BISHOP HEBER COLLEGE (AUTONOMOUS)
TIRUCHIRAPPALLI – 620017
TAMILNADU, INDIA

COURSE OUTCOMES

DEPARTMENT OF BIOTECHNOLOGY

STRUCTURE OF THE SYLLABUS

Program Name	Course	Course CODE	Course Name
B.Sc. Biotechnology	Core I	U20BT101	Cell Biology
B.Sc. Biotechnology	Core Prac. I	U16BT1P1	Cell Biology Lab
B.Sc. Biotechnology	Allied I	U16BT1Y1	Fundamentals of Microbiology
B.Sc. Biotechnology	Allied Prac.I	U16BTYP1	Fundamentals and Applied Microbiology lab
B.Sc. Biotechnology	Core II	U16BT202	Biochemistry
B.Sc. Biotechnology	Core Prac. II	U16BT2P2	Biochemistry Lab
B.Sc. Biotechnology	Allied II	U16BT2Y2	Applied Microbiology
B.Sc. Biotechnology	Allied prac.I	U16BT2S1	Basics of Bioinformatics
B.Sc. Biotechnology	Core III	U20BT303	Genetics
B.Sc. Biotechnology	Core Prac. III	U21BT3P3	Genetics Lab
B.Sc. Biotechnology	NMEC I	U16BT3E1	Basics of Biotechnology
B.Sc. Biotechnology	Core IV	U20BT404	Basics of Immunology
B.Sc. Biotechnology	Core prac. IV	U16BT4P4	Basics of Immunology Lab
B.Sc. Biotechnology	NMEC II	U16BT4E2	Applied Biotechnology
B.Sc. Biotechnology	Core V	U21BT505	Molecular Biology
B.Sc. Biotechnology	Core VI	U21BT506	Genetic Engineering
B.Sc. Biotechnology	Core Prac. V	U16BT5P5	Molecular Biology & Genetic Engineering Lab
B.Sc. Biotechnology	Elective I	U21BT5:1	Plant Physiology
B.Sc. Biotechnology	Elective I	U21BT5:A	Ecology
B.Sc. Biotechnology	Elective II	U21BT5:2	Developmental biology
B.Sc. Biotechnology	Elective II	U21BT5:A	Basics of evolution
B.Sc. Biotechnology	SBEC – II	U21BT5S2	Basics of Biostatistics
B.Sc. Biotechnology	SBEC –III	U21BT5S3	Food Biotechnology
B.Sc. Biotechnology	Core VII	U21BT607	Industrial Biotechnology
B.Sc. Biotechnology	Core VIII	U21BT608	Animal Biotechnology
B.Sc. Biotechnology	Core IX	U21BT609	Plant Biotechnology
B.Sc. Biotechnology	Core Prac. VI	U16BT6P6	Industrial, Plant & Animal Biotechnology lab
B.Sc. Biotechnology	Elective III	U21BT6:3	Human physiology
B.Sc. Biotechnology	Elective III	U21BT6:A	Bioethics and IPR

CORE COURSE I: CELL BIOLOGY

SEMESTER : 1 **COURSE CODE : U20BT101**
CREDITS : 4 **HOURS/WEEK : 4**

At the end of this course, the students will be able to

CO.No	Course Outcomes	Level	Unit Covered
CO 1	Recall the diversity of cells, and their evolution, appearance, organization, genetic make-up and function	K2	I
CO 2	List the definite significance and role of various cellular organelles.	K1	II
CO3	Correlate the mobility of cells with the mechanism of specific cellular components.	K4	III
CO4	Define the mechanism of cell division and species proliferation that depends on individual cell types.	K2	IV
CO5	Analyze the cellular networking with biochemical pathways based on receptor – ligand concept.	K4	V
CO6	Predict the consequences and regulation of cell cycle that leads to cellular deformities.	K5	V

ALLIED I : FUNDAMENTALS OF MICROBIOLOGY

SEMESTER : 1 **COURSE CODE : U16BT1Y1**
CREDITS : 4 **HOURS/WEEK : 4**

At the end of this course, the students will be able to

CO.No	Course Outcomes	Level	Unit Covered
CO1	Recall the history of microbiology - Antony Van Leeuwenhoek, Louis Pasteur, Robert Koch	K1	I
CO2	Explain various types of microscopy and staining techniques.	K2	II
CO3	Describe the different stages of microbial growth and measurement techniques	K2	III
CO4	Discuss the procedures used in preparing media needed for culturing microorganisms staining techniques	K2	IV
CO5	Illustrate the decontamination and sterilization process using an autoclave	K2	V
CO6	Analyze the various mechanisms of microbial control by using the different antimicrobial agents.	K3	V

CORE PRACTICAL I : CELL BIOLOGY LAB

SEMESTER : 1 **COURSE CODE : U16BT1P1**
CREDITS : 2 **HOURS/WEEK : 3**

At the end of this course, the students will be able to

CO.No	Course Outcomes	Level	Experiments
CO1	Visualize and differentiate the structural features of cells of plants and animals	K2	1,4
CO2	Identify the different stages of cell division and illustrate their specific morphological features.	K2	1, 2
CO3	Examine the genetic components of organisms and their related mechanisms.	K2	4
CO4	Distinguish the detailed cellular structures by different staining methods .	K4	4,5
CO5	Usedifferntypes of microscopes effectively	K3	1-4,6
CO6	Differentiate Meiosis and Mitosis	K4	1, 2

ALLIED PRACTICAL I : FUNDAMENTALS & APPLIED MICROBIOLOGY LAB

SEMESTER : II/I **COURSE CODE : U16BTYP1**
CREDITS : 2 **HOURS/WEEK : 3**

At the end of this course, the students will be able to

CO. No	Course Outcomes	Level	Experiments
CO 1	Explain various types of microscopy and staining techniques.	K2	5-7, 13
CO 2	Identify the different stages of bacterial growth curve.	K2	4
CO 3	Examine the composition of bacterial cell wall	K2	7
CO 4	Distinguish the detailed bacterial structures by different staining methods.	K4	7
CO 5	Choose the appropriate staining techniques.	K4	5-7, 13
CO 6	Prepare media and develop pure cultures .	K3	1-3, 8,-12

