కేంద్రీయ గిరిజన విశ్వవిద్యాలయం ఆంధ్ర ప్రదేశ్

केन्द्रीय जनजाति विश्व विद्यालय आंध्र प्रदेश

CENTRAL TRIBAL UNIVERSITY OF ANDHRA PRADESH

CURRICULUM AND SYLLABUS

(For 2023 -2025 admitted batch onwards)

Department of Biotechnology
School of Sciences

M.Sc. Biotechnology

REGULATIONS

(W.e.f 2023-2025 admitted batch onwards)

ADMISSIONS

Admissions into the M.Sc. Biotechnology program shall be made only through CUET (PG) conducted by the National Testing Agency (NTA).

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).

CHOICE BASED CREDIT SYSTEM

Choice based credit system (CBCS) is introduced based on UGC guidelines in order to promote:

- Student centered learning
- Cafeteria approach
- Inter-disciplinary learning.
- Industry-ready curriculum

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 credits for two hours of practicum.
- Twelve 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 Hon'ble 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.
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 2023-2025 admitted batch onwards)

	Course Level	Course Code	Title of the course	Lectures	Tutorial	Practicum	Credits	Max.Marks
Semester-I	500	BIT 501	Life forms, Cellular organization (for 2023 admitted batch) Cell Biology(From 2024 admitted batch onwards)	3	0	0	3	100
	500	BIT 502	Biomolecules and Biochemistry (for 2023 admitted batch) Basic Biochemistry (From 2024 admitted batch onwards)	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	Applied Instrumentation biology (2023 admitted batch)Bio-analytical tools &techniques(2024 admitted batch onwards)	3	0	0	3	100
	500	BIT 511	Life forms cellular organization and Genetics and molecular biology Practicum	0	0	6	3	100
	500	BIT 512	Biomolecules and Biochemistry and Applied instrumentation biology 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	3	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**	
Semester-IV	600	BIT 631-635	ELECTIVE-II	2	0	0	2	50
	600	BIT 671-675	ELECTIVE-III	2	0	0	2	50
	600	BIT 691	Soft skill development and scientific writing	0	0	4	2	50
	600	BIT 692	Research Project & Dissertation	0	0	24	15	300
	Total						**21**	

[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
BIT622	Food technology
BIT623	Agriculture technology and Animal Husbandry
BIT624	Dairy Technology
BIT625	Probiotics and their development

ELECTIVE-II

Course Code	Title of the Course
BIT 631	Aquaculture
BIT 632	Oyster culture
BIT 633	Pisciculture
BIT 634	Apiculture
BIT 635	Fundamentals of public health

ELECTIVE-III

Course Code	Title of the Course
BIT 671	Horticulture
BIT 672	Organic Farming
BIT 673	Silk Farming
BIT 674	Mushroom Culture
BIT 675	Poultry Farming

SEMESTER-I			
COURSE CODE	**TITLE OF THE COURSE**	**CREDITS**	**SEMESTER**
BIT501	**LIFE FORMS AND CELLULAR ORGANIZATION** (for 2023 admitted batch) **CELL BIOLOGY**(from 2024 admitted batch onwards)	**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. Comparison of prokaryote and eukaryote cells.

UNIT-II

Cell Structure and Function: Historical overview of cell theory and its significance, Overview of cell components: plasma membrane, cytoplasm, organelles, nucleus, Detailed study of cell membrane structure and function, Exploration of organelles: mitochondria, endoplasmic reticulum, Golgi apparatus, lysosomes, etc. Role of nucleus in genetic material storage and regulation.

UNIT-III

Cellular Processes and Energy Flow: Cell metabolism: anabolism and catabolism, Enzymes and their role in cellular reactions, Cellular respiration and energy production, Photosynthesis and its significance in energy capture, Cell cycle and cell division: mitosis and meiosis.

UNIT-IV

Methodology to assess cell function: principles and applications of different research techniques used in cell biology like microscopy, molecular biology and biochemical approaches.

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.
4. Cell Biology (Cytology, Biomolecules and Molecular Biology) by P S Verma and V K Agarwal
5. Fundamentals of Cell Biology by Singh S. K.

COURSE CODE	TITLE OF THE COURSE	CREDITS	SEMESTER
BIT502	**BIOMOLECULES AND BIOCHEMISTRY**(for 2023 admitted batch) **BASIC BIOCHEMISTRY**(From 2024 admitted batch onwards)	**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

Introduction to Biomolecules and Basic Concepts of Biochemistry: Definition and classification of biomolecules: carbohydrates, lipids, proteins, nucleic acids, Importance of biochemistry in understanding life processes, Overview of chemical bonding, molecular structure, and functional groups.

UNIT-II

Carbohydrates and Lipids: Structure and functions of carbohydrates: monosaccharides, disaccharides, polysaccharides, Role of carbohydrates in energy storage and cellular recognition, Structure and properties of lipids: fatty acids, triglycerides, phospholipids, steroids, Significance of lipids in cell membranes and energy storage.

UNIT-III

Proteins and Enzymes: Amino acids: structure, classification, and properties, Protein structure levels: primary, secondary, tertiary, quaternary, Protein functions: enzymes, structural proteins, signaling molecules, Enzymes: catalysis, specificity, enzyme kinetics, regulation.

UNIT-IV

Nucleic Acids and Metabolism: DNA and RNA structure: nucleotides, base pairing, double helix, DNA replication, transcription, and translation, Overview of metabolism: anabolism and catabolism, Energy carriers: ATP, NADH, FADH2, Overview of metabolic pathways: glycolysis, citric acid cycle, oxidative phosphorylation.

