipotency, morphogenesis (organogenesis & embryogenesis), regeneration. Overview of in vitro systems and comparative approaches in plant vs animal culture. Laboratory design, biocontainment levels, and biosafety regulations. Media basics: components, role of sugars, vitamins, growth regulators (auxins, cytokinin's, auxin/cytokinin balance), serum in animal media. Sterilization methods (physical/chemical), aseptic transfer techniques, contamination control

UNIT-II

Different types of culturing methods: Explant selection and preparation; callus culture, suspension cultures. Micropropagation strategies: axillary bud, meristem/shoot tip culture.

Haploid production techniques (anther/pollen culture), somaclonal variation. Protoplast isolation, culture and applications; fusion methods (PEG, electroporation). Synthetic seeds, somatic embryogenesis and their applications. Germplasm conservation, cryopreservation and synthetic seed technology.

UNIT-III

Fundamentals of Animal cell culture: Animal cell vs plant tissue culture: similarities and differences. Animal cell culture lab setup: equipment (CO_2 incubator, biosafety cabinet, microscope, centrifuge). Media formulations: DMEM, RPMI, FBS role, supplements, antibiotics. Primary culture establishment; disaggregation (enzymatic/ mechanical), subculturing/ passaging. Monolayer vs suspension cultures; anchorage dependence. Cell line maintenance and cryopreservation basics.

UNIT-IV

Tissue culture Applications &Emerging Areas: Applications of plant tissue culture: crop improvement, disease-free plant production, secondary metabolite production. Animal tissue culture applications: vaccine production, drug screening, regenerative medicine, hybridoma technology basics. *In vitro* toxicology, bioassays, cell viability/proliferation assays. Introduction to plant bioreactors and cell fermenters. Ethical issues, quality control, contamination handling.

Reference Books

1. Animal Cell Culture: Essential Methods by John M. Davis
2. Introduction to Cell & Tissue Culture: Theory& Technique by Jennie P. Mather
3. Plant Tissue Culture: Techniques and Experiments by Roberta H. Smith
4. Plant Tissue Culture: A Practical Approach by S. S. Bhojwani and M. K. Razdan

COURSE CODE	TITLE OF THE COURSE	CREDITS	SEMESTER
BIT561	MICROBIOLOGY AND IMMUNOLOGY PRACTICUM	3	II

Course Objectives: Students will gain proficiency in various fundamental microbiological techniques, including aseptic technique, culture media preparation, inoculation of bacterial cultures, and microbial staining techniques like Gram staining and Acid-fast staining. They will develop skills in observation and microscopy to visualize bacterial cells, along with methods for quantifying bacterial growth such as Turbidity measurement and CFU counting. Additionally, students will learn about growth curve analysis and the influence of environmental factors on bacterial growth, as well as molecular methods like PCR for DNA amplification and protein separation techniques like SDS-PAGE. Furthermore, they will understand transformation in bacteria, plasmid isolation, and DNA manipulation. In immunology, students will be introduced to techniques like Rocket immune-electrophoresis for antigen quantification and Ouchterlony Double Diffusion for antigen-antibody reaction detection, providing them with comprehensive practical skills essential for microbiology and immunology research.

Microbiology Experiments

1. Introduction to aseptic technique
2. Preparation of culture media
3. Inoculation of bacterial cultures
4. Microbial staining techniques (Gram staining and Acid-fast staining)
5. Observation and microscopy
6. Measurement of bacterial growth (Turbidity, CFU counting)
7. Growth curve analysis
8. Effect of environmental factors on bacterial growth
9. Kirby-Bauer disk diffusion method
10. Transformation in bacteria

Immunology Experiments

1. Rocket immune-electrophoresis
2. Ouchterlony Double Diffusion
3. Demonstration of flow cytometry

References

1. Microbiology: A Laboratory Manual by James G. Cappuccino and Chad T. Welsh
2. Brock Biology of Microorganisms by Michael T. Madigan, Kelly S. Bender, Daniel H. Buckley, and W. Matthew Sattley
3. Manual of Clinical Microbiology by Karen C. Carroll and Janet Butel
4. Janeway's Immunobiology by Kenneth Murphy