CORE II : BIOCHEMISTRY

SEMESTER : II **COURSE CODE : U16BT202**
CREDITS : 6 **HOURS/WEEK : 6**

At the end of this course, the students will be able to

CO.No	Course Outcomes	Level	Unit Covered
CO1	Recall the basic chemistry of elements & molecules learnt in high school and describe the structure-function aspects of biomolecules.	K2	I
CO2	Illustrate the influence of chemical bonding through intra and intermolecular forces in assemblage of higher order structures.	K2	II
CO3	Explain the methods of purification and qualitative & quantitative chemical analysis of various biomolecules.	K3	III
CO4	Analyze, the structure and function of biomolecules and their commercial uses.	K4	IV
CO5	Explain the theories pertaining to mechanisms of biomolecular action and physiological correlations thereof.	K2	V
CO6	Formulate strategies to isolate, purify and assay novel biomolecules from various sources.	K6	V

ALLIED II : APPLIED MICROBIOLOGY

SEMESTER : II **COURSE CODE : U16BT2Y2**
CREDITS : 4 **HOURS/WEEK : 4**

At the end of this course, the students will be able to

CO. No	Course Outcomes	Level	Unit Covered
CO1	Relate the concepts and integrate various areas like aquatic, medical, environment and agricultural microbiology where this technology can be applied to solve biological problems	K1	I
CO2	Assess the quality of water and report whether it is potable	K2	I
CO3	Evaluate the significance of biofertilizers & biopesticides over chemical methods.	K3	III
CO4	Apply food preservation techniques	K4	II
CO5	Translate their theoretical knowledge of waste water treatment into practice.	K5	IV
CO6	Analyze the modes of transmission of microbial diseases & their control.	K6	V

CORE PRACTICAL II : BIOCHEMISTRY LAB

SEMESTER : II **COURSE CODE : U16BT2P2**
CREDITS : 2 **HOURS/WEEK : 3**

At the end of this course, the students will be able to

CO.No	Course Outcomes	Level	Experiments
CO 1	Observe and examine how theory can be translated into practice	K1	1-7
CO 2	Learn to estimate the concentration of biomolecules and to report findings.	K1	4
CO 3	Familiar with calculations pertaining to preparation of reagents and buffers	K2	1
CO 4	Inculcate ability to devise experiments and to correlate the results with underlying mechanisms	K2	2-5
CO 5	Summarize their findings in the form of lab reports	K2	1-7
CO 6	Formulate methodologies to purify and estimate biomolecules	K4	6-7

SBEC I : BASICS OF BIOINFORMATICS

SEMESTER : II **COURSE CODE : U16BT2S1**
CREDITS : 2 **HOURS/WEEK : 2**

At the end of this course, the students will be able to

CO.No	Course Outcomes	Level	Unit Covered
CO1	Develop the basic skills of Bioinformatics concepts and its applications	K3	I
CO2	Analyze the biological importance of nucleic acid from the structural data bases	K4	II
CO3	Describe the features of the databases of local and multiple alignments	K2	III
CO4	Explain the aspects of protein-protein interaction, and visualization tools	K2	IV
CO5	Discuss the importance of biological database collections	K2	II
CO6	Design the molecular modification of lead compound and develop the drugs	K6	V

CORE III : GENETICS

SEMESTER : III **COURSE CODE : U20BT303**
CREDITS : 5 **HOURS/WEEK : 6**

At the end of this course, the students will be able to

CO.No	Course Outcomes	Level	Unit Covered
CO1	Explain the genetic concepts, chemical basis of heredity, Mendelism and its influential methodologies.	K2	I
CO2	Recognize the role of inheritance in sex determination and Perform pedigree analyses to establish genetic linkages.	K2	II
CO3	Summarize the experimental evidences for DNA as genetic material and gene transfer mechanisms in prokaryotes.	K2	III
CO4	Use phylogenetic tree construction and relate closed species.	K3	V
CO5	Analyse the variations in chromosome structure and number	K4	IV
CO6	Assess the factors responsible for genetic disorders and provide counseling.	K5	V

CORE PRACTICAL III : GENETICS LAB

SEMESTER : III **COURSE CODE : U21BT3P3**
CREDITS : 2 **HOURS/WEEK : 3**

At the end of this course, the students will be able to

CO.No	Course Outcomes	Level	Experiments
CO1	Design the media to culture Drosophila	K6	1,2
CO2	Test the capability of the chemical to cause mutation	K6	3
CO3	Analyze the polyploidy in onion root	K2	4
CO4	Create Models based on the Mendel law	K	5
CO5	Analyse the human karyotype	K4	6
CO6	Identify sex chromatin in buccal smear	K3	7

ALLIED:III: ALLIED CHEMISTRY-I

SEMESTER: III **COURSE CODE : U19BTC33**

CREDITS : 3 **HOURS/WEEK. : 4**

At the end of this course, the students will be able to

CO.No	Course Outcomes	Level	Unit
CO1	Distinguish the geometry and shape of molecules using VSEPR theory	K4	I
CO2	Illustrate the mechanism for different basic organic reactions	K3	II
CO3	Compare the different concepts of acids and bases	K2	III
CO4	Explain the kinetics of chemical reactions	K3	IV
CO5	Summarize the applications of catalytic reactions	K2	IV
CO6	Identify different applications of colloids in day-to-day life	K2	V

ALLIED PRAC:III VOLUMETRIC AND ORGANIC ANALYSIS

SEMESTER: IV **COURSE CODE: U19BTCP2**

CREDIT: 3 **HOURS/WEEK.:3**

At the end of this course, the students will be able to

S.No.	Course Outcomes	Level
CO1	Relate the basic principles and types of volumetric analysis**.**	K2
CO2	Infer the redox reaction concept.	K3
CO3	Estimate the strength of the given solution.	K3
CO4	Apply complexationconcept to check water quality	K3
CO5	**I**dentify organic compounds and quantifying.	K5
CO6	Classify the primary standard solutions and to prepare standard solutions in different concentration units.	K3

CORE IV : BASICS OF IMMUNOLOGY

SEMESTER : IV **COURSE CODE : U20BT404**
CREDITS : 6 **HOURS/WEEK : 6**

At the end of this course, the students will be able to

CO.No	Course Outcomes	Level	Unit Covered
CO1	Describe the structure and functions of the organs and cells of the immune system.	K2	II
CO2	Differentiate cell mediated and humoral immunity based on mechanism.	K4	I
CO3	Illustrate the characteristics of antigens and antibodies	K2	III
CO4	Compare the mechanisms of processing and presentation of endogenous and exogenous antigens.	K2	IV
CO5	Explain the activation pathways of T cells, B cells and complement system.	K2	IV
CO6	Demonstrate the immunological techniques used in Clinical Diagnosis.	K4	V