References

1. Lehninger Principles of Biochemistryby 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: Overview of genetics and its significance in biological processes, Historical development of genetics as a scientific discipline, Mendel's laws of inheritance: Law of Segregation and Law of Independent Assortment, Monohybrid and dihybrid crosses: Punnett squares and phenotype predictions

UNIT-II

Mendelian Genetics and Inheritance Patterns: Non-Mendelian inheritance: incomplete dominance, codominance, multiple alleles, Sex-linked inheritance and pedigree analysis, Linkage and crossing over, Cytoplasmic and mitochondrial inheritance, Human genetics and diseases.

UNIT-III

DNA Structure and Replication: Introduction to molecular biology and its role in understanding genetic mechanisms, Molecular structure of DNA: nucleotides, base pairing, double helix, DNA replication: semiconservative replication, enzymes involved Repair mechanisms: proofreading, mismatch repair, excision repair.

UNIT-IV

Gene Expression and Regulation: Transcription: RNA synthesis, RNA polymerase, promoters, enhancers, Translation: ribosomes, tRNA, codons, initiation, elongation, termination, Regulation of gene expression: transcription factors, operons, epigenetic modifications, Post-transcriptional modifications: alternative splicing, RNA editing.

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 homeo-box genes, pattern formation, and cell signaling in differentiation and morphogenesis. Furthermore, they will grasp the concept of Hardy-Weinberg equilibrium and become adept at analyzing evolutionary mechanisms such as mutations, genetic drift, and gene flow.

UNIT-I

Introduction to Ecology and Ecosystems: Definition and scope of ecology: study of interactions between organisms and their environment, Levels of ecological organization: populations, communities, ecosystems, biomes, Energy flow and nutrient cycling in ecosystems, Ecological niches, habitat, and adaptation, Ecosystem dynamics: food chains, food webs, trophic levels.

UNIT-II

Population Dynamics and Community Ecology: Population growth models: exponential and logistic growth, Factors influencing population size: birth rates, death rates, immigration, emigration, Succession: primary and secondary succession, climax communities, Biogeochemical cycles: carbon, nitrogen, phosphorus cycles, Human impact on ecosystems: habitat destruction, pollution, climate change, Conservation biology: biodiversity conservation, restoration ecology.

UNIT-III

Developmental biology: Introduction to developmental biology: embryonic development, differentiation, morphogenesis, Genetic basis of development: homeobox genes, pattern formation, cell signaling, Evo-devo: evolutionary developmental biology and the study of evolutionary changes in development

UNIT-IV

Evolution and Population genetics: Mendelian Populations, Reproductive isolating mechanisms: Models of population growth, Species concepts, interactions (competition, predation, mutualism), Variation in natural populations, The causes of evolution, Hardy-Weinberg equilibrium, Mutations and Gene flow, Genetic drift.

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	**APPLIED INSTRUMENTATION BIOLOGY** (for 2023 admitted batch) **BIO-ANALYTICAL TECHNIQUES**(From 2024 admitted batch onwards)	**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: Definition and scope of applied biology in various fields (medicine, agriculture, environment, etc.), Role of instrumentation in advancing biological research and applications, Overview of key techniques and tools used in applied biology.

UNIT-II

Medical Instrumentation and Diagnostics: Molecular diagnostics: PCR, ELISA, DNA sequencing, 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, Bioinformatics and computational biology tools.

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	LIFE FORMS, CELLULAR ORGANIZATION 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 an 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	BIOMOLECULES AND BIOCHEMISTRY AND APPLIED INSTRUMENTATION BIOLOGY 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 Nørholm, 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, morphology, structure. Microbial taxonomy and evolution of diversity, classification of microorganisms, criteria for classification, classification of bacteria, Cyanobacteria, acetic acid bacteria, Pseudomonads, lactic and propionic acid bacteria, endospore forming bacteria, Mycobacteria and Mycoplasma. Archaea: Halophiles, Methanogens, Hyper-thermophilic archae, Thermoplasm, Eukarya: algae, fungi, slime molds and protozoa, extremophiles and unculturable microbes.

UNIT-II

Aseptic techniques and properties of microbes: Sterilization, disinfection and antisepsis: physical and chemical methods for control of microorganisms, antibiotics, antiviral and antifungal drugs, biological control of microorganisms. Virus and bacteriophages, general properties of viruses, viral structure, taxonomy of virus, viral replication, cultivation and identification of viruses, sub-viral particles – viroids and prions. 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), innate immune response, mucosal immunity, antigens: immunogens, haptens, Major Histocompatibility Complex: MHC genes, MHC and immune responsiveness and disease susceptibility, Organs of immune system, primary and secondary lymphoid organs Immunoglobulins -

basic structure, classes & subclasses of immunoglobulins, antigenic determinants, multigene organization of immunoglobulin genes, B-cell receptor, Immunoglobulin superfamily, ADCC, cytokines: properties, receptors and therapeutic uses, antigen processing and presentation- endogenous antigens, exogenous antigens, non-peptide bacterial antigens and super-antigens, cell-cell co-operation, Hapten-carrier system.