COURSE CODE	TITLE OF THE COURSE	CREDITS	SEMESTER
BIT562	GENETIC ENGINEERING PRACTICUM	3	II

Course Objectives: In Genetic Engineering Experiments, students will master essential techniques pivotal to genetic manipulation. They will learn to extract DNA from plant material, a foundational step in genetic studies. Through agarose gel electrophoresis of DNA, they will understand the separation of DNA fragments based on size. Moreover, students will explore restriction enzyme digestion and DNA analysis, crucial for cutting DNA at specific sequences and analyzing resultant fragments. Transformation of E. coli with a plasmid will introduce them to the process of introducing foreign DNA into bacterial cells, a fundamental genetic engineering technique. Lastly, students will delve into Polymerase Chain Reaction (PCR), enabling the amplification of specific DNA sequences, pivotal for various genetic analyses and applications. These experiments will equip students with hands-on skills essential for genetic engineering research and applications.

Microbiology Experiments

1. Buffer preparation
2. DNA Extraction
3. Agarose Gel Electrophoresis of DNA
4. Restriction Enzyme Digestion and DNA Analysis
5. Transformation of E. coli with a Plasmid
6. PCR (Polymerase Chain Reaction)
7. Cloning in E. coli
8. Expression of cloned genes in E. coli by IPTG induction
9. Protein concentration determination by UV280, Lowry's, Bradford assays
10. Buffer preparation

References

1. Molecular Cloning: A Laboratory Manual by Joseph Sambrook and David W. Russell
2. Biotechnology for Beginners by Reinhard Renneberg
3. Molecular Biology of the Gene by James D. Watson, Tania A. Baker, Stephen P. Bell, Alexander Gann, Michael Levine, and Richard

SEMESTER-III			
COURSE CODE	**TITLE OF THE COURSE**	**CREDITS**	**SEMESTER**
BIT601	**BIOSTATISTICS AND BIOINFORMATICS**	**3**	**III**

Course Objectives: Students will embark on a comprehensive journey through the field of Biostatistics, beginning with an introduction covering data types, measurement scales, descriptive statistics, probability, and sampling methods. They will then delve into Inferential Statistics, exploring estimation, confidence intervals, hypothesis testing, ANOVA, correlation, regression analysis, and nonparametric statistics. Following this, students will be introduced to the basics of Bioinformatics, including sequence databases, alignment techniques, molecular evolution, phylogenetics, and structural bioinformatics.

UNIT-I

Introduction to Biostatistics: Measures of central tendency- Mean, Median, Mode. Measures of dispersion- Range, Quartile deviation, Mean deviation, Standard deviation. Absolute and Relative measures of dispersion. Probability and probability distributions- Binomial, Poison, Normal distribution

UNIT-II

Inferential Statistics in Biostatistics: Analysis of variance (ANOVA), Null and Alternative hypothesis. Correlation and Regression analysis, Variance and Covariance. Test of Hypothesis -T-test, Chi-square test, ANOVA for linear regression. Level of significance- p values, class limits, class intervals.

UNIT-III

Introduction to Bioinformatics: Basics of bioinformatics, Databases, Types of databases. File formats (GenBank- DNA sequence, NDB, uniprot- protein Sequence, PDB). DNA vs Protein Sequence alignment. Database search engine (entrez and SRS). dbSNP – variation**.**

UNIT-IV

Genomic and Proteomic Data Analysis: Genomic data analysis, Next-generation sequencing (NGS) data analysis, Functional annotation and pathway analysis, Protein structure prediction and modeling, Data visualization in bioinformatics.

Reference Books

1. Biostatistics: The Bare Essentials by Geoffrey R. Norman and David L. Streiner
2. Biostatistics: A Foundation for Analysis in the Health Sciences by Wayne W. Daniel and Chad L. Cross
3. Applied Linear Statistical Models by Michael H. Kutner, Christopher J. Nachtsheim, and John Neter
4. Statistics by Robert S. Witte and John S. Witte
5. Bioinformatics Algorithms: An Active Learning Approach by Phillip Compeau and Pavel Pevzner
6. Introduction to Bioinformatics by Arthur M. Lesk

COURSE CODE	TITLE OF THE COURSE	CREDITS	SEMESTER
BIT602	FERMENTATION AND INDUSTRIAL BIOTECHNOLOGY	3	III

Course Objectives: Students will embark on a comprehensive exploration of Fermentation and Bioprocessing, commencing with an introduction to industrial biotechnology, microorganisms commonly utilized in fermentation, and the design and optimization of fermentation processes. They will delve into the principles of bioreactors, fermentation equipment, and the vital aspects of bioprocess monitoring & control. Subsequently, they will study Fermentation Kinetics and Microbial Physiology, focusing on kinetics of microbial growth, product formation, metabolism, energetics, substrate utilization, and genetic engineering techniques for industrial microbes.

