JAYA COLLEGE OF ARTS AND SCIENCE, THIRUNINRAVUR-602024.

DEPARTMENT OF BIOTECHNOLOGY

B.Sc. BIOTECHNOLOGY

ACADEMIC YEAR 2020-2021

PROGRAMME OBJECTIVE

PO1	The B.Sc program of Biotechnology of Jaya College of Arts and Science, Thiruniravur was started in the year 2004.
PO2	The practical syllabus is designed to enable the students to link and support with their theory background.
PO3	The syllabus imparts the knowledge of handling instruments
PO4	The programme provides knowledge to start own enterprises by students for their future development.
PO5	The students can understand the role of biotechnology in society, health related issues and environmental concerns.

PROGRAMME OUTCOME

PO1	The B.Sc program of Biotechnology of Jaya College of Arts and Science, Thiruniravur was started in the year 2004.
PO2	The program aims to traine the students to develop global competience in the area of basic and applied biological sciences.
PO3	Biotechnology program has the opportunities in healthcare sector, diagnostics, research, food technology, pharmaceutical industry and education
PO4	It is an integrated science with interdisciplinary knowledge of Biochemistry, Molecular Biology, Microbiology, Genetics, Plant and Animal Sciences, Environmental and Pharmaceutical Sciences.
PO5	The subject knowledge of students are enhanced by using traditional and modern teaching methods

COURSE STRUCTURE:

FIRST SEMESTER

Course Content	Name of the Course	Ins. Hrs	Credits	Int. Marks	Ext. Marks	Total
Part – I	Language Paper – I	4	3	25	75	100
Part - II	English Paper – I	4	3	50	50	100
Part III	Core Paper I Cell and Molecular Biology	6	4	25	75	100
	Core Paper II Practical 1	3	4	40	60	100
	Allied I-Paper I Fundamentals of Microbiology	6	3	25	75	100
	Paper II Practical-I	3	**Examination will be held in Semester II**			
Part IV	*Basic Tamil/Adv. Tamil/Non Major Elective	2	2	25	75	100
	Soft skill - I	2	3	50	50	100

- **Non major elective subjects given separately**

SECOND SEMESTER

Course Content	Name of the Course	Ins. Hrs	Credits	Int. Marks	Ext. Marks	Total
Part – I	Language Paper – II	4	3	25	75	100
Part - II	English Paper – II	4	3	50	50	100
Part - III	Core Paper III Genetics	6	4	25	75	100
	Core Paper IV Practical II	3	4	40	60	100
	Allied –II- Chemistry	6	3	25	75	100
	Paper II Practical II	3	4	**Examinations for I & II will be held in Semester II**		
Part IV	Basic Tamil/Adv. Tamil/ Non Major Elective	2	2	25	75	100
	Soft skill - II	2	3	50	50	100

THIRD SEMESTER

Course Content	Name of the Course	Ins. Hrs	Credits	Int. Marks	Ext. Marks	Total
Part – I	Language Paper – III	6	3	25	75	100
Part - II	English Paper – III	6	3	50	50	100
Part - III	Core Paper V Genetic Engineering	5	4	25	75	100
	Core Paper VI – Practicals III	3	4	40	60	100
	Allied – III-Paper –I – Essentials of Biochemistry	5	3	25	75	100
	Paper – II -Practical III	3	Examination will be held in Semester IV			
PART IV	Environmental Studies	2	Examination will be held in Semester IV			

FOURTH SEMESTER

Course Content	Name of the Course	Ins. Hrs	Credits	Int. Hrs	Ext. Marks	Total
Part – I	Language Paper – IV	6	3	25	75	100
Part - II	English Paper – IV	6	3	50	50	100
Part - III	Core Paper VII –Plant Biotechnology	5	4	25	75	100
	Core Paper VIII Practicals IV	3	4	40	60	100
	Allied – IV-Paper –I Bioinstrumentation and Biostatistics	5	3	25	75	100
	Paper II – Practical IV	3	4	40	60	100
Part-IV	Environmental Studies	2	2	25	75	100

FIFTH SEMESTER

Course Content	Name of the Course	Ins. Hrs	Credits	Int. Marks	Ext. marks	Total
Part-III	Core Paper IX – Animal & Medical Biotechnology	6	4	25	75	100
	Core Paper X - Bioinformatics	6	4	25	75	100
	Core Paper XI - Immunology	5	4	25	75	100
	Core Paper XII – Practicals V	6	4	40	60	100
	Elective-I – Pharmaceutical Biotechnology/ NanoBiotechnology	5	5	25	75	100
Part-IV	Value Education	2	2	25	75	

SIXTH SEMESTER

Course Content	Name of the Course	Ins. Hrs	Credits	Int. Marks	Ext. Marks	Total
Part-III	Core Paper XIII – Industrial Biotechnology	6	4	25	75	100
	Core Paper XIV – Environmental Biotechnology	6	4	25	75	100
	Core Paper XV – Practicals VI	6	4	40	60	100
	Project or Electives*					
	Project	10	10			100
	Elective II - Bioentreprenurship / Marine Biotechnology	5	5	25	75	100
	Elective III – Basics in Research Methodology	5	5	25	75	100
Part V	Extension Activities	2	1		1	1

- Electives (one from elective II can be chosen and Elective III is compulsory) – Final semester

Course Content	Non major Electives	Ins. Hrs	Credits	Int. Marks	Ext. Marks	Total
I Semester	**Choice of subjects:** ● Animal physiology ● Biodiversity ● Food and Nutrition ● Microbiology	2	2	25	75	100
II Semester	**Choice of subjects:** ● Herbal Medicine ● Good Laboratory Practices ● Behavioral Biology ● Chemistry	2	2	25	75	100

SEMESTER I

CELL AND MOLECULAR BIOLOGY

Course Code: SC21A

Course Objective

- Students can understand the structural design of Prokaryotic and Eukaryotic cells.
- Students can gain knowledge in the synthesis, structure, importance and the inter-relationships between the DNA, RNA and Proteins.
- The major molecular processes which governs all the cellular activities and their regulations.