CORE PRACTICAL II :BASICS OF IMMUNOLOGY LAB

SEMESTER : IV **COURSE CODE : U16BT4P4**
CREDITS : 2 **HOURS/WEEK : 3**

At the end of this course, the students will be able to

CO.No	Course Outcomes	Level	Experiments
CO1	Explain the composition of the human blood	K2	1-3
CO2	Calculate the level of red blood cells and white blood cells in specific volume of blood	K3	2
CO3	Distinguish the various types of white blood cells based on nucleus morphology	K2	2,3
CO4	Analyze the blood group of an individual through blood grouping test	K4	4
CO5	Calculate the interactions of antigen and antibody through immunological assays	K4	5-6
CO6	Explain the preparation of antibodies and immunization techniques.	K2	7,8

CHEMISTRY FOR LIFE SCIENCES

SEMESTER: IV **COURSE CODE: U19BTC44**
CREDITS : 3 **HOURS/WEEK. : 4**

At the end of this course, the students will be able to

CO.No	Course Outcomes	Level	Unit
CO1	Explain the structure and properties of biomolecules	K4	I
CO2	Identify the types of water, quality parameters and treatment processes	K3	II
CO3	Distinguish various kinds of errors in data collection	K2	III
CO4	Explain the fundamentals of separation and purification techniques	K2	IV
CO5	Identify the significance of Chemistry in day-to-day life	K2	V
CO6	Outline the properties and applications of various polymers	K2	V

CORE V : MOLECULAR BIOLOGY

SEMESTER : V **COURSE CODE : U21BT505**
CREDITS : 6 **HOURS/WEEK : 6**

At the end of this course, the students will be able to

CO.No	Course Outcomes	Level	Unit Covered
CO1	Recollect the structure and functions of nucleic acids.	K2	I
CO2	Explainthe principles and mechanism of replication, Recombination DNA repair and transposition.	K2	I,III
CO3	Distinguish the types of mutation and its detection methods.	K4	II
CO4	Describe gene expression and regulation mechanism of prokaryotes and eukaryotes.	K4	III
CO5	Integrate the concept of central dogma and genetic code.	K5	IV
CO6	Justify the importance of post transcriptional and post translational modification.	K5	V

CORE VI : GENETIC ENGINEERING

SEMESTER : V **COURSE CODE : U21BT506**
CREDITS : 6 **HOURS/WEEK : 6**

At the end of this course, the students will be able to

CO.No	Course Outcomes	Level	Unit Covered
CO1	Explain the concept of genetic engineering.	K1	I
CO2	Relate the role of enzymes used in the construction of gene cassettes and vectors	K2	II
CO3	Apply the biological methods of gene transfer in molecular cloning	K3	III
CO4	Analyze and identify the recombinant bacteria by blue- white colony screening and conform the result from Immunological techniques.	K4	IV
CO5	Summarize the gene cloning techniques at molecular level.	K5	III
CO6	Infer the applications of recombinant DNA in scientific research	K2	V

CORE VI : MOLECULAR BIOLOGY AND GENETIC ENGINEERING LAB

SEMESTER : V **COURSE CODE : U16BT5P5**
CREDITS : 4 **HOURS/WEEK : 4**

At the end of this course, the students will be able to

CO.No	Course Outcomes	Level	Experiments
CO1	Relate the basic experimental knowledge about the molecular techniques and genetic engineering	K2	1-10
CO2	Perform the gel electrophoresis (AGE & PAGE)	K1	5
CO3	Explain molecular and reproductive cloning strategies	K2	6, 9, 10
CO4	Describe the uses of biotechnology in medicine and agriculture	K1	1-3
CO5	Identify the purpose of screening and selection of gene transformation	K2	10
CO6	Explain the genetic engineering techniques at a molecular level	K2	5-10

ELECTIVE I : PLANT PHYSIOLOGY

SEMESTER : V **COURSE CODE : U21BT5:1**
CREDITS : 5 **HOURS/WEEK : 5**

At the end of this course, the students will be able to

CO.No	Course Outcomes	Level	Unit Covered
CO1	Acquire a basic knowledge on the photosynthesis mechanism of plants	K1	I
CO2	Understand the plant respiration	K2	II
CO3	Illustrate the physiological activities carried out within the plant	K3	II
CO4	Analyse the mechanism of nitrogen metabolism takes place in plants.	K4	III
CO5	Differentiate short distance transport from long distance transport in plants	K4	IV
CO6	Summarize the capability of the plants to withstand the environmental stresses	K5	V

ELECTIVE I : ECOLOGY

SEMESTER : V **COURSE CODE : U21BT5:A**
CREDITS : 5 **HOURS/WEEK : 5**

At the end of this course, the students will be able to

CO.No	Course Outcomes	Level	Unit Covered
CO1	Differentiate between biotic and abiotic components based on their characteristics	K4	I
CO2	Summarize the characteristics features of different types of ecosystem	K2	II
CO3	Describe the population and community ecology	K2	III
CO4	Design strategy to treat/reuse the liquid and solid waste	K6	IV
CO5	Differentiate the effect of different pollutants	K2	V
CO6	Report about national environment policy	K2	II

ELECTIVE II : DEVELOPMENTAL BIOLOGY

SEMESTER : V **COURSE CODE : U21BT5:2**
CREDITS : 5 **HOURS/WEEK : 5**

At the end of this course, the students will be able to

CO.No	Course Outcomes	Level	Unit Covered
CO1	Define the origin of development pattern and to explain the principles of development design the life cycle.	K1	I
CO2	Illustrate of early embryonic development and its stages.	K2	II
CO3	Explain the later embryonic development with the classification of germ layers.	K3	III
CO4	Infer Post embryonic development, with the regeneration mode.	K4	IV
CO5	Explain about implications of developmental biology.	K5	V
CO6	Explain the Medical implications of developmental biology, determine the infertility, and diagnosis infertility of IVF	K5	V