UNIT-I

Introduction to Fermentation and Bioprocessing: Types of fermentation and fermenters, Batch-fed batch and continuous, conventional fermentation vs biotransformation, solid substrate, surface and submerged fermentation, fermentation economics, media, plug flow, continuous, enzyme reactors, upstream processing: Sterilization, media formulation, aeration and agitation in bioprocess, isolation & maintenance of industrially important microbes,

UNIT-II

Fermentation Kinetics and Microbial Physiology: Kinetics of microbial growth, growth curve and Product formation, Metabolism and energetics of microorganisms, Substrate utilization and product yield, Genetic engineering in industrial microbes, Strain improvement and selection.

UNIT-III

Downstream Processing and Bio-product Recovery- Bio separation: Filtration, centrifugation, sedimentation, flocculation, cell disruption, extraction, use of chromatographic techniques for purification, use of ultrafiltration and reverse osmosis, Crystallization and drying of product, storage and packaging

UNIT-IV

Applications of Industrial Biotechnology: Bio-production of biofuels and chemicals, Pharmaceutical and vaccine production, Food and beverage fermentation, industrial production of chemicals-alcohol(ethanol) acids (citric acid &gluconic acid), antibiotics (penicillin, tetracycline, streptomycin), amino acid (glycine, glutamic acid) Environmental biotechnology, Emerging trends in industrial biotechnology.

Reference Books

1. Bioprocess Engineering: Basic Concepts by Michael L. Shuler and FikretKargi
2. Industrial Microbiology: An Introduction by Michael J. Waites, Neil L. Morgan, and John S. Rockey
3. Bioprocess Engineering: Kinetics, Sustainability, and Reactor Design by Shijie Liu and Michael Shuler
4. Microbial Physiology by Albert G. Moat, John W. Foster, and Michael P. Spector
5. Downstream Processing of Proteins: Methods and Protocols by Mohammed A. Quraishi

COURSE CODE	TITLE OF THE COURSE	CREDITS	SEMESTER
BIT603	BIOSAFETY, IPR AND ENTERPRENEURSHIP	3	III

Course Objectives: Students will embark on a comprehensive journey through Biosafety and Biosecurity, beginning with an introduction to biosafety and biosecurity, including the classification of biological agents, risk assessment, laboratory safety protocols, containment levels, regulatory guidelines, and case studies highlighting biosafety incidents. Next, they will explore Intellectual Property Rights (IPR) in Biotechnology, covering patents, copyrights, trademarks, patentability criteria for biotechnological inventions, IPR management, commercialization, and the ethical and legal aspects of IPR.

UNIT-I

Introduction to Biosafety and Biosecurity: Introduction to biosafety and biosecurity, Classification of biological agents and risk assessment, Laboratory safety and containment levels, Regulatory guidelines and compliance, Case studies on biosafety incidents.

UNIT-II

Intellectual Property Rights (IPR) in Biotechnology: Introduction to IPR and its significance, Patents, copyrights, and trademarks, Quality accreditation and certification. Patentability criteria for biotechnological inventions, IPR management and commercialization, Ethical and legal aspects of IPR in biotechnology.

UNIT-III

Entrepreneurship in Biotechnology: Introduction to entrepreneurship in biotechnology, Business plan development, Funding sources and venture capital, Market analysis and commercialization strategies, protocols for research, GLP and GMP, relevant EOPs and SOPs, product manufacturing, product life cycle and product properties, competitor products, stability studies- generate stability data and prepare stability reports for innovation products. Start-up challenges and success stories.