Course Outcomes

CO1	To understand the structure and organization of prokaryotes and eukaryotes
CO2	To gain knowledge about the cell organelles and function
CO3	To know the structure and function of DNA and RNA
CO4	To understand to central dogma of the cell
CO5	To gain knowledge about cell cycle, cell division, cell differentiation and communication

Syllabus

UNIT 1:

Introduction to the cells: Discovery and diversity of cells - Cell theory - Structure of prokaryotic (bacteria) and eukaryotic cells (plant and animal cells).

UNIT II:

Biomolecules and Cell organelles: Biomacromolecules and Biomicromolecules (Primary functions in the cell). Structure and Functions of Cell Organelles: Cell wall - Cell membrane (Fluid Mosaic Model) - Cytoplasm - Nucleus - Endoplasmic reticulum (RER & SER) - Ribosomes - Golgi bodies - Plastids - Vacuoles - Lysosomes - Mitochondria - Microbodies - Flagella - Cilia - Centrosome and Centrioles - Cytoskeleton.

UNIT III:

Introduction to Nucleic acids: Discovery of Nucleic acids - Primary and Secondary structure of DNA - DNA Replication - Models of DNA Replication - Circular and Linear forms of DNA - A, B & Z Types of DNA - DNA Damages - DNA Repair Mechanisms - Mutations - Functions of DNA. RNA Types, Structure and Function.

UNIT IV:

Central Dogma of the cell: Structure of chromosomes and genes - Gene expression - Genetic code - Transcription in Prokaryotes and Eukaryotes - RNA Processing - Translation - Similarities and differences in prokaryotic and eukaryotic translation - Post Translational Modifications - Protein Sorting - Protein degradation

UNIT V:

Cell cycle, cell division, cell differentiation & cellular communications: Cell cycle - Cell cycle check points - Cell division - Mitosis & Meiosis - Cellular differentiation - Cell junctions - Cell Adhesion - Extra Cellular Matrix - Cell to cell communications - Signal transduction - G - Protein Coupled Receptors Signal transduction pathways

CELL AND MOLECULAR BIOLOGY – PRACTICAL

1. Components of a Microscope
2. Types and uses of Microscopes
3. Blood smear preparation and Identification of Blood cells
4. Buccal smear preparation and Identification of squamous epithelial cells
5. Red Blood Cell counting using hemocytometer
6. White Blood cell Counting using hemocytometer
7. Isolation and Identification of plant cells
8. Cell fractionation and Identification of cell organelles (Demo)

FUNDAMENTALS OF MICROBIOLOGY

Course Code: SN31A

Course Objective

- Understand the basics of microbiology, types of microbes, classification and characterization.
- Students can understands the various applied aspects of microbes in biotechnology field and the role of microbes in human health

Course outcomes

CO1	To understand the basics of microbiology, classification and characterization of microbes
CO2	To know the culture of bacteria, fungi, virus and algae
CO3	To acquire knowledge about sterilization methods and antibacterial agents
CO4	To know the role of microbes as Bioinsecticides and Biofertilizers
CO5	To aware on various microbial diseases, diagnosis and treatment

Syllabus

UNIT I :

History of Microbiology, Classification of bacteria, fungi, virus, protozoa and algae – classical and molecular approaches. Future of microbiology – Role of microbes in biotechnology.

UNIT II :

Structure of bacteria - Bacterial growth and measurement of growth, Media – types and preparation-plating methods - staining methods (grams, capsule, spore, LCB mount)- methods of preservation and storage of microbes. Culture of fungi, virus and algae.

UNIT III :

Sterilization methods - physical and chemical methods- Mode of action – Antibiotic in clinical use - Resistance to antibacterial agents - MRSA, ESBL.

UNIT IV :

Bioinsecticides - *Bacillus thuringiensis*, Baculoviruses - Biofertilizers - *Azospirillum* and blue green algae-single cell protein – prebiotics and probiotics - Dairy products (Cheese and Yoghurt).

UNIT V :

Microbial Disease- host -pathogen interaction, clinical features, lab diagnosis and treatment of Airborne disease (Pneumonia, Chicken pox), food borne disease (Typhoid, Aspergillosis), Water borne disease (Cholera, Amebiasis), Sexually transmitted disease (AIDS, Trichomoniasis), Vector borne disease (Dengue, Malaria).

FUNDAMENTALS OF MICROBIOLOGY-PRACTICALS

- Sterilization techniques – Preparation of Media
- Inoculation techniques- Pour plate, spread plate and dilution techniques.
- Staining techniques: Simple, Gram's, Capsule (Negative), Spores, LCB mount
- Biochemical identification of bacteria (demonstration)
- Motility tests: Hanging drop technique

SEMESTER - II

GENETICS

Course Code: SC22A

Course Objective:

- Upon successful completion the students will gain the knowledge on the concepts of heredity, Genes, Mendelian genetics, Blood grouping, genetic map preparation
- Helps students to understand about human and population genetics, the role of genes in evolution.

Course outcomes:

CO1	To understand the genetic concepts and scope of genetics
CO2	To gain knowledge about Mendelian genetics
CO3	To acquire knowledge about linkage,crossing over and genetic mapping of chromosome
CO4	To gain comprehensive detail understanding of chemical basis of heredity
CO5	Students can able to recognise the experimental rational of genetic studies

Syllabus

UNIT I

Concepts and Scope of Genetics. Gene, Chromosome structure and organization in Prokaryotes and Eukaryotes. Identification of the DNA as the genetic material- Griffith experiments, Avery, McLeod, Mccarty and Hershey Chase experiment.

UNIT II

Mendel and his Experiments, Monohybrid and Dihybrid inheritance,Test cross. Genetic interaction. Multiple alleles- Blood group antigens, eye colour in Drosophila, Coat colour in Rabbit.

UNIT III

Linkage, Crossing over and Genetic Mapping of Chromosomes., Three point test cross. Conjugation, Interrupted mating technique Transformation and Transduction and their mapping.

UNIT IV

Variation in Chromosome Number and Structure. Mendelian Inheritance in Man (Autosomal Dominant, Autosomal Recessive Sex linked Inheritance,) Gender defective Phenotypes, Pedigree Analysis, Eugenics.