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, CMI techniques: lymphoproliferation assay, mixed lymphocyte reaction, cell cytotoxicity assays, apoptosis, 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 and topoisomerases. 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. 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: PCR and related techniques: Polymerase chain reaction: Thermal profile and reaction components: Optimization (touch-down/ hot start and gradient PCR) Types of PCR and their applications: Conventional PCR, AP-PCR, Anchored-PCR, Inverse-PCR, Multiplex-PCR, Reverse Transcription-PCR, DDRT-PCR and Real Time-PCR. PCR based cloning: T/A cloning, TOPO cloning and gateway cloning. 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, hybridization based (using radio labelled and non-radio labelled probes) and immuno-screening 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. Finally, Biotechnology in Plant Improvement will introduce students to genetic engineering techniques, tissue culture methods, and molecular breeding strategies aimed at enhancing crop resilience and productivity, highlighting the pivotal role of plant physiology in agriculture and ecological sustainability.

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 mechanisms and pathways, Photosynthesis: light dependent and light independent reactions, factors influencing, photosynthesis.

UNIT-II

Plant Growth and Development: Hormones of plant growth and development, 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, Physiological adaptations to water, heat and salinity, Plant defense mechanisms: secondary metabolites, induced resistance, Plant-microbe interactions: symbiosis, pathogenesis.

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: bio fortification, 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 Muller, 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 and its significance in veterinary science and animal management. 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 processes like glycolysis, the citric acid cycle, and oxidative phosphorylation, while also exploring metabolic adaptations seen in animals during hibernation, migration, and fasting..

UNIT-I

Animal Physiology Fundamentals: Overview of animal physiology and its significance in veterinary science and animal management, Cell structure and function in animal tissues, Homeostasis and regulatory mechanisms: nervous and endocrine systems, Circulatory and respiratory systems: transport and exchange of gases and nutrients.

UNIT-II

Animal Nutrition and Metabolism: Digestive system and nutrient absorption, Energy metabolism: glycolysis, citric acid cycle, oxidative phosphorylation, Metabolic adaptations in animals: hibernation, migration, fasting.

UNIT-III

Reproduction and Reproductive Biotechnology: Reproductive physiology: gametogenesis, fertilization, pregnancy, Assisted reproductive techniques: artificial insemination, in vitro fertilization, Embryo transfer, cloning, and transgenesis in animal biotechnology, Genetic selection and breeding strategies.

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
BIT571	PLANT AND ANIMAL TISSUE CULTURE	3	II

Course Objectives: The course aims to provide a comprehensive understanding of plant and animal culture, covering its definition, historical development and significance in biomedicine & research. Unit-I focuses on introducing the fundamentals of tissue culture, including cell types, primary cultures, laboratory setup, aseptic techniques, culture media composition, sterilization methods& quality control. Unit-II delves into advanced topics such as cell differentiation, organogenesis, 3D cell culture techniques, co-culture systems, tissue engineering & stem cell culture with an emphasis on their applications and challenges. Units III and IV aims to deepen the understanding and practical application of specialized cell culture techniques. Through these units, students will gain necessary knowledge & skills to conduct tissue culture techniques.

UNIT-I

Concepts of Plant Tissue culture: Early attempts in tissue culture of plants. Concept of totipotency. Sterilization Procedures – Fumigation, wet and dry sterilization, ultraviolet sterilization, ultra-filtration and surface sterilization, Design of laboratory and commercial tissue culture facility.

Tissue culture media for *in vitro* culture: Types of media – Solid, liquid & commercial prepacked media, Media composition – Macronutrients, Micronutrients & growth regulators, Preparation of media, Selection of suitable media. Explants for Tissue Culture: Shoot tip, axillary buds, leaf discs, cotyledons, inflorescence & floral organs.

UNIT-II

Different types of culturing methods: Callus culture - initiation and maintenance of callus. Micro-propagation - direct and indirect morphogenesis, somatic embryogenesis and synthetic seed production. Suspension Culture - Culture systems, Isolation of single and aggregate of cells and regeneration of plants, Immobilization of cells and use of bioreactors. Protoplast Culture - Isolation of protoplast, culture of protoplast, regeneration and sub-protoplast, Somatic cell hybridization, selecting desired hybrids and their regeneration into plants.

UNIT-III

Introduction to Animal Tissue Culture: Definition and significance of animal tissue culture, Historical development of animal cell culture, Applications in biomedicine and research, cell types and primary cultures, laboratory setup and aseptic techniques.

Culture media composition and selection, Sterilization methods and equipment, Cell line establishment and maintenance, Sub-culturing and passaging techniques, Quality control and contamination management.

UNIT-IV

Cell Differentiation and Specialized Culture Techniques: Cell differentiation and organogenesis, 3D cell culture techniques, Co-culture systems and tissue engineering, Stem cell culture and applications, Challenges in specialized cell culture.

1. Plant Tissue Culture: Techniques and Experiments by Roberta H. Smith
2. Introduction to Plant Tissue Culture by M. K. Razdan
3. 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, phylogenetic, and structural bioinformatics.

UNIT-I

Introduction to Biostatistics: Introduction to biostatistics, Data representation and plotting, Arithmetic mean, Geometric mean, Measure of Variability, Standard deviation, Data types and scales of measurement, Descriptive statistics, Probability and probability distributions, Sampling and sampling distributions.

UNIT-II

Inferential Statistics in Biostatistics: Estimation and confidence intervals, Hypothesis testing, Analysis of variance (ANOVA), Correlation and Regression analysis, Nonparametric statistics Permutations Expectation, Variance and Covariance. Test of Hypothesis -T-test, Chi-square test, ANOVA for linear regression.

UNIT-III

Introduction to Bioinformatics: Basics of bioinformatics, Sequence databases and searching, Sequence alignment techniques, Molecular evolution and phylogenetic analysis, Structural bioinformatics.