UNIT-IV

Biosafety and IPR Compliance in Entrepreneurship; Integrating biosafety into entrepreneurship, IPR strategies for biotech start-ups, Regulatory hurdles and approvals, Ethical considerations in biotech entrepreneurship, Case studies on successful biotech ventures.

Reference Books

1. Laboratory Biosafety Manual by World Health Organization (WHO)
2. Biosafety in Microbiological and Biomedical Laboratories by U.S. Department of Health and Human Services
3. Intellectual Property Rights: A Critical History by Christopher May
4. Biotechnology Entrepreneurship: Starting, Managing, and Leading Biotech Companies by Craig Shimasaki
5. The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses by Eric Ries

COURSE CODE	TITLE OF THE COURSE	CREDITS	SEMESTER
BIT604	RESEARCH METHODOLOGY	3	III

Course Objectives: Students will embark on a comprehensive journey through Research Methodology, beginning with an introduction to the research process, differentiating between Qualitative and Quantitative research, formulating research questions and hypotheses, and understanding research ethics and integrity. They will delve into Research Design and Data Collection, exploring experimental and non-experimental research designs, sampling techniques, sample size determination, and various data collection methods such as surveys, interviews, observations, and questionnaire design. Following this, they will focus on Data Analysis and Interpretation, covering data preparation and descriptive statistics.

UNIT-I

Introduction to Research Methodology: Understanding the research process, Types of research: Qualitative vs. Quantitative, Basic, applied, clinical Formulating research questions and hypotheses, Research ethics and integrity, The role of literature review in research.

UNIT-II

Research Design and Data Collection: Experimental vs. Non-experimental research designs, Sampling techniques probability & non-probability sampling and sample size determination, Data collection methods: Surveys, Interviews, Observations, Questionnaire design and validation, Data collection tools and instruments.

UNIT-III

Data Analysis and Interpretation: Data preparation and cleaning, Descriptive statistics and data visualization, Inferential statistics: Hypothesis testing and confidence intervals, Qualitative data analysis methods, Presenting research findings. Overview of statistical tools, biostatistics basics

UNIT-IV

Research Writing and Reporting: Structuring a research report or thesis, writing styles and academic integrity, Citation and referencing styles (APA, MLA, etc.), citation tools (Zotero, Mendeley) Plagiarism, Peer review process and publishing, Effective communication of research results.

Reference Books

1. Research Methodology: A Step-by-Step Guide for Beginners by Ranjit Kumar
2. Research Design: Qualitative, Quantitative, and Mixed Methods Approaches by John W. Creswell and J. David Creswell
3. Sampling: Design and Analysis by Sharon L. Lohr
4. Statistical Methods for the Social Sciences by Alan Agresti and Barbara Finlay
5. Qualitative Data Analysis: A Methods Sourcebook by Matthew B. Miles, A. Michael Huberman, and Johnny Saldana.

COURSE CODE	TITLE OF THE COURSE	CREDITS	SEMESTER
BIT621	ELECTIVE-I IMMUNO-TECHNOLOGY	3	III

Course Objectives: Students will embark on an exploration of Immuno-technology, beginning with an introduction to its fundamentals, including an overview of the immune system, immuno-assays, antigen-antibody reactions, and diagnostic applications. They will delve into various Immunoassay Techniques such as ELISA, RIA, FIA, CLIA, and IFA, understanding their principles and applications. Moving forward, students will focus on Molecular Diagnostics and Immuno-technology, exploring PCR in diagnostics, nucleic acid-based immunoassays, real-time PCR, microarray technology, and next-generation sequencing in immuno-diagnostics.

UNIT-I

Introduction to Immuno-technology: Overview of immune system components, Antigens, antibodies, and immune recognition, Polyclonal and monoclonal antibodies, Hybridoma technology: principle and application, Antibody engineering and humanized antibodies

UNIT-II

Immunoassay Techniques: Enzyme-Linked Immunosorbent Assay (ELISA), Radioimmunoassay (RIA), Fluorescent Immunoassay (FIA), Chemiluminescent Immunoassay (CLIA), Immuno-fluorescence Assay (IFA), Immunoprecipitation and co-immunoprecipitation, Rapid immunodiagnostic tests (LFA, ICT)

UNIT-III

Cellular Diagnostics and Immuno-technology: Flow cytometry: principles and applications, Fluorescence-activated cell sorting (FACS). Immunofluorescence and confocal microscopy, Cell surface markers (CD markers), Cytokine detection assays

UNIT-IV

Advanced Topics and Case Studies: Immunoinformatic and AI in immune profiling Personalized immunodiagnostics Biosensors in immuno-diagnostics, Point-of-care immunoassays, Immuno-technology in disease monitoring and surveillance, Regulatory aspects and quality control in immuno-diagnostics, Case studies of immuno-technology applications.