ELECTIVE II: BASICS OF EVOLUTION

SEMESTER : V **COURSE CODE : U21BT5:A**
CREDITS : 5 **HOURS/WEEK : 5**

At the end of this course, the students will be able to

CO.No	Course Outcomes	Level	Unit Covered
CO1	Summarize the theories of evolution	K2	I
CO2	Interpret the fossil record	K3	II
CO3	Apply the Hardy-Weinberg principles to calculate the genotype frequency in the Population	K3	III
CO4	Differentiate the species isolation mechanism	K4	IV
CO5	Illustrate the phylogenetic tree of Homosapiens	K2	V
CO6	Review the speciation mode in particular population	K2	IV

SBEC II: BASICS OF BIOSTATISTICS

SEMESTER : V **COURSE CODE : U21BT5S2**
CREDITS : 2 **HOURS/WEEK : 2**

At the end of this course, the students will be able to

CO.No	Course Outcomes	Level	Unit Covered
CO1	Define the Concept of Biostatistics	K1	I
CO2	Describe the characteristics of Data and it's Sources	K2	II
CO3	Articulate the basic Calculations in Average	K3	III,IV
CO4	Analyze and categorize the concepts of Measuring Central Tendency	K4	III
CO5	Describe the principle of Mean, Median, and Mode	K2	III
CO6	Appraise the accession and passing arguments using Software in Biostatistics	K3	V

SBEC III: FOOD BIOTECHNOLOGY

SEMESTER : V **COURSE CODE : U21BT5S3**
CREDITS : 2 **HOURS/WEEK : 2**

At the end of this course, the students will be able to

CO.No	Course Outcomes	Level	Unit Covered
CO1	Define food and its uses.	K1	I
CO2	Analyze the constituents of food.	K2	II
CO3	Differentiate the intentional and non intentional food additives.	K3	II
CO4	Classify the concepts of raw material characteristics.	K4	III
CO5	Asses the techniques followed in the food processing.	K5	IV
CO6	Evaluate the techniques followed in food preservation	K5	V

CORE VII : INDUSTRIAL BIOTECHNOLOGY

SEMESTER : VI **COURSE CODE : U21BT607**
CREDITS : 6 **HOURS/WEEK : 6**

At the end of this course, the students will be able to

CO.No	Course Outcomes	Level	Unit Covered
CO1	Describe the methods of strain development	K1	I
CO2	Explain the techniques to screen industrially important microorganisms.	K2	I
CO3	Determine the fermentation media preparation, immobilization methods and downstream processing	K3	II
CO4	Diagramatically represent the fermentor design and its types	K4	II
CO5	Summarize the production of pharmaceutically important products like antibiotics and enzymes	K5	III, IV
CO6	Assess the production of commercially important beverages and biofuels	K5	V

CORE VIII : ANIMAL BIOTECHNOLOGY

SEMESTER : VI **COURSE CODE : U21BT608**
CREDITS : 5 **HOURS/WEEK : 6**

At the end of this course, the students will be able to

CO.No	Course Outcomes	Level	Unit Covered
CO1	List out the methods and uses of animal cell culture.	K1	I
CO2	Describe the basic principles involved in Invitro fertilization and embryo transfer technology.	K2	III
CO	Assist in the choice of vectors that can be used to deliver the constructed DNA.	K3	II
CO4	Demonstrate the possible therapy methods that use DNA and proteins to cure diseases instead of the usual antibiotics.	K4	IV
CO5	Codify microorganisms to get useful products based on our needs.	K6	V
CO6	Propose the applications of recombinant DNA technology in animal agriculture or production of therapeutic proteins.	K5	V

CORE IX : PLANT BIOTECHNOLOGY

SEMESTER : VI **COURSE CODE : U21BT609**
CREDITS : 5 **HOURS/WEEK : 6**

At the end of this course, the students will be able to

CO.No	Course Outcomes	Level	Unit Covered
CO1	Acquire knowledge about the role of growth regulators under in vitro condition.	K1	I
CO2	Discuss various culture techniques for haploid production	K2	II
CO3	Demonstrate Gene transfer techniques to produce genetically modified plants	K3	III
CO4	Analyze the various methods of plant micropropagation strategies.	K4	IV
CO5	Defend endangered species of plants through plant tissue culture.	K5	V
CO6	Describe the secondary metabolite production and its applications on biodiversity conservation.	K5	V

CORE PRACTICAL IV : INDUSTRIAL,PLANT AND ANIMAL BIOTECHNOLOGY LAB

SEMESTER : VI **COURSE CODE : U16BT6P6**
CREDITS : 2 **HOURS/WEEK : 3**

At the end of this course, the students will be able to

CO.No	Course Outcomes	Level	Experiments
CO1	Knowledge of techniques used in milk quality analysis	K1	2, 3
CO2	Report the significance of extra cellular enzyme producers	K2	1
CO3	Describe basic working processes of fermentor	K2	6
CO4	Practice the preparation of plant and animal culture media	K4	7-12
CO5	Differentiate viable and non- viable cells	K5	13
CO6	Develop practical skills in plant and animal tissue culture techniques	K5	7-12

ELECTIVE III : HUMAN PHYSIOLOGY

SEMESTER : VI **COURSE CODE : U21BT6:3**
CREDITS : 5 **HOURS/WEEK : 5**

At the end of this course, the students will be able to

CO.No	Course Outcomes	Level	Unit Covered
CO1	Reproduce the components of mammalian physiology	K1	I
CO2	List out the functions of the human physiology from a regional perspective for the systems	K1	II
CO3	Describe the functions of important physiological systems including the cardio-respiratory, renal, reproductive and metabolic systems	K2	III
CO4	Infer the working mechanism of the human system	K2	IV
CO5	Distinguish the major structures of the human anatomy and analyze the mechanisms of human physiology	K4	V
CO6	Tell briefly the basic components and functions of the gastrointestinal, renal/ urinary, endocrine/metabolic, hepatic/biliary, genital/ reproductive and immunologic, systems.	K1	V

ELECTIVE III : BIOETHICS AND IPR

SEMESTER : VI **COURSE CODE : U21BT6:A**
CREDITS : 5 **HOURS/WEEK : 5**

At the end of this course, the students will be able to

CO.No	Course Outcomes	Level	Unit Covered
CO1	Interpret the basis of biosafety and bioethics and to know its impact on all the biological Sciences	K2	I
CO2	Explain the rules of biosafety practices and guidelines in research	K2	II
CO3	Realize the need of patents to safeguard novel research and innovations	K2	II,III
CO4	Discuss about the ethical issues related to biomedical research	K2	IV
CO5	Criticize the benefits and limitations of GM technology	K5	V
CO6	Substantiate the significance of in vivo study and clinical trials under ethical guidance.	K3	V