UNIT V

Lamarckism and Darwin`s Natural Selection. Gene frequency and genotype frequency. Mutation, Genetic drift, Inbreeding, Speciation. Hardy Weinberg law and the factors affecting hardy Weinberg equilibrium.

GENETICS- PRACTICAL

1. Identifications of human blood groups
2. Mitotic stages of onion (*Allium cepa*) root tip
3. Meiotic stages of cockroach testes/ Flower bud
4. Giant chromosomes from Chironomus larvae/ Drosophila salivary glands
5. Identification of barr bodies from Buccal smear
6. Preparations of culture medium and culture of Drosophila – methods of maintenance
7. Identifications of mutants of Drosophila
8. Human Karyotyping (Demo)

ALLIED CHEMISTRY

Course Code: SC32A

Course Objective:

- To understand the basic concepts of organic chemistry
- To understand the fundamentals of coordination chemistry and its application

Course Outcomes

CO1	Understand the principle of various fields of chemistry
CO2	Students will have firm foundation of current chemicals
CO3	Students will be skilled in the problem solving and analytical reasoning
CO4	Students will be able to communicate the results of scientific work
CO5	Students will be able to explain integral activity for environmental problems

Syllabus

UNIT I

Electrochemistry: Electrolytic conductance in metals and in electrolytic solution –specific conductance and equalent conductance-Arrhenius theory of electrolytic dissociation and its limitation- weak and strong electrolytes and according Arrhenius theory- Ostwald's dilution law- applications and limitations-conducto metric titration-strong acid vs strong base only

UNIT II

Fundamentals of organic Chemistry: Classification of organic compounds- hyberdization in methane, ethane, ethylene, acetylene, benzene- classifications of reagents –electrophiles, nucleophiles and free radicals-classification of reactions- addition, substitution, elimation, condensation and polymerization

UNIT III

Industrial Chemistry: Fuels-Classification- Gaseous fuels like water gas, producer gas, liquefied petroleum gas, gobar gas, compressed natural gas- fertilizers-classifiaction-Urea, ammonium sulphate, super phosphate, triple super phosphate, potassium nitrate-manufacture and uses-silicones- preparation, properties and applications. Hardness of water. Temporary and permenent hardness.

UNIT IV

Coordination Chemistry: Definition of terms –classification of ligands –nomenclature-chealtion – EDTA and its application- werner's theory-effective atomic number-pauling's theory- posteulates- biological role of hemoglobin and chlorophil (Elementary idea only)

Catalysis: Characteristics of catalytic reaction, autocatalysis, promoters, catalytic poisons-types of catalysis –homogenizes and heterogenous-Enzyme catalysis (no derivation, elemental idea only)

UNIT IV

Nuclear Chemistry: Fundamentals particle sof nuclear isotopes, isobars, isotomes and isomers – differences between chemical reactions, nuclear reactions, fusion and fission –radioactive series. Group displacement law- mass defect- applications of radioisotopes-carbon dating, rock dating and in medicine

SEMESTER–III

GENETIC ENGINEERING

Course Code: SC23A

Course Objective:

- The students gain knowledge about genes and its manipulation
- Helps to gain knowledge on techniques involved in the cloning and its applications in genetic engineering.

Course Objective

CO1	To gain knowledge about genes and its manipulation techniques
CO2	To identify, select and screen the recombinant
CO3	To acquire knowledge about expression system and their application
CO4	To have insight on gene transfer techniques in plants
CO5	To know the applications of genetic engineering in agriculture, horticulture and pharmaceuticals

Syllabus

UNIT I

Introduction of genetic engineering:– Tools in recombinant DNA technology – recombinant DNA – cloning strategies (enzymes, vectors, host) – introduction of rDNA into host cells.

UNIT II

Recombinant DNA Technology:- Identification of recombinants, selection and screening for recombinants DNA sequencing – Construction of library (Genomic DNA library, cDNA library), Chromosome walking.

UNIT III

Gene Expression: Expression system and their applications - gel electrophoresis and 2D gel electrophoresis – protein based products – protein engineering (designing protein) – production of protein from cloned genes.

UNIT IV

Gene transfer techniques in plants :- vector-mediated gene transfer (Agrobacterium mediated gene transfer) and vector-less gene transfer (Physical methods : Electroporation, Microinjection, Microprojectile) – transgenic plants *Bacillus thuringiensis* - stress tolerance – Abiotic stress tolerance –secondary metabolite – Biosafety of GM plants and Animals.

UNIT V

Applications of genetic engineering:- Transgenic animals and its applications - Agriculture, Horticulture , Diagnostics, Prevention and Treatment of diseases Pharmaceuticals ,Forensics ,Other Industrial applications.

GENETIC ENGINEERING - PRACTICAL

1. Isolation of genomic DNA
2. Isolation of Plasmid DNA
3. Agarose gel electrophoresis
4. Restriction digestion of DNA.
5. Isolation of RNA and run in electrophoresis.
6. Production of competent cells and transformation.
7. Southern blotting techniques
8. Western blotting techniques (Demo)
9. PCR (Demo)

ALLIED SUBJECT II - ESSENTIALS OF BIOCHEMISTRY

Course Code: SB33A

Course Objective:

- To understand the structure, properties and functions of Biomolecules,
- Major metabolic pathways, role of vitamins and hormones in humans, understand the importance of enzymes and porphyrins and the basics of Biological oxidation.