Reference Books

1. Immunoassay: A Practical Guide by David Wild
2. Immuno-technology: Principles and Applications by John C. Rife
3. Immunochemistry in Practice by Peter Delves
4. Molecular Diagnostics: Techniques and Applications for the Clinical Laboratory by Lela Buckingham and Maribeth L. Flaws
5. PCR Technology: Principles and Applications for DNA Amplification by Henry A. Erlich

COURSE CODE	TITLE OF THE COURSE	CREDITS	SEMESTER
BIT622	ELECTIVE-I AQUA CULTURE	3	III

Course Objectives: Students will embark on an exploration of Aquaculture, commencing with an introduction to its historical development, aquatic ecosystems, species selection, and sustainable practices. They will then delve into Aquaculture Systems and Management, covering facility design, water quality management, feeding and nutrition, disease prevention, and post-harvest processing. Transitioning to Species-Specific Aquaculture, students will focus on freshwater fish farming, marine fish and shrimp farming, bivalve and mollusk culture, ornamental fish production, and emerging trends. Lastly, they will examine Aquaculture Economics and Sustainability, addressing the economics of aquaculture, market analysis, environmental impact, certification and standards, as well as future challenges and opportunities, providing insights into the dynamic field of aquaculture and its future directions.

UNIT-I

Introduction to Aquaculture: Introduction to aquaculture, Historical development of aquaculture, Scope, importance, and economic significance, Capture fisheries vs aquaculture Types of aquacultures: freshwater, brackish water, marine Role of aquaculture in food security and Blue Economy

UNIT-II

Aquaculture Systems and Management: Aquaculture facility design, Pond, cage, raceway, RAS and bio floc systems, Role of temperature, pH, salinity, dissolved oxygen, ammonia, nitrite, nitrate, phosphate., Stocking density and carrying capacity

UNIT-III

Species specific Aquaculture: Major freshwater species: Carp, Catfish, Tilapia, Brackish water species: Shrimp, Mud crab, Marine species: Seabass, Cobia, Bivalves, Exotic and indigenous species – advantages and risk

UNIT-IV

Aquaculture Economics and Sustainability: Aquacultural wastes and future developments in waste minimization, environmental consequences of hyper-nutrification, Climate-smart aquaculture, Aquaculture regulations and certification (MPEDA, ICAR, FAO)

Reference Books

1. Aquaculture: Principles and Practices by T.V.R. Pillay and M. Sugunan
2. Aquaculture Science by Rick Parker
3. Freshwater Aquaculture by Craig S. Tucker and Lawrence M. Connor
4. Economics and Marketing of Aquaculture Products by Carole R. Engle and Kwamena K. Quagrainie

COURSE CODE	TITLE OF THE COURSE	CREDITS	SEMESTER
BIT623	ELECTIVE-I ORGANIC FARMING	3	III

Course Objectives: Students will explore Organic Farming, covering its basics, principles, certification standards, and common challenges. Organic Crop Management will focus on soil health, crop rotation, pest control, weed management, and seed production. Livestock and Organic Animal Husbandry will delve into standards, welfare, and practices in organic livestock production. Marketing, Certification, and Future of Organic Farming will cover aspects such as product marketing, certification processes, consumer demand, research, innovation, and future prospects in the field.