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 and control. Subsequently, they will study Fermentation Kinetics and Microbial Physiology, focusing on the kinetics of microbial growth, product formation, metabolism, energetics, substrate utilization, and genetic engineering techniques for industrial microbes.

UNIT-I

Introduction to Fermentation and Bioprocessing: Introduction to industrial biotechnology, Microorganisms used in fermentation, Fermentation process design and optimization, Bioreactors and fermentation equipment, Bioprocess monitoring and control.

UNIT-II

Fermentation Kinetics and Microbial Physiology: Kinetics of microbial growth 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: Separation and purification techniques in bioprocessing, Cell disruption and extraction, Filtration and centrifugation, Chromatography and column purification, Formulation and packaging of bio products.

UNIT-IV

Applications of Industrial Biotechnology: Bio-production of biofuels and chemicals, Pharmaceutical and vaccine production, Food and beverage fermentation, 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
6. Bio-separations Science and Engineering by Roger G. Harrison, Paul W. Todd, and Scott R. Rudge
7. Biotechnology for Beginners by Reinhard Renneberg

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, 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, 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 diagnostic 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, 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 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.

UNIT-IV

Research Writing and Reporting: Structuring a research report or thesis, writing styles and academic integrity, Citation and referencing styles (APA, MLA, etc.), 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-II 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: Introduction to immuno-technology, Immune system fundamentals, Types of immuno-assays, Principles of antigen-antibody reactions, Applications of immuno-technology in diagnostics.

UNIT-II

Immunoassay Techniques: Enzyme-Linked Immunosorbent Assay (ELISA), Radioimmunoassay (RIA), Fluorescent Immunoassay (FIA), Chemiluminescent Immunoassay (CLIA), Immuno-fluorescence Assay (IFA).

UNIT-III

Molecular Diagnostics and Immuno-technology: Polymerase Chain Reaction (PCR) in diagnostics, Nucleic acid-based immunoassays, Real-time PCR and its applications, Microarray technology in immuno-diagnostics, Next-generation sequencing (NGS) and immuno-genomics.

UNIT-IV

Advanced Topics and Case Studies: 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-II FOOD TECHNOLOGY	3	III

Course Objectives: Students will embark on an exploration of Food Technology, beginning with an introduction to its basics, covering food preservation methods, additives, safety protocols, and quality control, alongside trends shaping the field. They will explore Food Processing Techniques, including heat processing, refrigeration, drying, canning, and packaging methods essential for food preservation and distribution. Moving forward, students will focus on Food Quality and Safety, delving into quality assessment, foodborne pathogens, HACCP principles, quality assurance, and regulatory frameworks governing food technology. Finally, they will examine Emerging Trends in Food Technology, including functional foods, nanotechnology, sustainable production practices, biotechnology's role, and the burgeoning field of food innovation and entrepreneurship, providing a comprehensive understanding of the dynamic landscape of food technology and its future directions.

UNIT-I

Introduction to Food Technology: Introduction to food technology, Food preservation, methods, Food additives and ingredients, Food safety and quality control, Trends in food technology.

UNIT-II

Food Processing Techniques: Heat processing and pasteurization, Refrigeration and freezing technology, Drying and dehydration methods, Canning and bottling processes, Food packaging and labeling.

UNIT-III

Food Quality and Safety: Food quality assessment ,Foodborne pathogens and food safety, Hazard Analysis and Critical Control Points (HACCP), Quality assurance in food production, Regulatory aspects in food technology.

UNIT-IV

Emerging Trends in Food Technology: Functional foods and Nutraceuticals, Food nanotechnology, Sustainable food production, Food biotechnology and GMOs, Food innovation and entrepreneurship.

Reference Books

1. Food Science by Norman N. Potter and Joseph H. Hotchkiss
2. Food Technology: Principles and Practice by Peter J. Fellow
3. Food Processing: Principles and Applications by Stephanie Clark and Stephanie Jung
4. Food Packaging Science and Technology by Dong Sun Lee
5. Food Analysis by S. Suzanne Nielsen

COURSE CODE	TITLE OF THE COURSE	CREDITS	SEMESTER
BIT623	ELECTIVE-II AGRICULTURE TECHNOLOGY AND ANIMAL HUSBANDRY	3	III

Course Objectives: Students will explore Agriculture Technology, commencing with an introduction to modern agricultural practices, precision agriculture, sustainable agriculture, and the role of agricultural innovation and biotechnology. They will delve into Crop Production Techniques, covering crop selection, soil management, pest and disease management, irrigation, and post-harvest handling. Moving on to Livestock and Animal Husbandry, students will focus on livestock management, breeding, nutrition, disease control, dairy farming, and sustainable animal agriculture. Lastly, they will examine Agricultural Innovations and Future Trends, including agricultural machinery, biotechnology, organic and regenerative agriculture, agricultural policy and economics, and global challenges in agriculture, providing a comprehensive understanding of the dynamic field of agriculture and its future directions.

UNIT-I

Introduction to Agriculture Technology: Introduction to agriculture technology, Modern agricultural practices, Precision agriculture and smart farming, Sustainable agriculture, Agricultural innovation and biotechnology.

UNIT-II

Crop Production Techniques: Crop selection and breeding, Soil management and fertilization, Pest and disease management, Irrigation and water management, Harvesting and post-harvest handling.

UNIT-III

Livestock and Animal Husbandry: Livestock management and breeding, Animal nutrition and feed technology, Health and disease control in livestock, Dairy farming and milk production, Sustainable animal agriculture.