Course Outcomes:

CO1	Understand the chemistry of carbohydrates, lipids and proteins
CO2	To understand the Biological pathways and to learn about amino acids and proteins
CO3	To understand about the function, classification, of simple lipids fatty acids and lipoproteins
CO4	Understand about the nucleic acids, vitamins and hormones
CO5	To understand the importance of enzyme and porphyrin

Syllabus

UNIT I: CARBOHYDRATES AND BIOLOGICAL OXIDATION

Definition and classification of carbohydrates, linear and ring forms (Haworth' s formula) for monosaccharides (glucose,fructose,mannose) and disaccharides (maltose, lactose, sucrose). Physical properties-mutarotation, chemical properities, ten reactions of glucose and four reactions of fructose (oxidation,reduction,osazone formation, Seliwanoff's reaction), Disaccharide-maltose, lactose, sucrose-structure, occurrence, physical and chemical properties. Polysaccharides-starch, glycogen. cellulose, structure and properities. Glycolysis, TCA cycle, energy yield, HMP pathway, Electron Transport Chain, Oxidative phosphorylation and its mechanism

UNIT II: AMINOACIDS AND PROTEINS

Aminoacids - Classifications - Essential and Non-essential aminoacids, Non-protein aminoacids, Amphoteric nature, Isoelectric point. Proteins – Classification based on shape , solubility and composition, Biological functions of Proteins, Physical Properties – Ampholytes, Isoionic point, Salting in and Salting out, Denaturation, Peptide bond. Deamination, Transamination, Decarboxylation and Urea Cycle

UNIT III : LIPIDS

Fat - function, classification, simple lipids, fatty acids (saturated and unsaturated) compound lipids, derived lipids, properties-saponification, rancidity, reduction, oxidation, halogenation. Functions of Phospholipids. Cholesterol structure - biological importance, chemical properties. Bile salts-function. Lipoproteins: Structure, properties and Biochemical functions Ketone bodies: structure and functions. Metabolism: Fatty acid oxidation – β oxidation. Biosynthesis of saturated and unsaturated fatty acids.

UNIT IV: NUCLEIC ACIDS, VITAMINS AND HORMONES

Purine and pyrimidine bases, nucleosides, nucleotides, polynucleotides, DNA structure, various types, properties-absorbance, effect of temperature. Different types of RNA, structure and functions. Vitamins - Definition, classification, Fat soluble vitamins-A, D. E and K.- Occurrence, deficiency diseases, biochemical roles, daily requirements. Water soluble vitamins-B1, B2, B3, B6, B9, B12 and vitamin C - occurrence, deficiency diseases, biochemical roles, daily requirements. Hormones – Definition, Classification based on Chemical nature and Mechanism of Action. Eicosanoids- Definition, types and functions.

UNIT V: ENZYMES AND PORPHYRINS

Enzyme definition, units, various classifications, nomenclature, specificity, isoenzymes, factors affecting enzyme activity-substrate, pH, temperature. Classification of porphyrins, their structure and properties; structure of metalloporphyrins- haeme and chlorophyll.

ESSENTIALS OF BIOCHEMISTRY- PRACTICAL

I. Preparation of Buffers – Phosphate Buffer and determination of pH.

II. Qualitative Analysis

Qualitative analysis of carbohydrates – Glucose, Fructose, Lactose, maltose and sucrose . Unknown Sugar Sample I, Sample II –urine sample. Qualitative analysis of amino acids: Tyrosine, Tryptophan, Arginine and cysteine. Unknown Sample I and II

III VOLUMETRIC ANALYSIS:

1. Estimation of Glycine- Formal Titration.

2. Determination of Ascorbic acid – DCPIP method.

3. Determination of reducing sugar- Benedict's method

IV COLORIMETRIC ANALYSIS

1. Estimation of glucose – Anthrone method
2. Estimation of Protein - Biuret method
3. Estimation of Cholesterol- Zak's method
4. Estimation of DNA – Diphenylamine method

IV. Biochemical Preparations

1. Starch from potato.
2. Casein from milk.
3. Lecithin from egg yolk.

SEMESTER-IV

PLANT BIOTECHNOLOGY

Course Code: SC24A
Course Objective:

- Upon completion of the course, the student would be able to gain the knowledge about the plant tissue culture and transgenic plants, nitrogen fixation mechanism and significance of viral vectors.
- Can gain knowledge for the development of organic products

Course Outcomes:

CO1	To understand the organization of plant genome
CO2	To know the importance and molecular basis of action of hormones
CO3	To have insight on various plant tissue culture techniques
CO4	To aware on plant transformation technique and application of plant genetic engineering
CO5	To acquire knowledge on plant vaccine and genetically modified food.

Syllabus

UNIT I

Plant Genome: Organization, structure of representative plant genes and gene families in plants – chloroplast genome organization and mitochondrial genome.

UNIT II

Hormones – Auxins, cytokinins and gibberlins – molecular basis of action – phytochrome – role in photomorphogeneisis – Regulation of gene expression – abscisic acid – and stress – induced promoter switches in the control of gene expression – Ethylene and fruit ripening.

UNIT III

Plant tissue culture - Media composition (MS media) - Micropropagation techniques - direct and indirect organogenesis - somoclonal variation - somatic embryogenesis - haploid and triploid - Protoplast isolation and culture - hybrid and cybrid production, Synthetic seed production. Secondary metabolite production.

UNIT IV

Agrobacterium and crown gall tumors – Mechanism of T-DNA transfer to plants, Ti Plasmid vectors and its utility – Plant viral vectors. Symbiotic nitrogen fixation in Rhizobia. Applications of Plant Genetic Engineering: Genetic engineering & crop improvement, herbicide resistance, insect resistance, virus resistance, plants as bioreactors.

UNIT V

Seed storage proteins. Transgenic plants, Regeneration of gene expression . Applications – plant vaccine and plant development, genetically modified food - future perspectives & ecological impact of transgenic plants.

PLANT BIOTECHNOLOGY - PRACTICAL

- Plant tissue culture sterilization techniques.
- Plant tissue culture media preparation
- Generation of Callus from leaf,root,bud, shoot apex
- Maintenance of callus culture.
- Cell suspension culture
- Anther culture
- Pollen culture
- Embryo culture.
- Isolation of plant protoplast
- Protoplast viability test.
- Localization of nucleus using nuclear stain.
- Isolation of plant DNA and plant RNA(Demo)
- Southern blotting and northern blotting (Demo)
- Southern and Northern hybridization(Demo)
- Isolation of Agrobacterium plasmid DNA (Demo)
- Electropropagation- Biolistic transformation (Demo)

BIOINSTRUMENTATION AND BIOSTATISTICS

Course Code: SC34A

Course Objective:

- The students would have depth knowledge in the analytical techniques and principles and handling of instruments
- Students would have knowledge on research data analysis

Course Outcomes:

CO1	Students can measure and calibrate pH, centrifuge and spectroscopy
CO2	Students have depth knowledge about principle and instrumentation of different chromatography and electrophoresis techniques
CO3	Students acquire knowledge about various Radioiaotipic techniques
CO4	Students have insight on scope of biostatistics
CO5	Students can interpret correlation, regression and ANOVA

UNIT-I

Measurement of pH and calibration of pH meter, Centrifuge-Preparative and Analytical centrifuge, density gradient centrifugation. Spectroscopy: Principle, Instrumentation and applications of UV-Visible. Microscopy: Principle and applications of Compound , Bright field, phase contrast and fluorescence Microscope.