UNIT-I

Introduction to Organic Farming: Basics concepts of organic farming, Principles and approaches, characteristics of organic farm, composting &manuring, vermicomposting techniques, characteristics of an Organic farm

UNIT-II

Harvesting and control of disease: Harvesting of vermicompost, preparation of vermiwash, biofertilizers, other practices to control the disease, preparation of botanicals, Seed and Planting techniques in Organic Farming, Livestock Management in Organic Farming

UNIT-III

Management of crop &livestock in Organic Farming: Seed and Planting techniques in Organic Farming, Livestock Management in Organic Farming, Crop Rotation Practices in Organic Farming, Water Management in Organic farm, Organic Standards

UNIT-IV

Marketing, Certification, and Future of Organic Farming: Procedure of Inspection and Certification, Documentation for Organic Certification, Quality Management and Organic Trademark, Concept of Marketing and Indian Organic Market labeling, consumer demand and market trends, Research and innovation in organic farming, Challenges and future prospects.

Reference Books

1. APEDA (2001). Guidelines for Production of Organic Rice in India, Agricultural and Processed Food Products Export Development Authority, New Delhi.
2. Training Manual for Organic Agriculture guide on Introduction to Organic Agriculture (FAO-TECA), International Federation of Organic Agriculture Movements (IFOAM - Organics International).
3. Gupta, M. (2004). Organic agriculture development in India. ABD publishers, Jaipur, India.
4. Kannaiyan, S. (2000). Biofertilizers-Key Factor in Organic Farming. The Hindu Survey of Indian Agriculture. Published by S.Rangrajaneon behalf of M/s Kasturi and Sons Ltd. At the National Press, Kasturi Building, Chennai.
5. Organic Livestock Farming: A Practical Guide by Anne-Kathrin Schultz and Maria Schautz

COURSE CODE	TITLE OF THE COURSE	CREDITS	SEMESTER
BIT624	**ELECTIVE-I SCIENTIFIC WRITING**	**3**	**III**

Course Objectives The course will explain the fundamental concepts in drafting a scientific manuscript to effectively communicate research findings. It will provide an overview of the steps and principals involved in organizing a manuscript logically and sequentially within a structure. It will also introduce writing styles and formatting guidelines to be adhered to while drafting a scientific manuscript.

UNIT-I

Research, meaning and objectives-Research techniques in literary studies and linguistics/ social sciences/ quantitative methods for research, Resources and means of research: books, journals, anthologies, unpublished theses, conference proceedings, newspaper articles, e-journals, thesauruses, encyclopedias, Dissertation Abstracts, web references, research sites, printed indexes, e-mail discussion groups, special libraries, advanced study centers, virtual libraries, internet search engine

UNIT-II

Scientific writing process-selecting a research topic; review of literature; identifying aims and objectives; formulating the thesis statement; referencing using Zotero, writing method section

UNIT-III

Research Presentation- format of research; pagination; grammar, punctuation and the conventions of academic writing: organization of materials; tables, figures, writing result & discussion section, avoiding plagiarism; in-text citations; list of works cited; footnotes and endnotes; research findings; bibliography; using standard style sheets – MLA, APA, Chicago Manual, Harvard system of referencing

UNIT-IV

Publication ethics &Submission of manuscript- publication ethics, choosing journal for submission, responding to peer review, scientific writing style

Reference Books

1. Guidance on Scientific Writing- Equator Network
2. Kotz D, Cals J. Scientific writing and publishing in medicine and health sciences: A quick guide in English and German. Berlin, Boston: De Gruyter; 2021.
3. Trisha Greenhalgh. How to read a paper.
4. Eliot, Simon and W. R. Owens (4th end. 1998), A Handbook to Literary Research, London: Routledge & Open University
5. Miller, R. H. (1995), Handbook of Literary Research, Methue

COURSE CODE	TITLE OF THE COURSE	CREDITS	SEMESTER
BIT625	**ELECTIVE-I Dairy and Food Processing Technology**	**3**	**III**

Course Objectives: This course will cover basics of dairy (liquid food) food processing and preservation technologies required in any dairy and food processing industries. The basic knowledge on dairy food processing is intermingled with most of the unit operations at some or other stage of processing. Since, this basic aspect of food processing and preservations not taught in most of the Agricultural engineering institutions elaborately, a comprehension of these aspects of processing and preservation will enrich the knowledge base of the students in general.

UNIT-I

Introduction to Food Processing: Basics concepts, Basic principles and methods of food processing and preservation. Emerging Technologies in food processing. Food additives and preservatives.: Food laws and standards.