NMEC I : BASICS OF BIOTECHNOLOGY

SEMESTER : III **COURSE CODE : U21BT3E1**
CREDITS : 2 **HOURS/WEEK : 2**

At the end of this course, the students will be able to

CO.No	Course Outcomes	Level	Unit Covered
CO1	Outline the basic idea of Biotechnology and how it evolved into a new branch	K2	I
CO2	Describe the information regarding the various tools and techniques involved in making a recombinant DNA molecule	K2	II
CO3	Interpret the construction of recombinant DNA using vectors	K3	III
CO4	Indicate the various gene transfer methods that are in existence	K2	IV
CO5	Verify the properties of the transformed DNA molecule by screening methods	K2	V
CO6	Debate how to apply these acquired ideas in Biotechnology and put them into practice.	K4	V

NMEC II : APPLIED BIOTECHNOLOGY

SEMESTER : IV **COURSE CODE : U16BT4E2**
CREDITS : 2 **HOURS/WEEK : 2**

At the end of this course, the students will be able to

CO.No	Course Outcomes	Level	Unit Covered
CO1	Describe the basic idea of Plant Biotechnology and how valuable products can be obtained	K2	I
CO2	Outline the informations regarding the various cell lines and techniques involved in making a transgenic animal	K2	II
CO3	Select the appropriate vectors to deliver the chimeric DNA	K3	III
CO4	Specify the possible therapy methods that use DNA and proteins to cure diseases instead of the usual antibiotics	K4	IV
CO5	Apply the knowledge gained by basic principles in biotechnology to get better commercial useful products.	K3	V
CO6	Illustrate the methodology for the manipulation of genetically engineered microorganisms	K3	V

BIO- ENTREPRENEURSHIP

SEMESTER : V **COURSE CODE :**
CREDITS : 2 **TOTAL HOURS : 30**

At the end of this course, the students will be able to

CO.No	Course Outcomes	Level	Unit Covered
CO1	Explain the biological process systematically and to promote it commercially. (K1)	K1	I
CO2	Describe strategies for successful implementation of ideas. (K2)	K2	II
CO3	Manipulate the preparations of various bio formulations that can benefit the society. (K3)	K3	III
CO4	Analyze about the cultivation methods of commercially important organisms. (K4)	K4	IV
CO5	Access the skills about various organic farming strategies. (K5)	K5	V
CO6	Appraise the marketing strategies of bio products. (K5)	K5	II

STRUCTURE OF THE SYLLABUS

Program Name	Course	Course code	Course name
M.Sc. Biotechnology	Core I	P20BT101	Cell and Molecular Biology
M.Sc. Biotechnology	Core II	P20BT102	Biochemistry
M.Sc. Biotechnology	Core III	P20BT103	Microbiology
M.Sc. Biotechnology	Core Prac. I	P20BT1P1	Biochemistry and cell biology lab
M.Sc. Biotechnology	Core Prac. II	P20BT1P2	Microbiology lab
M.Sc. Biotechnology	Elective I	P20BT1:1	Bioinstrumentation
M.Sc. Biotechnology	Elective I	P20BT1:A	Basics of Bioinformatics
M.Sc. Biotechnology	Core IV	P20BT204	Animal Biotechnology
M.Sc. Biotechnology	Core V	P20BT205	Plant Biotechnology
M.Sc. Biotechnology	Core VI	P20BT206	Industrial Biotechnology
M.Sc. Biotechnology	Core Prac. III	P20BT2P3	Animal, Plant and Industrial Biotechnology Lab
M.Sc. Biotechnology	Elective II	P20BT2:2	Research Methodology and Biostatistics
M.Sc. Biotechnology	Elective II	P20BT2:A	Nanobiotechnology
M.Sc. Biotechnology	Elective III	P20BT2:3	Biosafety, Bioethics & IPR
M.Sc. Biotechnology	Elective III	P20BT2:B	Drug Discovery & Development
M.Sc. Biotechnology	VLO	P17VL2:1/ P17VL2:2	RI/MI
M.Sc. Biotechnology	Core VII	P20BT307	Gene Technology
M.Sc. Biotechnology	Core VIII	P20BT308	Immunology
M.Sc. Biotechnology	Core IX	P20BT309	Medical Biotechnology
M.Sc. Biotechnology	Core Prac. IV	P20BT3P4	Gene Technology Lab
M.Sc. Biotechnology	Core Prac. V	P20BT3P5	Immunology and Medical Biotechnology Lab
M.Sc. Biotechnology	Elective IV	P20BT3:4	Stem cell Biology
M.Sc. Biotechnology	Elective IV	P20BT3:A	Development Biology
M.Sc. Biotechnology	Core X	P20BT410	Environmental Biotechnology
M.Sc. Biotechnology	Elective V	P20BT4:5	Biotechnology Management
M.Sc. Biotechnology	Elective V	P20BT4:A	Food Biotechnology
M.Sc. Biotechnology	Core Project	P20BT4PJ	Project

Core Course: I - CELL AND MOLECULAR BIOLOGY

Semester: 1 **Course Code: P20BT101**
Credits : 5 **Total Hrs/ Week : 5**

At the end of this course, the students will be able to

CO. No	Course Outcomes	Level	Unit
CO1	Classify the cell into prokaryotes and eukaryotes based on the intracellular structures	K2	I
CO2	Distinguish the organization and structures of different cytoskeleton	K4	II
CO3	Evaluate the mutagenicity of the chemicals	K6	III
CO4	Differentiate the process of replication, transcription and translation	K4	IV
CO5	Apply basic knowledge on siRNA to use siRNA as therapeutic agents	K3	V
CO6	Illustrate cell cycle mechanism	K2	V

Core Course: II- BIOCHEMISTRY

Semester: 1 **Course Code: P20BT102**
Credits : 5 **Total Hrs/ Week : 5**

At the end of this course, the students will be able to

CO. No	Course Outcomes	Level	Unit
CO1	Recall the basic chemistry of elements & molecules and know the structure-function aspects of biomolecules	K1	I
CO2	Illustrate the biosynthesis, metabolic fates and regulation of biochemical pathways and perceive the overall scheme of energy metabolism in health and disease with a particular focus on enzymes	K2	II
CO3	Develop a keen interest for biomolecular chemistry and identify the methods of chemical analysis of various biomolecules	K5	III
CO4	Analyze, compare and contrast the structure and function of biomolecules and survey their commercial uses	K4	III
CO5	Determine and estimate various biomolecules qualitatively and quantitatively	K2	IV
CO6	Formulate strategies and plan assays to study, isolate and purify biomolecules from their natural sources	K5	V