UNIT-II

Chromatography: Principle, Instrumentation and applications of Paper, TLC, Ion exchange, Gel filtration, Affinity, GLC and HPLC. Electrophoretic techniques: Agarose gel Electrophoresis, SDS-PAGE, Isoelectric focusing, Immunoelectrophoresis.

UNIT-III

Radioisotopic techniques: Principle and applications of GM counter, Solid and Liquid Scintillation, Autoradiography, Radioimmunoassay and Radiation Dosimetry.

UNIT-IV

Scope of Biostatistics, Data- collection, tabulation, classification. Frequency table, graphical representation of data-bar diagram. Measures of central tendency- Mean,Median,and Mode. Measures of Dispersions-Range, Mean deviation, Std deviation. Variance.

UNIT-V

Correlation- types and methods. Regression. Probability distribution-Binomial, Negative binomial, multinomial distribution, Poisson distribution. Test of significance- t test, F test,chi square test.Spreadsheet.ANOVA-One way and Two way.

BIOINSTRUMENTATION & BIOSTATISTICS – PRACTICAL

1. Preparation of bar diagram, line diagram and pie diagram using MS EXCEL.
2. Calculation of Central tendency-mean, geometric mean, median using MS EXCEL
3. Calculation of dispersion – Mean deviation, quartile deviation and standard deviation using MS EXCEL
4. Calculation of student's t test using MS EXCEL
5. UV spectra of Nucleic acids and proteins.
6. Chromatography analysis of sugar, amino acids, lipids by paper chromatography
7. Chromatography analysis of sugar, amino acids, lipids by Thin layer chromatography
8. Determination of concentration of dye by calorimetry

SEMESTER V

ANIMAL AND MEDICAL BIOTECHNOLOGY

Course Objective:

- To gain knowledge in the concepts of animal and medical biotechnology would be developed. To demonstrate an understanding of setting up an animal tissue culture laboratory would be obtained.
- Ability to recall the transmissions, pathogenicity, symptoms of microorganisms.
- To describe various molecular techniques in disease diagnosis and reproduction technologies
- To differentiate various vaccine producing methodologies

Course Outcomes:

CO1	To gain knowledge on the concepts of animal and medical biotechnology
CO2	To understand the different manipulation techniques
CO3	To perceive knowledge various animal diseases and diagnosis
CO4	To acquire knowledge on vaccine, types and production
CO5	To demonstrate an understanding of setting up an animal tissue culture laboratory

UNIT I

Historical aspects - Basics of developmental biology - Animal Biotechnology – setting up animal cell line laboratory and SOP - Principles of sterile techniques and cell propagation - media and types of cell culture - Scaling up of animal cell cultures.

UNIT II

Manipulation of reproductive process: Artificial insemination – freezing of semen – Embryo technology – *in vitro* maturation and fertilization – Pregnancy diagnosis – Assisted reproductive technology – cloning strategies – Preservation and characterization of animal cells- transgenic animals

UNIT III

Medical Biotechnology – Zoonotic diseases: Bacterial, Viral, Fungal and Protozoan disease - diagnosis using modern techniques – DNA/RNA probes- application of Probes for diagnosis of existing and emerging disease in animal and human disease.

UNIT IV

Vaccines – Production of recombinant vaccines – bacterial, viral or parasitic infections – DNA Vaccines. Synthetic peptide, anti-idiotype, deletion, mutant and vaccinia vectored vaccine – Prophylaxis.

UNIT V

Genetic engineering of Microorganisms and molecules – Protein production by genetically engineered mammalian cell lines, Stem cells and their applications-; Cell culture as a source of valuable products.

ANIMAL AND MEDICAL BIOTECHNOLOGY - PRACTICAL

1. Instruments and equipments needed for setting up the animals cell line laboratory
2. Preparation of Tissue culture medium and membrane filtration
3. Preparation of Single cell Suspension
4. Cell counting and cell viability
5. Role of serum in cell culture
6. Trypsinization of monolayer and sub culturing
7. Measurement of phagocytic activity
8. MTT Assay (Demo)
9. Cryopreservation and thawing

BIOINFORMATICS

Course Objective:

- The students will be able to extract information from large databases and to use this information in computer modeling,
- Students will get the ability to develop new algorithms and analysis methods.

Course Outcomes:

CO1	Students have an insight on overview and clarification of biological database
CO2	Students will able to analyse the sequence using various tools
CO3	Students will be able to perform phylogenetic analysis
CO4	Students can understand the haitory of drug discovery and deug designing
CO5	Students can predict the structure of protein

Syllabus

UNIT I

Introduction of Bioinformatics: Overview and Definition, Application of Bioinformatics, Sequences format used in Bioinformatics- Biological Database: Introduction, Classification of biological databases, Primary database- Nucleic acids- NCBI-DDBJ-EMBL. Protein- PDB-SWISSPORT. Secondary database- PROSITE ,PFAM. Structure and classification-SCOP-CATH, Metabolic pathway database.

UNIT II

Sequences Analysis: Sequences similarity, Identify & homology- Definition of homologues, Orthologues, Paralogues. Scoring matrices, Pairwise Sequences alignment. Dot Matrix, BLAST, FASTA- Needleman Wunsch – Smith and waterman Algorithm.

UNIT III

Phylogenetic Analysis (DEMO-Optional): Multiple Sequences alignment – Different method of multiple sequences alignment- Evolutionary analysis, clustering methods Phylogenic trees-rooted and unrooted tree- Methods to generate phylogenetic tree- Tools for multiple sequences alignment and phylogenetic analysis (PHYLIP)

UNIT IV

Drug Discovery: History of Drug Discovery, Steps in Drug design - Chemical libraries – Role of molecular docking in drug design.