UNIT-IV

Agricultural Innovations and Future Trends: Agricultural machinery and automation, Biotechnology in agriculture, Organic and regenerative agriculture, Agricultural policy and economics, Global challenges in agriculture.

Reference Books

1. Introduction to Agriculture by Akhtar H. Siddiqi
2. Sustainable Agriculture by Eric Lichtfouse
3. Principles of Agronomy by Reddy and V.R. Willey
4. Integrated Pest Management: Principles and Practice by Dharam P. Abrol

COURSE CODE	TITLE OF THE COURSE	CREDITS	SEMESTER
BIT624	ELECTIVE-II DAIRY TECHNOLOGY	3	III

Course Objectives: Students will embark on an exploration of Dairy Technology, commencing with an introduction to the dairy industry, milk composition, processing techniques, and quality control. They will delve into Dairy Processing Techniques, including pasteurization, homogenization, cheese, yogurt, butter, ice cream production, and fermented dairy products. Moving forward, students will focus on Dairy Product Quality and Safety, covering quality assessment, microbiology, food safety, hygiene, packaging, storage, and regulatory standards. Lastly, they will examine Emerging Trends in Dairy Technology, exploring innovations in processing, dairy biotechnology, sustainable production, value-added products, and opportunities in dairy entrepreneurship and marketing, providing a comprehensive understanding of the dynamic field of dairy technology and its future directions.

UNIT-I

Introduction to Dairy Technology: Introduction to dairy technology, Dairy industry and its importance, Milk composition and properties, Dairy processing and value addition, Quality control and safety in dairy products.

UNIT-II

Dairy Processing Techniques: Dairy product manufacturing, Milk pasteurization and homogenization, Cheese and yogurt production, Butter and ice cream manufacturing, Fermented dairy products.

UNIT-III

Dairy Product Quality and Safety: Dairy product quality assessment, Microbiology of dairy products, Food safety and hygiene in dairy processing, Packaging and storage of dairy products, Regulatory standards for dairy industry.

UNIT-IV

Emerging Trends in Dairy Technology: Innovations in dairy processing, Dairy biotechnology and probiotics, Sustainable dairy production, Value-added dairy products, Dairy entrepreneurship and marketing.

Reference Books

1. Probiotics in Food Safety and Human Health by IpekGoktepe and Lutfi O. Ozel
2. Sustainable Dairy Production by Rattan Lal and Alphons G.J. Vorst
3. Dairy Microbiology Handbook: The Microbiology of Milk and Milk Products by Richard K. Robinson
4. Food Safety Management: A Practical Guide for the Food Industry by Yasmine Motarjemi and Huub Lelieveld

COURSE CODE	TITLE OF THE COURSE	CREDITS	SEMESTER
BIT625	ELECTIVE-II PROBIOTICS AND THEIR DEVELOPMENT	3	III

Course Objectives: Students will embark on an exploration of Probiotics, beginning with an introduction to probiotic microorganisms, their health benefits, and regulatory aspects. They will explore Probiotic Strains and Their Functionality, including types of strains, mechanisms of action, and their impact on digestive health, the immune system, and metabolic health. Transitioning to Probiotics in Food and Beverages, students will focus on incorporating probiotics into food products, particularly fermented dairy products and beverages, as well as non-dairy options, while considering formulation and shelf-life. Lastly, they will examine Probiotics Research and Future Trends, covering clinical trials, probiotics for specific health conditions, prebiotics and synbiotics, emerging trends, and ethical considerations in probiotics research, offering insights into the dynamic field of probiotics and its future directions.

UNIT-I

Introduction to Probiotics: Introduction to probiotics, Probiotic microorganisms, Health benefits of probiotics, Probiotics in the human gut, Regulatory aspects and safety of probiotics.

UNIT-II

Probiotic Strains and Their Functionality: Types of probiotic strains, Mechanisms of probiotic action, Probiotics for digestive health, Probiotics and the immune system, Probiotics in metabolic health.

UNIT-III

Probiotics in Food and Beverages: Incorporating probiotics into food products, Fermented dairy products and probiotics, Probiotic beverages, Non-dairy probiotic foods, Formulation and shelf-life considerations.

UNIT-IV

Probiotics Research and Future Trends: Clinical trials and research on probiotics, Probiotics for specific health conditions, Prebiotics and synbiotics, Emerging trends in probiotics, Ethical considerations in probiotics research.

Reference Books

1. Handbook of Probiotics and Prebiotics by Yuan Kun Lee
2. Probiotics and Prebiotics: Current Research and Future Trends by Koen Venema and Ana Paula do Carmo
3. Probiotic Dairy Products by Adnan Y. Tamime and Muhammed M. Shahidi
4. Probiotics and Prebiotics in Food, Nutrition and Health by SemihÖtles
5. Probiotics: Immunobiotics and Immunogenics by Venketeshwer Rao and Leticia G. Rao

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-squaretest
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 SomnathDatta 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'sHemometer
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**
BIT631	**ELECTIVE-III AQUA CULTURE**	**2**	**IV**

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, Aquatic ecosystems and species selection, Sustainable aquaculture practices, Regulatory and ethical considerations.

UNIT-II

Aquaculture Systems and Management: Aquaculture facility design, Water quality management, Feeding and nutrition in aquaculture, Disease prevention and management, Harvesting and post-harvest processing.

UNIT-III

Species-Specific Aquaculture: Freshwater fish farming, Marine fish and shrimp farming, Bivalve and mollusk culture, Ornamental fish production, Emerging trends in aquaculture.