UNIT-II

Fundamentals of Dairy processing: Chemical and microbial spoilage of milk and milk products; Fluid milk Processing, packaging and distribution. Common dairy processes – cream separation (standardization), pasteurization, sterilization and Homogenization, Process technology for manufacture of evaporated milk, condensed milk, dried milk, malted milk, infant and baby foods, ice-cream, cheese, butter, fermented milk and indigenous dairy products. Methods and procedures for sampling and testing of milk and milk products. Laws and standards for milk and milk products.

UNIT-III

Industrially manufactured Foods Technological processes for industrially manufactured foods of commercial importance, from plant and animal origin**.** Cereals, vegetables, fruits, meats, poultry and egg products; Bakery, pasta and confectionary products, ready to eat foods, fermented foods, alcoholic and non-alcoholic Beverages, tea, coffee and cocoa, fabricated foods**.**

UNIT-IV

Packaging, quality and Regulation: Procedure of Packaging materials; Characteristics, properties and their design. Packaging requirement for Different processed and unprocessed foods, Working Principles of various type of fillers: form-fill-seal machine, Gas packaging and modified atmosphere Package design. Shelf-life prediction of foods in packages. Quality control in Food packaging. Product safety and packaging regulations.

Reference Books

1. Milk and Dairy Product Technology — Edgar Spreer
2. Food Science and Technology — Srilakshmi, B.
3. Food Science — Norman N. Potter & Joseph H. Hotchkiss
4. Food Processing: Principles and Applications — Stephanie Clark, Stephanie Jung & Buddhi Lamsal
5. Dairy Science and Technology — Thom Huppertz

COURSE CODE	TITLE OF THE COURSE	CREDITS	SEMESTER
BIT626	ELECTIVE-I FUNDAMENTALS OF PUBLIC HEALTH	3	III

Course Objectives: Students will be introduced to Public Health, covering its historical development, core principles, systems, organizations, ethics, and social determinants. Moving to Epidemiology and Disease Control, they'll delve into basic epidemiology, disease surveillance, infectious and chronic disease epidemiology, preventive measures, and global health. In Health Promotion and Behavior Change, students will explore health promotion strategies, behavior theories, community health education, campaigns, interventions, and environmental health. Finally, Health Systems and Policy will focus on healthcare systems, policy development, disparities, disaster preparedness, and future challenges in public health.

UNIT-I

Introduction to Public Health: Definition of Public Health and Related Terms, Current Concerns in Public Health: Global and Local, Understanding of contemporary public health challenges from their collective experiences or areas. Role of Humanities and Social Sciences in Public Health

UNIT-II

Human health & disease: Human body and its various systems, Concept of health and disease, Natural history of disease, Levels of prevention

UNIT-III

Health Promotion and Behavior Change: Health promotion strategies, Health behavior theories and models, Community health education, public health campaigns and interventions, Environmental health and safety.

UNIT-IV

Health Systems and Policy: Healthcare systems and delivery models, Health policy development and analysis, Health disparities and inequalities, Disaster preparedness and response, Future challenges and trends in public health.

Reference Books

1. Health Behavior: Theory, Research, and Practice by Karen Glanz, Barbara K. Rimer, and K. Viswanath
2. Behavioral Economics and Public Health by Christina A. Roberto and Ichiro Kawachi
3. Epidemiology by Leon Gordis
4. Epidemiology: Beyond the Basics by MoysesSzklo and F. Javier Nieto
5. Introduction to Public Health by Mary-Jane Schneider

COURSE CODE	TITLE OF THE COURSE	CREDITS	SEMESTER
BIT611	BIOSTATISTICS AND BIOINFORMATICS PRACTICUM	3	III

Course Objectives: This practical provides basic training and practical experience in biostatistics and bioinformatics. Students will learn how to use basic biostatistics tools and to apply them in research methodologies and to analyze data. They will learn bioinformatics methods and apply them to the state of art biological application.