UNIT V

Protein prediction: Studyof internet resources in Bioinformatics -Tools for primary (Compute PT/Mw, Protparam), secondary (PROSITE), Tertiary (Swiss Model), Structure prediction of proteins, Homology modeling of proteins. Visualization tools (RASMOL), Gene prediction tools (Genscan, Grail).

IMMUNOLOGY

Course Objective

- The students will gain the knowledge about the immune response and reactions.
- A student also understands cells involved in immunity, vaccines and tissue rejection.

Course Outcomes

CO1	To gain the knowledge about the immune system and types of immunity
CO2	To know characteristics and types of antigen and antibody
CO3	To understand antigen antibody interactions and purification of antibodies
CO4	To have a elaborate understanding on the complementary system
CO5	To gain the knowledge about hypersensitivity reaction and types

Syllabus

UNIT I

Introduction – Historical development in Immunology. Cells involved in immune response. Primary and Secondary lymphoid organs – Thymus, Bone marrow, Lymph nodes and Spleen. Hematopoiesis – development of B and T lymphocytes. Types of immunity – Innate and acquired.

UNIT II

Antigen: Characteristics and types. Antibody – Structure, Types, Properties and their Biological function. polyclonal - monoclonal antibody production and its biomedical applications.

UNIT III

Antigen – Antibody interactions, Immunodiffusion and Immuno electrophoresis. Principle and application of ELISA and RIA and Flourescent antibody technique. Purification of antibodies.

UNIT IV

The complement system and activation and regulation. Types – Classical, alternative and Lectin pathway. Biological function of C' proteins. Cytokines- Structure and Function. Vaccines – Types , Production and application.

UNIT V

Hypersensitivity Reactions and Types. Major Histocompatability Complex – MHC genes, MHC in immune responsiveness, Structure and function of Class I and Class II MHC molecules. HLA tissue typing.

IMMUNOLOGY – PRACTICAL

1. Separation of Serum and Plasma.
2. Blood grouping and Rh typing.
3. WBC counting
4. Differential blood count
5. WIDAL test
6. ASO test
7. Double Immunodiffusion
8. Single Radial Immunodifusion
9. ELISA – Demonstration
10. Handling of Laboratory animals – Demonstration
11. Skin test - Demonstration

PHARMACEUTICAL BIOTECHNOLOGY

Course Objective

- Students can understand the series of processes involved in drug development patenting and drug approval, therapeutic potentials
- Students also can understand adverse effects of drugs; focus on the demand and career opportunities in pharmaceutical industries

Course Outcomes

CO1	Students can understand the series of processes involved in drug development
CO2	Students can gain knowledge in the special areas of pharmaceutical biotechnology and it products
CO3	Students acquire knowledge in the biopharmaceutical products
CO4	Students have insight on adverse effects of drug and toxicity analysis
CO5	To aware on national and international drug approved agencies and pharmaceutical industries

Syllabus:

UNIT I

Pharmaceutical Biotechnology & Drug Development: Objectives of Pharmaceutical biotechnology - Generic and biogeneric drugs. Stages in the drug development process - Drug discovery - Drug designing - Drug production - Preclinical trials - Clinical trials - Pharmacokinetics and Pharmacodynamics - Patenting & Drug Approval - Drug Marketing - Post clinical trials

UNIT II

Special Areas of Pharmaceutical Biotechnology: Production of recombinant proteins - Development of Nucleic acid based therapies - Biopharmaceutical considerations - Pharmaceutical regulations - Formulation of Biotechnology products - Drug delivery - Pharmacognacy - Biomimetics.

Unit III

Biopharmaceutical products and their uses: Human Insulin (Humulin),, Growth hormones (Humatrope) - Blood coagulating factor (factor VIII - Kogenate) - Erythropoietin - (Epogen) Granolocyte colony stimulating factors (Neulasta) - Interferons (Avonex) - Antimicrobial peptides (β - defensin 2) - Vaccines (Pentavac), Biologics (Humira - Adalimumab), - Cancer based biologics (rituximab).

UNIT IV

Adverse effects of drugs: Drug toxicity analysis - Common side effects of drugs and managements - Drugs of abuse - Life changing complications - Prevention and management

UNIT V

Pharmaceutical Industries: National and International Drug approval agencies - Top National and International pharmaceutical industries - Scope and carrier opportunities in pharmaceutical sectors

NANOBIOTECHNOLOGY

Course Objective

- This makes the students to understand the advancing research and fostering innovations in the synthesis and characterization of nano particles
- A students can get knowledge on Types of nanomaterial and their applications.

Course Outcomes

CO1	To know the history and contributions of indian research institutes in the field of nanobiotechnology
CO2	To gain knowledge about the synthesis and characterization of nanoparticle
CO3	To have insight on nanobiomaterials
CO4	To acquire knowledge in applications of nanobiotechnology the field of agriculture and medicine
CO5	To aware on the nanobiosensors and Biomimetics

Syllabus

UNIT I History of Nanobiotechnology

Glimpse of Nanotechnology based material in ancient India: Wootz steel (iron carbide) and the Delhi iron pillar (anticorrosive nanomaterial), Bhasma (nanomaterial as medicine). Contributions of Indian Research Institutes in the field of nanobiotechnology.

UNIT II Synthesis and characterization of nanoparticle

Metals: Silver nanoparticle synthesis and its analyses by UV-spectroscopy and FTRI. Self Assembly nanomaterial: Cell membrane and its analyses by SEM

UNIT III Types of Nanobiomaterials.

Nano-thin films: Chitosan thin film, Nanodevices (nanorobots), Nanotubes: Microtubules assembly and its importance, Nanoshells- Dendrimers: Liposomes, Nanofibers: Collagen, Fibronectin & elastin, nanofluidics: Extracellular matrix assembly and its importance.

UNIT IV Application of Nanotechnology the field of agriculture and medicine

Agriculture: Crop production- Nanofertilizers technology, Biomaterial to improve shelf life of vegetables. Medicine: Collagen thin films in wound healing mechanism, Nanoscale devices – DNA microarray for disease diagnosis, Antibodies as drug delivery system.