UNIT-IV

Aquaculture Economics and Sustainability: Economics of aquaculture, Market analysis and trade in aquaculture, Environmental impact and sustainability, Aquaculture certification and standards, Future challenges and opportunities.

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
BIT632	ELECTIVE-III OYSTER CULTURE	2	IV

Course Objectives; Students will embark on an exploration of Oyster Culture, commencing with an overview that includes oyster species, biology, site selection, and farming methods. They will then delve into Oyster Hatcheries and Larval Culture, covering larval development, hatchery operations, larval nutrition, and spat collection. Moving forward, the focus will shift to Oyster Farming Techniques, encompassing bottom versus suspended culture, grow-out methods, handling, grading, predator control, and biosecurity measures. Finally, attention will be given to Sustainability and Challenges in Oyster Culture, addressing sustainable practices, environmental impacts, disease management, market trends, value-added products, and future prospects, offering a comprehensive understanding of oyster culture and its dynamics.

UNIT-I

Introduction to Oyster Culture: Overview of oyster culture, Oyster species and biology, Site selection and water quality, Oyster farming methods, Historical perspective.

UNIT-II

Oyster Hatcheries and Larval Culture: Oyster larval development, Oyster hatchery operations, Larval feeding and nutrition, Spat collection and nursery culture.

UNIT-III

Oyster Farming Techniques: Bottom culture vs. suspended culture, Oyster grow-out methods, Handling and grading oysters, Oyster predator control, Biosecurity measures.

UNIT-IV

Sustainability and Challenges in Oyster Culture: Sustainable practices in oyster culture, Environmental impacts and conservation, Oyster diseases and management, Market trends and value-added products, Future prospects of oyster culture.

Reference Books

1. Oyster Culture by John R. Cross Oyster: A Gastronomic History (with Recipes) by Drew SmithOyster Hatchery Manual by Robert H. Stickney
2. Oyster Biology and Culture in the Pacific Northwest by Carol MalasOyster Farming by Stephen W. Nottingham.
3. Oyster Culture by I.C. Potter
4. Oysters: Biology, Consumption, and Ecological Importance by Marin Leroy and Brigitte Leroy
5. Oyster Culture on the BC Coast by Dick Beamish

COURSE CODE	TITLE OF THE COURSE	CREDITS	SEMESTER
BIT633	ELECTIVE-III PISICULTURE	2	IV

Course Objectives: Students will embark on an exploration of Pisciculture, beginning with an overview covering its history, fish species, farming systems, and sustainability. They will then delve into Fish Reproduction and Hatcheries, focusing on fish breeding, hatchery management, larval rearing, genetics, and disease prevention. Following that, attention will shift to Fish Farm Operations and Management, addressing site selection, water quality, nutrition, health, disease control, and post-harvest handling. Finally, students will examine Economics, Marketing, and Future Trends in Pisciculture, exploring economic aspects, marketing strategies, regulations, emerging technologies, and challenges and opportunities in fish farming.

UNIT-I

Introduction to Pisciculture: Introduction to pisciculture (fish farming), History of fish farming, Fish species for aquaculture, Fish farming systems, Sustainability in pisciculture.

UNIT-II

Fish Reproduction and Hatcheries: Fish reproduction and breeding, Fish hatchery management, Larval rearing and fry production, Genetics in fish farming, Disease prevention in hatcheries.

UNIT-III

Fish Farm Operations and Management: Fish farm site selection, Water quality and environmental management, Fish nutrition and feeding, Fish health and disease control, Harvesting and post-harvest handling.

UNIT-IV

Economics, Marketing, and Future Trends in Pisciculture: Economic aspects of fish farming, Marketing and value chain analysis, Regulations and certifications in pisciculture, Emerging trends and technologies, Challenges and opportunities in fish farming.

Reference Books

1. Economics and Marketing of Aquaculture Products by Carole R. Engle and Kwamena K. Quagrainie
2. Sustainable Aquaculture by John Hargreaves
3. Fish Farm: A Guide to Understanding and Avoiding Environmental Problems by John E. Bardach, William O. McLarney, and James R. Collins
4. Fish Nutrition by John E
5. Fish Hatchery Management by Gary E. Mims and Michael L. Gayle

COURSE CODE	TITLE OF THE COURSE	CREDITS	SEMESTER
BIT634	ELECTIVE-III APICULTURE	2	IV

Course Objectives: Students will explore Apiculture, starting with an introduction to beekeeping, including types of honeybees, hive construction, history, and sustainable practices. Moving to Bee Biology and Hive Management, they will learn about the honeybee life cycle, hive inspection, swarm prevention, queen bee rearing, and disease control. In Honey Production and Products, students will study honey sources, production, extraction, processing, beeswax, pollination services, and marketing. Finally, in Challenges, Sustainability, and Future of Apiculture, they will examine issues like colony collapse disorder, sustainable practices, organic certification, technological innovations, and future trends and opportunities in beekeeping.

UNIT-I

Introduction to Apiculture: Overview of apiculture (beekeeping), Types of honeybees, Hive construction and equipment, Beekeeping history and significance, Sustainable beekeeping practices.

UNIT-II

Bee Biology and Hive Management: Honeybee life cycle and behavior, Hive inspection and maintenance, Swarm prevention and management, Queen bee rearing and genetics, Disease identification and control.

UNIT-III

Honey Production and Products: sources and honey production, Extracting and processing, honey, Beeswax and other hive products, Pollination services and beekeeping income, Marketing honey and hive products.