Biostatistics Experiments

1. Mean median and mode
2. Measurement and Sampling
3. Frequency Distributions
4. Probability 15
5. Introduction to Hypothesis Testing and Principal Component Analysis (PCA)
6. T-test and chi-square test
7. Anova analysis
8. Correlation and regression
9. Mean median and mode

Bioinformatics Experiments

1. Sequence Alignment Using BLAST
2. DNA Sequence Analysis
3. Protein Structure Prediction
4. Multiple Sequence Alignment
5. Gene Expression Analysis
6. Phylogenetic Tree Construction
7. Genomic Data Visualization
8. Sequence Alignment Using BLAST
9. DNA Sequence Analysis

Reference Books

1. Bioinformatics Algorithms: An Active Learning Approach by Phillip Compeau and Pavel Pevzner
2. Biostatistics: The Bare Essentials by Geoffrey R. Norman and David L. Streiner
3. Biological Sequence Analysis: Probabilistic Models of Proteins and Nucleic Acids by Richard Durbin, Sean Eddy, Anders Krogh, and Graeme Mitchison
4. Statistical Analysis of Next Generation Sequencing Data by Somnath Datta and S. M. A. H. S. Damelin
5. Biostatistics for the Biological and Health Sciences by Marc M. Triola and Mario F. Triola

COURSE CODE	TITLE OF THE COURSE	CREDITS	SEMESTER
BIT612	DIAGNOSTIC TOOLS AND TECHNIQUES PRACTICUM	3	III

Course Objectives: Students will explore a variety of diagnostic tools and techniques used in medical settings. These include microscopy for detailed examination, hemoglobin estimation using Sahli's Hemometer, urinalysis for routine diagnostic testing, blood typing through agglutination reactions, and the Enzyme-Linked Immunosorbent Assay (ELISA) for detecting antibodies. Additionally, they will learn about the Polymerase Chain Reaction (PCR) for amplifying DNA, serological testing for infectious diseases, blood glucose monitoring, stool examination for parasites, and imaging techniques in diagnostic radiology for visualizing internal structures and abnormalities.

Diagnostic tools Techniques

1. Microscopy in Diagnostic Medicine
2. Hemoglobin Estimation Using Sahli's Hemometer
3. Urinalysis for Routine Diagnostic Testing
4. Blood Typing Using Agglutination Reactions
5. Enzyme-Linked Immunosorbent Assay (ELISA)
6. Serological Testing for Infectious Diseases
7. Blood Glucose Monitoring
8. Stool Examination for Parasites
9. Imaging Techniques in Diagnostic Radiology

Reference Books

1. Clinical Chemistry: Principles, Techniques, and Correlations by Michael L. Bishop, Edward P. Fody, and Larry E. Schoeff
2. Clinical Laboratory Chemistry by Robert L. Sunheimer and Linda Graves
3. Diagnostic Microbiology by Mahon, Connie R., Donald C. Lehman, and George Manuselis
4. Hematology: Basic Principles and Practice by Ronald Hoffman, Edward J. Benz Jr., Leslie E. Silberstein, and Helen Heslop
5. Medical Laboratory Technology: Methods and Interpretations by RamnikSood

SEMESTER IV			
COURSE CODE	**TITLE OF THE COURSE**	**CREDITS**	**SEMESTER**
BIT692	**RESEARCH PROJECT AND DISSERTATION**	**20**	**IV**

The aim of the research project and dissertation is to assess and strengthen the independent research skills acquired by students through systematic project work. The project enables students to apply theoretical knowledge to practical research problems aligned with their academic interests. It aims to develop competencies in research design, experimentation, data analysis, and scientific interpretation. Students are expected to document their work in the form of a dissertation demonstrating originality and methodological rigor. The project also encourages critical thinking, problem-solving, and ethical research practices. Furthermore, students are motivated to communicate their findings effectively and disseminate quality research outcomes through publications in reputed national or international journals.

The following evaluation pattern will be followed.

Examination	**Items**	**Marks**
Pre-project seminar	Seminar on literature review (Guide+ one member within the department)	**50**
Midterm presentation	M.Sc. dissertation presentation (Guide+ one member within the department)	**50**
End semester evaluation	Presentation: 50 marks Viva-voce: 50 marks Dissertation: 100 marks (Guide+ one member within the department + External expert)	**200**

Student should submit 3 hard copies and a soft copy of the final research project dissertation along with plagiarism report in proper recommended format to HOD with all declarations and signatures and confidential supervisor assessment report. The students should follow research ethics and guidelines of the University.

The End