UNIT V Applications of Bionanoparticles

Nanobiosensors (Firefly-luciferase) and its applications, Introduction to Biomimetics (Gecko foot effect, Lotus leaf effect: Paint and fabrics, Box fish based Car).

SEMESTER VI

INDUSTRIAL BIOTECHNOLOGY

Course Objective

- This programme will help the students to explore the beneficial potentials of microbes in the fermentation industry, production of primary and secondary metabolites using microbes
- Students also get knowledge its recovery and purification of biomolecules and methods using biotechnological principles.

Course Outcome

CO1	Students can explore the beneficial porentials of microbes in fermentation industry
CO2	Students can gain knowledge about designing and aspetic operation of bioreactor
CO3	Students know about unit operators in downstream processing
CO4	Students acquire knowledge about microbial biomass and enzymes
CO5	Students understand the production, recovery and purification of biomolecules using biotechnological principles

Syllabus

UNIT I

Biotechnology & Bioprocess Engineering, steps in bioprocess development, Microbial culture, Screening and selection for fermentation processes; Preservation and improvement of industrially important microorganisms, Strain development. Media for industrial fermentations: Media ingredients, medium formulation, oxygen requirements, antifoams, medium optimization, Media sterilization, Batch Process, continuous sterilization process; sterilization of fermenter and other ancillaries, filter sterilization of air and media. Inoculum development. Types of fermentation – Aerobic & Anaerobic systems - Submerged, Semisolid, Solid and slurry fermentation processes.

UNIT II

Design of bioreactors: Basic objective of fermenter design, aseptic operation & containment, body construction, agitator and sparger design, baffles, stirrer glands and bearings. Bioreactor configurations and types: Bubble column, airlift reactor, packed bed, fluidized bed, trickle bed, Membrane reactor, Photobioreactor, Animal and plant cell bioreactors. Factors affecting broth viscosity, Mixing in Fermenters. Fermentation systems Batch culture, Continuous culture, Fed-batch culture,

UNIT III

Downstream processing Filtration, Centrifugation, Cell disruption, Liquid-liquid extraction, Chromatography, membrane processes, Drying, Crystallization, Whole broth processing. Different types of fermented foods produced from microorganisms- Idli, Soysauce, Sauerkraut - Dairy products- Cheese and Yoghurt.

UNIT IV

Microbial biomass, Microbial enzymes– Amylase & protease, Immobilization of enzymes: Methods, Properties, Applications, Advantages and Disadvantages of Immobilization, Biosensors and Biochips-Types and applications. Microbial Polysaccharide production: Xanthan, Dextran, Alginate, Scleroglucan, Gellan, Pullulan, Curdlan. Bioplastic-Biopol, Microbial rubber and adhesive polymers.

UNIT V

Ore leaching (methods and examples), MEOR, Production of antibiotics – Penicillin - Alcoholic beverages: Wine, Beer –Biofertilizers- Rhizobium & Azotobacter. Biopesticides – *Bacillus thuringiensis* and microbial toxin production and their applications - Single cell protein, Biosurfactants, Vitamins- Folic acid & Vitamin B12, Organic acids. Biotechnology biosafety – Norms and measures

INDUSTRIAL BIOTECHNOLOGY - PRACTICAL

1. Study of Growth Curve and Generation time of Bacteria/ Yeast using turbidometry
2. Screening of industrially valuable microorganisms
3. Microbial Production of amylase
4. Determination of enzyme activity.
5. Immobilization of whole yeast cells/ enzyme by suitable method and determination of stability of immobilized enzyme.
6. Isolation and identification (Genus level) of spoilage causing microorganisms from spoiled foods.
7. Production of wine
8. Isolation and identification of starter organisms from Idli batter/ curd 9 Grading of raw milk (Dye reduction test)
9. Determination of efficiency of Pasteurization by quantitative phosphatase test
10. Demo - Preparation and Efficiency testing of Biofertilizer/ Biopesticide.
11. Demo - Production of microbial Polysaccharide.

ENVIRONMENTAL BIOTECHNOLOGY

Course Objective

- This course is planned to provide an idea about Global environmental changes
- Biotechnological methods of handling recent environmental problems like waste water treatment, solid waste management and bioenergy

Course Outcome

CO1	Students aware on global environmental changes and environmental pollution
CO2	Students can learn about waste water treatment using aerobic and anaerobic methods
CO3	Students perceive knowledge about biodiversity, biodegradation and ecological conservation
CO4	Students can know the various biotechnogical approches for bioremediation
CO5	Students can able to learn the methods of handling recent environmental problems

Syllabus

UNIT I

Environmental Pollution – Sources and types - Water, Air, Thermal, Industrial and Radiation - Global environmental changes. Global warming, Green house effect, acid rain, ozone depletion, and photochemical smog. Environmental issues, management strategies and safety, Biotechnological approaches for management.

UNIT – II

Waste water treatment: Aerobic and anaerobic methods (Primary, Secondary and Tertiary) –Use of aquatic plants in waste water treatment. Solid waste management. Bioenergy and SCP from waste. Drinking water treatment.

UNIT – III

Biodiversity and Biodegradation: Biodiversity at global level, species diversity. Conservation - *insitu* and *exsitu* conservation. Loss of biodiversity and its causes. Ecological considerations, decay behaviour and degradative plasmids; hydrocarbons, oil pollution, surfactants, pesticides.

UNIT – IV

Bioremediation: Biotechnology approaches for industrial effluent (Paper, tannery and dye). Pesticide waste disposal and use of genetically engineered microbes. Biosorption and Bioaccumulation principles. Hazards of genetically engineered microbes, plants and animals to the environment and their recovery.

UNIT V

Environmental toxicology – Toxicants – Toxicity, Acute, sub acute, chronic, dose effect and LD_{50}. Dose response safe limits. Dose response relationship, detoxification of hazardous chemicals.