UNIT-IV

Challenges, Sustainability, and Future of Apiculture: Challenges in beekeeping (e.g., colony collapse disorder), Sustainable beekeeping practices, Organic beekeeping and certification, Innovations in beekeeping technology, Future trends and opportunities in apiculture.

Reference Books

1. The Beekeeper's Problem Solver: 100 Common Problems Explored and Explained by James E. Tew
2. Beekeeping at Buckfast Abbey by Brother Adam
3. Beekeeping For Dummies by Howland Blackiston
4. The Beekeeper's Handbook by Diana Sammataro and Alphonse Avitabile
5. Honey Bee Biology and Beekeeping by Dewey M. Caron and Lawrence John Connor

COURSE CODE	TITLE OF THE COURSE	CREDITS	SEMESTER
BIT635	ELECTIVE-III FUNDAMENTALS OF PUBLIC HEALTH	2	IV

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: Introduction to public health., Historical development of public health, Core principles of public health, Public health systems and organizations, Public health ethics and social determinants of health.

UNIT-II

Epidemiology and Disease Control: Basics of epidemiology, Disease surveillance and outbreak investigation, Infectious and chronic disease epidemiology, Preventive measures and vaccination, Global health and pandemics.

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
BIT671	ELECTIVE-III HORTICULTURE	2	IV

Course Objectives: Students will explore Horticulture, its definition, significance in agriculture, and the classification of horticultural crops, along with the requirements of climate and soil for their cultivation, emphasizing sustainable practices. Crop Production and Management will cover propagation methods, nursery management, planting techniques, irrigation, and pest management. Fruit and Vegetable Production will delve into orchard and garden management, post-harvest handling, and the cultivation of high-value crops. Landscape Design and Ornamental Horticulture will focus on principles of landscape design, plant selection, turfgrass management, urban forestry, and commercial floriculture.

UNIT-I

Introduction to Horticulture; Definition and scope of horticulture, Importance of horticulture in agriculture, Horticultural crops and their classification, Climate and soil requirements for horticultural crops, Sustainable practices in horticulture.

UNIT-II

Crop Production and Management: Propagation methods in horticulture, Nursery, management and seedling production, Planting, spacing, and pruning techniques, Irrigation and nutrient management, Pest and disease management in horticultural crops.

UNIT-III

Fruit and Vegetable Production: Fruit cultivation and orchard management, Vegetable cultivation and garden planning, Post-harvest handling and storage, High-value horticultural crops, Organic and sustainable horticulture.

UNIT-IV

Landscape Design and Ornamental Horticulture: Landscape design principles, Ornamental plant selection and care, Turfgrass management and lawn care, Urban forestry and tree maintenance, Commercial floriculture.

Reference Books

1. Introduction to Horticulture by N. Kumar
2. Principles of Horticulture by J. K. Arora
3. Horticultural Crop Production by David M. Webster
4. Horticultural Pests: Detection and Control by V. A. Sankaran
5. Fruit and Vegetable Production: Principles and Practices by David H. Trinklein and Wallace E. Tyner

COURSE CODE	TITLE OF THE COURSE	CREDITS	SEMESTER
BIT672	ELECTIVE-III ORGANIC FARMING	2	IV

Course Objectives: Students will explore Organic Farming, covering its basics, principles, certification standards, environmental benefits, 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, including poultry, dairy farming, and beekeeping. 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 of organic farming ,Principles and philosophy of , organic agriculture, Organic certification and standards, Environmental benefits of organic farming, Challenges and misconceptions.

UNIT-II

Organic Crop Management: Soil health and organic soil management, Crop rotation and diversification, Organic pest and disease control, Weed management in organic farming, Organic seed production and saving.

UNIT-III

Livestock and Organic Animal Husbandry: Organic livestock production standards, Animal welfare and organic practices, Organic poultry and egg production, Organic dairy farming, Beekeeping in organic agriculture.

UNIT-IV

Marketing, Certification, and Future of Organic Farming: Organic product marketing and labeling, Certification processes and requirements, Consumer demand and market trends, Research and innovation in organic farming, Challenges and future prospects.

Reference Books

1. Organic Farming: A Comprehensive Guide by Paul Abercrombie
2. Organic Agriculture: A Global Perspective by Paul Kristiansen, AcramTaji, and John Reganold
3. Organic Crop Production: Ambitions and Limitations by John E. Lenz and Rod J. Turner
4. Weed Management for Organic Farmers, Growers, and Smallholders by Steve Jennings
5. Organic Livestock Farming: A Practical Guide by Anne-Kathrin Schultz and Maria Schautz

COURSE CODE	TITLE OF THE COURSE	CREDITS	SEMESTER
BIT673	ELECTIVE-III SILK FARMING	2	IV

Course Objectives: Students will explore Sericulture, its history, significance, and geographical distribution, along with the life cycle and biology of silkmoths. Silkworm Rearing and Cocoon Production will cover techniques, genetics, mulberry cultivation, cocoon harvesting, and disease management. Silk Reeling and Yarn Production will delve into the reeling process, filament extraction, spinning, twisting, dyeing, and quality control. Economics, Trade, and Future of Sericulture will focus on economic aspects, trade dynamics, cooperatives, technological advancements, challenges, and future prospects in the field.

UNIT-I

Introduction to Sericulture: History and significance of sericulture, Sericulture and silk production regions, Silkmoth life cycle and biology, Varieties of silk-producing insects, Sustainability in sericulture.