Core Course: III -MICROBIOLOGY

Semester: 1 **Course Code: P20BT103**
Credits : 5 **Total Hrs/ Week : 5**

At the end of this course, the students will be able to

CO. No	Course Outcomes	Level	Unit
CO1	Recollect the basic concepts of microbiology and advanced developments	K2	I
CO2	Explain the advanced concepts and significance of the microbial physiological process	K2	II
CO3	Articulate the various mechanisms of microbial control and apply the concepts for obtaining practical solutions and breakthrough towards drug resistance in research	K3	III
CO4	Analyze the role of microbes as tools in finding sustainable solutions related to environment and societal issues	K4	IV
CO5	Evaluate the significance of biopesticides over chemicals	K5	IV
CO6	Develop strategies to understand the pathogenicity and identify the modes of transmission of microbial diseases and their control	K5	V

Core Practical: I- BIOCHEMISTRY AND CELL BIOLOGY LAB

Semester: 1 **Course Code: P21BT1P1**
Credits : 3 **Total Hrs/ Week : 5**

At the end of this course, the students will be able to

CO. No	Course Outcomes	Level	Experiments Covered
CO1	To recall the basic concepts pertaining to preparation of various kinds of reagents (molar, normal solutions) and buffers	K1	1 , 2
CO2	To observe how a spectrophotometer works and how to assay the concentrations of unknown solutions	K2	3
CO3	To develop working knowledge of estimation of biomolecules and learn to report their findings through construction of tables and lab reports	K5	4,5
CO4	To apply theoretical knowledge of Biochemistry in the laboratory setting and formulate newer alternative methodologies to estimate the concentration of biomolecules	K4	6,7
CO5	To distinguish between assay methods and comprehend the principle underlying the assays/experiments	K4	8
CO6	The student will learn to stain cells, visualize them and to isolate as well as estimate nucleic acids from various sources	K3	9, 10, 11, 12, 13

Core Practical: II - MICROBIOLOGY LAB

Semester: 1 **Course Code: P20BT1P2**
Credits : 3 **Total Hrs/ Week : 5**

At the end of this course, the students will be able to

CO. No	Course Outcomes	Level	Experiments Covered
CO1	Apply basic knowledge on basic staining techniques to differentiate bacteria based on grams reaction	K3	1
CO2	Differentiate bacterial spores from vegetative cells	K4	2
CO3	Design and conduct experiments involving bacterial growth	K5	3,4
CO4	Analyze the role of various factors affecting bacterial growth	K4	3,4,5,6
CO5	Apply pure culture techniques in isolation of bacteria from different samples and analyzing the quality based on microbial load	K3	2
CO6	Evaluate the potability of water sample	K4	7

Elective Course: Ia-BIOINSTRUMENTATION

Semester: 2 **Course Code: P20BT1:1**
Credits : 4 **Total Hrs/ Week : 5**

At the end of this course, the students will be able to

CO. No	Course Outcomes	Level	Unit
CO1	Construct the basic operators of Centrifuges	K1	I
CO2	Understand the characteristics of chemical reactions	K2	I
CO3	Analyze and categorize the concepts of Chromatography	K4	II
CO4	Describe the principle of Electrophoresis and list out its types	K2	III
CO5	Define the accession and passing arguments in functions of Spectroscopy	K5	IV

Elective Course: Ib-BASICS OF BIOINFORMATICS

Semester: 1 **Course Code: P20BT1: A**
Credits : 4 **Total Hrs/ Week : 5**

At the end of this course, the students will be able to

CO. No	Course Outcomes	Level	Unit
CO1	Understand the basic information of Bioinformatics tools and software	K2	I
CO2	Describe the features of the Biological databases	K1	II
CO3	Analyze the pair wise sequence alignment methods	K4	III
CO4	Determine the major principle aspects of protein-protein interaction, BLAST and PSI- BLAST	K3	IV
CO5	Apply and explain the application of Bioinformatics	K3	V
CO6	Distinguish the importance of Bioinformatics in the drug designing	K5	V

Core Course IV - ANIMAL BIOTECHNOLOGY

Semester: 2 **Course Code: P21BT204**
Credits : 5 **Total Hrs/ Week : 5**

At the end of this course, the students will be able to

CO. No	Course Outcomes	Level	Unit
CO1	Understand the significance of maintenance of cell lines & their application in cancer studies & toxicity testing	K2	I
CO2	Gain knowledge in the various techniques such cell synchronization & cell hybridization	K2	I
CO3	Compute the methods of construction of viral vectors in transfer of gene of interest to host in gene therapy	K3	II
CO4	Analyze the importance & advantages of recombinant vaccines over conventional vaccines	K4	II
CO5	Appraise the use of transgenic animals as models for human disease & for commercial products & explain the concepts in selective & cross breeding	K5	IV
CO6	Evaluate the application of employing *C.elegans*, mice, zebra fish & drosophila as alternative animal models in research	K5	V

Core Course: V-PLANT BIOTECHNOLOGY

Semester :2 **Course Code:P20BT205**
Credits : 5 **Total Hrs/ Week : 5**

At the end of this course, the students will be able to

CO. No	Course Outcomes	Level	Unit
CO1	Explain the basics, methodology and applications of plant tissue culture	K2	I
CO2	Experiment with the function and composition of different plant structures, tissues, and organelles	K3	II
CO3	Categorize the role of GM crops and products in the market and pipeline, and their contributions towards food security, sustainable environment and medicine	K4	III
CO4	Determine plant transformation, selection of desirable genes for crop improvement, design binary vector and procedure for generating GM crops	K5	IV
CO5	Compose plant related research, government regulatory bodies, education, food industry and other plant-based product development and related businesses	K5	V
CO6	Combinethe topics of technical insights into plant breeding, tissue culture, plant genes and genetic modification	K5	V