PRACTICAL:

1. Isolation of Air borne Pathogens
2. Bacteriological examination of water- Drinking water- Methods; Membrane filter, MPN test.
3. Soil Analysis- fertility test-comparison between fertile soil and chemical exposed soil
4. BOD-polluted water & Drinking water
5. Production of Biogas –.In vitro
6. Compost Making
7. Biofertilizer production/Spirulina production - field visit. (Report should be included in the record)

BIO-ENTREPRENEURSHIP

Course objective

- The student will be able to identify the challenges of being a bio entrepreneur and describe the current status of the bio industry globally.
- They will also be able to generate a detailed business plan and identify various funding agencies.
- The technical skills in vermicomposting, Sericulture, aquaponics, mushroom cultivation and SCP Production will also be obtained.

Course outcomes

CO1	Students will be able to identify the challenges of veing a bioentrepreneur and describe the current status of the bio industry globally
CO2	Students able to generate a detailed business plan and identify various funding agencies
CO3	Students gain knowledge or technical skills in vermicomposting
CO4	Students know about phases of mushroom cultivation and aquaponics
CO5	Students perceive knowledge on single cell protein and spiruline cultivation

Syllabus

UNIT I

Bio entrepreneurship: Basics of Bio entrepreneurship -biotechnology in a global scale; ; types of bio-industries – biopharma, bioagri and bioservices innovation – successful entrepreneur – creativity, leadership, managerial skills, team building, decision making; public and private funding agencies (MSME, DBT, BIRAC, Startup & Make in India)

UNIT II

Business Plan: Business plan preparation; business feasibility analysis by SWOT, business plan proposal for virtual startup company; statutory and legal requirements for starting a company/venture; basics in accounting practices. Market Conditions, Identifying the need of the customers

UNIT III

Vemicomposting and Sericulture: Vermicomposting –Earth worms-Ecological types-Vermiculture-Compost pit-Vermi bed- applications - Sericulture-Mulberry cultivation-silkworm rearing-Economics of silkworm production-Chawki rearing-Sericulture in India

UNIT IV

Mushroom Cultivation & Aquaponics:Phases of Mushroom Cultivation; Selection of an acceptable mushroom species/strains, Management of mushroom development, Mushroom harvesting; Mushroom diseases, Medicinal and Nutritional properties of mushroom. Aquaponics- systems-Fish and Vegetables-Nutrients and Biofilters-Advantages and Disadvantages.

UNIT V

Single Cell Protein:Single Cell Protein Production: Source: Algae, Bacteria, Yeast – Cultivation of Single Cell protein: SPIRULINA Cultivation – Production site, Microorganism, Experimental design; harvesting and drying

MARINE BIOTECHNOLOGY (ELECTIVE)

Course Objective

- The students will gain knowledge about marine pharmacology, marine resources and byproducts, aquaculture and commercial development and value creation of marine resources in Industries

Course Outcomes

CO1	Students can gain knowledge on marine ecosystems
CO2	Students can insight on marine microorganisms
CO3	Students can understand the importance of marine pharmacology in current scenario
CO4	Students can acquire detailed knowledge aquaculture technology
CO5	Students can gain knowledge about aquaculture and commercial development and value creation of marine resources

Syllabus

UNIT I

Introduction to Marine Ecosystems: Marine Ecosystems & Its functioning, Ocean currents, Physical & chemical properties of sea water, Ecological divisions of the Sea- Euphotic- Mesopelagic- Bathopelagic- Benthos-Intertidal, Estuarine- Saltmarsh- Mangrove- Coral Reef.

UNIT II

Marine Microorganism: Marine microbial habitats- Screening for Secondary metabolites from marine microbes (Bacteria, Fungi, Actinomycetes and marine microalgae). Biofouling - Biofilm- Antifouling-Anticorrosion. Probiotic bacteria and their importance in aquaculture.

UNIT – III

Introduction to Marine Pharmacology: Definitions- Medicinal compounds from flora (Seaweeds, Seagrass and Mangrove) and fauna (Sponges, Sea anemone and Corals)- marine toxins- antiviral and antimicrobial agents.

UNIT IV

Aquaculture Technology: Culture aspect-Seaweed (*Kappaphycus alvarezii*), Fish chromosome manipulation in aquaculture- Hybridization- Gynogenesis-Androgensis- Polyploidy, Artificial Insemination, Eye stalk ablation- Trangensis and Cryopreservation.

UNIT V

Marine By products: Agar- Agrose – Algin- Alginate- Carragennan- Chitin- Chitosa- Heparin.

RESEARCH METHODOLOGY

Course Objective

- This course aims to inculcate the clear idea of research among students.
- This course enables the students' community to understand the existing social issues to frame the research objectives, frame hypothesis, design the wet lab procedures and to properly execute the result interpretations.

Course Outcomes

CO1	To inculcate the clear ideas of research among students
CO2	To know about the basic concept sampling and data analysis
CO3	To understand the research process and research designs
CO4	To interpret the data and to write research papers
CO5	To know various tools or techniques foe research

Syllabus

UNIT-I

Foundations of Research: Objectives, Motivation to perform research. Types of research (Descriptive vs analytical; applied vs fundamental; quantitative vs qualitative; conceptual vs empirical). Research methods vs methodology. Literature-review and its consolidation; Library research; field research; laboratory research.

UNIT-II

Sampling and Data analyses: Basic concepts of Statistical sampling methods, Sample Size, Sampling Frame, Sampling Error, Characteristics of a good sample, Data Analysis: Data Preparation – Univariate analysis (frequency tables, bar charts, pie charts, percentages)

UNIT –III

Research Process and design: Research Question & Investigation Question, Hypothesis, Qualities of a good Hypothesis, Features of a good research design, Exploratory Research Design – concept, types and uses, Descriptive Research Designs – concept, types and uses. Experimental Design: Concept of Independent & Dependent variables.

UNIT IV

Interpretation of Data and Paper Writing: Layout of a Research Paper, Journals in Life Science, Impact factor of Journals, Ethical issues related to publishing: Plagiarism and Self-Plagiarism. Use of Encyclopedias, Research Guides, Handbook etc., Academic Databases for Computer Science Discipline.

UNIT V

Use of tools / techniques for Research: Methods to search required information effectively, Reference Software like Zotero/Mendeley, Software for paper formatting like LaTeX/MS Office, Softwares for detection of Plagiarism.