UNIT-II

Silkworm Rearing and Cocoon Production: Silkworm rearing techniques, Silkworm genetics,andbreeding, Mulberry cultivation for silkworms, Cocoon harvesting and processing, Disease management in sericulture.

UNIT-III

Silk Reeling and Yarn Production: Silk reeling process, Silk filament extraction and spinning, Silk yarn twisting and dyeing, Quality control in silk production, Value-added silk products.

UNIT-IV

Economics, Trade, and Future of Sericulture: Economic aspects of sericulture, Silk trade and market dynamics, Sericulture cooperatives and organizations, Technological advancements in sericulture, Challenges and future directions.

Reference Books

1. Sericulture: The Biology of Silk by N. B. Krishnamoorthy
2. Silkworm Rearing and Cocoon Production by Sandhya Pandey
3. Silk Worms and Sericulture Sarbjit Kaur and Surinder Kumar
4. Practical Manual on Sericulture by K. C. Das and A. B. Rai
5. Sericulture and Seri-Biodiversity by V. Ramamurthy

COURSE CODE	TITLE OF THE COURSE	CREDITS	SEMESTER
BIT674	ELECTIVE-III MUSHROOM CULTURE	2	IV

Course Objectives: Students will explore Mushroom Culture, covering its cultivation, types of edible mushrooms, life cycle, species selection, and agricultural significance. Mushroom Substrate and Spawn Production will focus on substrate preparation, spawn production, inoculation techniques, environmental factors, and disease management. Cultivation Techniques for Specific Mushroom Varieties will include button mushrooms, shiitake mushrooms, oyster mushrooms, specialty varieties, and sustainable farming practices. Marketing, Value-Added Products

UNIT-I

Introduction to Mushroom Culture: Overview of mushroom cultivation, Types of edible mushrooms, Life cycle of mushrooms, Selection of mushroom species, Importance of mushrooms in agriculture.

UNIT-II

Mushroom Substrate and Spawn Production: Substrate preparation for mushroom cultivation, Mushroom spawn and its production, Inoculation techniques, Environmental factors for mushroom growth, Disease and pest management in mushroom farms.

UNIT-III

Cultivation Techniques for Specific Mushroom Varieties: Cultivation of button mushrooms (*Agaricus bisporus*), Shiitake mushroom cultivation (*Lentinula edodes*), Oyster mushroom cultivation (*Pleurotus* spp.), Specialty mushroom varieties, Organic and sustainable mushroom farming.

UNIT-IV

Marketing, Value-Added Products, and Future of Mushroom Culture: Marketing strategies for mushroom farmers, Value-added mushroom products, Mushroom-based bioactive compounds, Research and innovations in mushroom culture, Challenges and opportunities in mushroom farming.

Reference Books

1. Mushroom Cultivation: An Illustrated Guide to Growing Your Own Mushrooms at Home by Tavis Lynch
2. Mushroom Biology: Concise Basics and Current Developments by Philip G. Miles and Shu-Ting Chang
3. Mushroom Cultivation: Growing Mushrooms at Home for Food by Ben Haggard
4. Mushroom Pest and Disease Control: A Color Handbook by T. R. Glare and T. G. A. Green
5. The Shiitake Way: Vegetarian Cooking with Shiitake Mushrooms by Jennifer Snyder
6. Oyster Mushroom Cultivation: Simple and Advanced Techniques by Satyajit Panda and Hajra Pandit

COURSE CODE	TITLE OF THE COURSE	CREDITS	SEMESTER
BIT675	**ELECTIVE-III POULTRY FARMING**	**2**	**IV**

Course Objectives: To see and practice the paths that lead to the success of any entrepreneurship on live animals and birds. To develop the knowledge of poultry in an operational farm for more profit management, feed requirements, etc. To make the participants/ professionals well versed in their practical skills starting from hatching of chicks to the egg production stage. This course will enlighten the farmers/ students about the operation of livestock and poultry farming. Learning of poultry farming will generate a source of employment opportunities in rural areas and employment to the farmers.

UNIT-I

Introduction to Poultry farming: Current status of poultry farming. Challenges and opportunities

UNIT-II

Types of Poultry Farming: Different types of poultry, Raising chicken in farm.

UNIT-III

Management of Poultry farms: Management of poultry, The layout of Poultry houses, Housing, cleaning and space management.

UNIT-IV

Poultry Feeding and Health Management: Poultry feed classification and principles of feeding, Feed additives and supplements, Poultry Health management, Poultry diseases and their management.

Reference Books

1. Poultry Production: A Textbook by Leslie E. Card Topic 2016
2. Handbook of Poultry Science and Technology, Primary Processing by Isabel Guerrero-Legarreta 2010
3. Commercial Poultry Nutrition: 3rd Edition by S. Leeson and J.D. Summers 1991
4. Poultry Diseases by Mark Pattison 2007
5. Poultry House Construction: The Gold Standard by Michael Roberts 1997

COURSE CODE	TITLE OF THE COURSE	CREDITS	SEMESTER
BIT691	**SCIENTIFIC WRITING AND PRESENTATION**	**2**	**IV**
A seminar presentation is a good opportunity for students to gain knowledge and skills in a specific topic or field.			

COURSE CODE	TITLE OF THE COURSE	CREDITS	SEMESTER
BIT691	**RESEARCH PROJECT AND DISSERTATION**	**15**	**IV**
The aim of the project is to identify the independent research skills of students acquired during their project work. The research project is the quintessential part of their course and the basis of their dissertation/thesis. The project is not only integral in passing the course but also serves as the final test of students' capability to work independently and think critically.			