Core Course: VI-INDUSTRIAL BIOTECHNOLOGY

Semester: 2 **Course Code: P20BT206**
Credits : 4 **Total Hrs/ Week : 5**

At the end of this course, the students will be able to

CO. No	Course Outcomes	Level	Unit
CO1	To acquire knowledge about the screening techniques of industrially important microbes	K1	I
CO2	To understand the nutrition sources, types and stages of fermentation systems	K2	II
CO3	To distinguish the components and types of fermentor	K4	II
CO4	To comprehend about the downstream processing	K5	III
CO5	To apply the knowledge about the production of industrially significant products using fermentation technology	K3	IV
CO6	To apply the knowledge in the production of commercially valuable	K3	V

Core Practical: III- ANIMAL, PLANT & INDUSTRIAL LAB

Semester: 2 **Course Code: P20BT2P3**

Credits : 3 **Total Hrs/ Week : 5**

At the end of this course, the students will be able to

CO. No	Course Outcomes	Level	Experiments Covered
CO1	Understandthe organization of plant and animal culture labs	K2	1,6
CO2	Familarise in preparation of plant and animal culture media	K2	1,4,7
CO3	Apply the theoretical knowledge in developing practical skills in plant tissue culture techniques	K3	6,7
CO4	Analyse the effect of toxicants in human cells by MTT assay	K4	10,13
CO5	Visualize the live cells and differentiate them from dead cells	K4	2
CO6	Explore the significance of extra cellular enzyme producers	K5	11,12

Elective Course: IIa - RESEARCH METHODOLOGY AND BIOSTATISTICS

Semester: 2 **Course Code: P20BT2:2**

Credits : 4 **Total Hrs/ Week : 4**

At the end of this course, the students will be able to

CO. No	Course Outcomes	Level	Unit
CO1	Define the Concept of Research	K1	I
CO2	Understand the characteristics of Research in Biological Sciences	K2	II
CO3	Understand the method to write research reports, thesis, and manuscript for publication	K3	III
CO4	Analyze and categorize the concepts of Measuring Central Tendency	K4	IV
CO5	Describe the principle of Mean, Median, and Mode	K5	IV
CO6	Define the accession and passing arguments using Software in Biostatistics	K2	V

Elective Course: IIb- NANOBIOTECHNOLOGY

Semester: 2 **Course Code:P20BT2:A**
Credits : 4 **Total Hrs/ Week : 4**

At the end of this course, the students will be able to

CO. No	Course Outcomes	Level	Unit
CO1	Understand the concepts of nanoscale and its related dimension among natural components	K1	I
CO2	Associate the perception of nanotechnology in biotechnology and promote its interdisciplinary aspect	K2	I
CO3	Construe the working mechanisms of instruments in synthesizing and characterizing nanomaterials	K3	II
CO4	Focus on the various approaches of fabricating nanomaterials, along with significance and limitations	K3	III
CO5	Appraise the importance of engineered nanomaterials for biomedical, therapeutic and environmental applications	K4	IV
CO6	Formulate novel implants to improve physical impairments and evaluate the potential toxic effects of nanotechnology on living organisms related to the environment	K6	V

Elective Course: III - BIOSAFETY, BIOETHICS AND IPR

Semester: 2 **Course Code: P20BT2:3**
Credits : 4 **Total Hrs/ Week : 4**

At the end of this course, the students will be able to

CO. No	Course Outcomes	Level	Unit
CO1	Discuss the importance of Biosafety	K2	I
CO2	Explain the role of Ecological and Ethical issues related to GMOs	K3	II
CO3	Discuss about the Ethical issues biomedical research	K2	III
CO4	Understand the basics of IPR and marketing regulations	K1	IV
CO5	Illustrate the role of IPR in pharm sector	K4	IV
CO6	Evaluate the risk management in IPR commercialization	K5	V

Elective Course: III b DRUG DISCOVERY AND DEVELOPMENT

Semester: 2 **Course Code: P20BT2:B**

Credits : 4 **Total Hrs/ Week : 4**

At the end of this course, the students will be able to

CO. No	Course Outcomes	Level	Unit
CO1	Describe the detailed study of drugs dosage and its type of nature, particularly their actions on living systems	K2	I
CO2	Understand the drug discovery process, starting with target selection, to compound screening to designing lead candidates	K2	II
CO3	Analyze the various drug action of ADME process and methods that are used for finding and identifying a new drug	K4	III
CO4	Determine the major principle, method and designing a new drug	K3	III
CO5	Predict the importance of chemotherapeutic value and pharmacokinetic action of drugs in human bodies	K5	IV
CO6	Design the basic concepts of drug manufacturing principles and development of product and its importance	K6	V

CORE COURSE: VII –GENE TECHNOLOGY

Semester :3 **Course Code: P20BT307**

Credits :5 **Total Hrs/ Week : 5**

At the end of this course, the students will be able to

CO. No	Course Outcomes	Level	Unit
CO1	Recollect the basic knowledge about the strategies of cloning used in genetic engineering	K1	I
CO2	Understand the tools of recombinant DNA technology and genetic engineering	K2	II
CO3	Compare the principle and working mechanisms of DNA sequencing methodologies	K3	III
CO4	Analyze the function and expression of genes by using various expression vector systems	K4	IV
CO5	Develop steps into the promising area of research in the field of recombinant DNA technology	K5	V
CO6	Assess the genome 4.Mapping Scheme and sequencing and methods for gene therapy	K6	V

Core Course: VIII - IMMUNOLOGY

Semester :3 **Course Code:P20BT308**
Credits: 5 **Total Hrs/ Week : 5**

At the end of this course, the students will be able to

CO. No	Course Outcomes	Level	Unit
CO1	Recall the role of immune cells, organs and their mechanism in body defense Mechanism	K1	I
CO2	Describe the cellular and resistance mechanisms against foreign bodies	K2	II
CO3	Demonstrate the association of immune system with allergic and infectious disease thereby developing vaccines	K3	III
CO4	Differentiate the defense mechanism of complicated immune diseases and disorders that can strategize remedies	K4	IV
CO5	Access the solutions to various infections and physiological problems	K5	V
CO6	Apply immune associated mechanisms in medical research to formulate design novel drugs and vaccine	K3	V

CORE COURSE: IX - MEDICAL BIOTECHNOLOGY

Semester: 3 **Course Code: P20BT309**
Credits: 5 **Total Hrs/ Week : 5**

At the end of this course, the students will be able to

CO. No	Course Outcomes	Level	Unit
CO1	Recognize the role of enzymes and nucleic acids in health sector	K1	I
CO2	Identify the various markers and techniques in cancer diagnosis	K2	II
CO3	Determine the safety measures on handling the clinical samples for diagnosis.	K4	III
CO4	Evaluate and analyze the disorders of carbohydrate metabolism and their detection	K5	IV
CO5	Appraise the novel drug application and approval in pharmaceutical industries	K5	V

CORE PRACTICAL: IV - GENE TECHNOLOGY LAB

Semester :3 **Course Code : P20BT3P4**
Credits: 3 **Total Hrs/ Week : 5**

At the end of this course, the students will be able to

CO. No	Course Outcomes	Level	Experiments Covered
CO1	Comprehend the principles in PCR amplification for DNA fingerprinting analysis via RAPD and restriction digestion	K1	5,3,7
CO2	Apply skills on techniques of construction of recombinant DNA - Cloning vectors and isolation of gene of interest through restriction digestion and ligation methods	K2	3,4
CO3	Analyze gene amplification experiments by PCR analysis Purification of Protein through SDS and Native PAGE	K3	5,8,9
CO4	Identify the concept of integration of transgenes by Southern blot analysis	K4	10
CO5	Evaluate the importance of plasmids, cloning of gene and transformation into suitable bacteria for selection of recombinant clones	K5	11
CO6	Conclude with the introduction of rDNA into bacterial cells. Selection of transformants and recombinants (Blue and white screening)	K6	11

CORE PRACTICAL: V IMMUNOLOGY AND MEDICAL BIOTECHNOLOGY LAB

Semester :3 **Course Code :P20BT3P5**
Credits : 3 **Total Hrs/ Week : 5**

At the end of this course, the students will be able to

CO. No	Course Outcomes	Level	Experiments Covered
CO1	Understand the key concepts in immunology through demonstration and visual examination.	K1	1,2
CO2	Comprehend the salient features of antigen antibody reaction and its application in disease diagnostics.	K2	3,4
CO3	Recognize the biochemical and genetic basis of immune response and disease resistance.	K3	7,8
CO4	Analyze the structural and physiological features of immune cells and organs.	K4	2,6
CO5	Apply advance immunological techniques to diagnose and procure remedies against various physiological ailments.	K5	2
CO6	Decipher the pathogenic mechanisms and develop skills to produce novel antidotes	K4	3,4

ELECTIVE III A : STEM CELL BIOLOGY

Semester : 3 **Course Code :P20BT3:4**
Credits: 4 **Total Hrs/ Week : 5**

At the end of this course, the students will be able to

CO. No	Course Outcomes	Level	Unit
CO1	Understand basic biology of stem cells, and cell cycle regulators in stem cells	K1	I
CO2	Describe the characteristics of stem cells and the different types of stem cells	K2	II
CO3	Apply the knowledge on the isolation process and cultivation of various stem cells and can learn the importance of preservation of stem cells	K3	III
CO4	Inspect the ethical and regulatory issues associated with use of stem cells	K4	IV
CO5	Integrate the application of stem cell therapy for various diseases	K5	IV
CO6	Review the Opportunities and Policy of Stem Cells	K6	V

ELECTIVE IV B – DEVELOPMENTAL BIOLOGY

Semester : 3 **Course Code :P20BT3:A**
Credits: 4 **Total Hrs/ Week : 5**

At the end of this course, the students will be able to

CO. No	Course Outcomes	Level	Unit
CO1	Defining the general concepts of organisms developement. general principles of cell and cell communication in development	K1	I
CO2	Illustration of fertilization, development and sex determination in humans and their germ layers	K2	II
CO3	Inference on organogenesis-I of central nervous system and the epidermis and the formation of neural tube	K3	III
CO4	Explaination on organogenesis-II of mesoderm and endoderm layers	K4	IV
CO5	Medical implications of developmental biology, determine the infertility, and diagnosis infertility of IVF	K5	V
CO6	Enumerating the mechanisms of evolutionary changes	K6	V

CORE COURSE: X - ENVIRONMENTAL BIOTECHNOLOGY

Semester: 4 **Course Code:P20BT410**
Credits: 4 **Total Hrs/ Week : 5**

At the end of this course, the students will be able to

CO. No	Course Outcomes	Level	Unit
CO1	Remember and list the types of pollutions and environmental issues	K1	I
CO2	Describe and compare the methodologies of waste water treatment	K2	II
CO3	Apply the strategies of waste water treatments and recycle pollutants into bioenergy	K3	II
CO4	List out the diversity of life forms and develops the methodologies for biodiversity conservation	K3	III
CO5	Apply genetic engineered microbes in the field of agriculture and bioremediation for sustainable growth	K3	IV
CO6	Analyze the environmental toxicity using different parameters and predict the safe limits of drugs	K4	V

ELECTIVE : V A - BIOTECHNOLOGY MANAGEMENT

Semester : 4 **Course code : P20BT4:5**
Credits : 4 **Total Hrs/ Week : 5**

At the end of this course, the students will be able to

CO. No	Course Outcomes	Level	Unit
CO1	Build a foundation in mangement and main business processes needed within the biotechnology field and plan to develop the strategies, project management, risk and entrepreneurship	K2	I
CO2	Correlate the ideas of biotechnology in safety and hazard management especially using timely techniques like nanotechnology	K3	III
CO3	Specify the basic processing methods followed in food and such related industries and manage to integrate them	K2	II
CO4	Trace the pollution preventive measures, develop and adher to the procedures wherever necessary	K4	IV
CO5	Practice and prioritize life science industry customs including ethical practices, laboratory guidelines and other standards followed in research	K5	V
CO6	Display both leadership skills as well as neccessary knowledge of biotechnology to help in career advancement	K4	I

ELECTIVE : Vb. FOOD BIOTECHNOLOGY

Semester : 4 **Course code : P20BT4:A**
Credits : 4 **Total Hrs/ Week : 5**

At the end of this course, the students will be able to

CO. No	Course Outcomes	Level	Unit
CO1	Remember and recognize sources of microorganisms and food borne illness	K1	II
CO2	Learn and understand a new dimension in food industry	K2	IV, I
CO3	Apply concepts related to food technology in a fundamental way and it can be applied to in a professional domain. Apply the principles of food science to control and assure the quality of food products	K6	V
CO4	Analyze the chemistry underlying the properties and reactions of various food components	K4	III, I
CO5	Evaluate the food Processing industries and preservation techniques	K5	IV
CO6	Demonstrate practical proficiency in a food analysis laboratory	K3	III, II