Biotechnology – Scheme of Examination under CBCS pattern – 2018-19

Year	Sem	Course	Title of the Paper	Credits	Maximum marks Theory			Maximum marks Practical			Exam duration	
				L: T: P	C1 (IA1)	C2 (IA2)	C3 Exam	C1 (IA1)	C2 (IA2)	C3 Exam	Theory	Practical
I BSc	I	DSC-1	Biomolecules, Cell Biology and Genetics	4: 0: 2	10	10	50	5	5	20	3hrs	3hrs
	II	DSC-2	Microbiology,Enzymology & Cellular Metabolism	4: 0: 2	10	10	50	5	5	20	3hrs	4hrs
II BSc	III	DSC-3	Bio-Analytical Techniques , Molecular Biology and Genetic engineering	4: 0: 2	10	10	50	5	5	20	3hrs	4hrs
	IV	DSC-4	Immunology, Immunotechnology and Medical Biotechnology	4: 0: 2	10	10	50	5	5	20	3hrs	4hrs
III BSc	V	DSE-1	DSE 1A : Plant tissue culture, Animal cell culture and Reproductive technology	4: 0: 2	10	10	50	5	5	20	3hrs	4hrs
			DSE 2A : Bioinformatics and Computer applications in Biotechnology	4: 0: 2	10	10	50	5	5	20	3hrs	4hrs
	VI	DSE-2	DSE 2A : Environment Biotechnology, Agricultural Biotechnology and Food Biotechnology	4: 0: 2	10	10	50	5	5	20	3hrs	4hrs
			DSE 2B Industrial Biotechnology	4: 0: 2	10	10	50	5	5	20	3hrs	4hrs
		SEC	SEC 1A : Microbial Technology SEC 2A : Biostatistics	2:0:0	10	10	30	-	-	-	2 Hrs	-

Theory: C1 & C2 will be conducted for 20 marks each and it will be reduced to 10 Marks each, C3 will be conducted for 70 marks and it will be reduced to 50 marks
Practicals: C1 & C2 will be conducted for 10 marks each and it will be reduced to 05 Marks each, C3 will be conducted for 40 marks and it will be reduced to 20 marks

Examination	C1	C2	C3	Total
Theory	20	20	70	
Reduced to	**10**	**10**	**50**	**70**
Practicals	10	10	40	
	5	**5**	**20**	**30**
			Grand Total	**100**

I Semester – Paper I

DSC-1: BIOMOLECULES, CELL BIOLOGY AND GENETICS

4 hours per week x 16 weeks = 64 hours

Unit-I **16 Hrs**

Carbohydrates: Overview of classification of Carbohydrates, structures and biological importance of derived monosaccharide-sugar acid (glucuronic acid), amino sugars (glucose amine and galactose amine) and deoxy sugars (2-deoxy β, D- ribose). Fischer and Haworth structure of disaccharides and their importance-Sucrose

Polysaccharides—Classification with examples, Structure and biological importance of:-

Homopolysaccharides – Cellulose, Hetero polysaccharide- Heparin.

Amino acids- General and Zwitter ionic structure of alpha amino acids, classification based on polarity, pKa values, D and L amino acids.

Proteins- Primary, Secondary, Tertiary and Quaternary structural organization of proteins. Structure of Hemoglobin.

Lipids: Definition, Classification & Biological importance.

Fatty acids- Unsaturated and saturated fatty acids and their nomenclature.

Essential and non-essential fatty acids

Nucleic Acids: Structure of Nucleosides & Nucleotides

DNA-Types and forms, secondary structure of DNA (Watson and Crick model)

RNA- Types and biological functions, structure of t- RNA (Clover leaf model)

Unit-II **16 Hrs**

Cell Organelles: Ultrastructure and functions of cell wall, plasma membrane, nucleus, mitochondria, chloroplast, endoplasmic reticulum, golgi bodies, lysosomes and microbodies.

Cell cycle: Over view of cell division, Mitosis and Meiosis.

Structure and functions of different types of muscle cells, mechanism of muscle contraction, nerve cell structure and functions.

Special Cells: Stem cells, differentiation of stem cells and their application.

Blood cells- structure and functions of different types of blood cells.

Cancer cells: Definition of Proto-oncogene, oncogenes, Tumor suppressor genes and its types.

Differences between normal cell and cancer cell.

Unit-III **16 Hrs**

Regulation of cell cycle, Cell senescence and programmed cell death

Cell cell interaction: Cell junctions- Septate, Tight and gap junctions, Neuro muscular junction and mechanism of neurotransmission.

Cell- Cell communication: Basics of Cellular Signaling, Types of cell signaling, Classes of cell surface receptors. Second messengers- example: cAMP,

Eukaryotic chromosome: Types, chromatin structure - Centromere, secondary constriction, telomere, chromonema, euchromatin and heterochromatin.

Ultra structure: Nucleosome models.

Special chromosomes- Structure of Lamp brush and Polytene Chromosome

Chromosomal aberrations: Deletion, duplication, inversion, translocation and ploidy.

Unit-IV **16 Hrs**

Mendelian theory: Overview of Mendelian inheritance, test cross and back cross.

Deviation to Mendelian inheritance-Interaction of genes (13:3 ratios), Incomplete dominance & Co dominance.

Interaction of genes: Supplementary factors (comb pattern in fowls), Complimentary genes (flower colour in sweet peas). Multiple factors-skin colour in human beings, Epistatis-plumage colour in poultry, Sex linked inheritance.

Linkage and crossing over: Types, linkage in Maize and linkage in Drosophila.

Mechanism of crossing over, types and its importance of crossing over

Chromosomal disorders in humans- Turner's, Down's and Klenifelter's syndrome – Causes,symptoms and treatment

Mutation: Natural and induced mutations- Chemical and physical mutagens

Extra chromosomal inheritance in plants and animals-Mitochondrial and chloroplast.

2 Credits for practicals of 4 hours per week. 4 hoursx16 weeks=64 hours.

DSC- 1 PRACTICALS

1. Qualitative analysis of Carbohydrates-Glucose, fructose, galactose, maltose, Lactose & starch.
2. Qualitative tests of amino acids- Phenylalanine, Tyrosine, Tryptophan, Cystine, Histidine
3. Estimation of Reducing sugar by DNS method.
4. Estimation of Protein by Biuret method
5. Haemocytometer.
6. Micrometry.
7. Separation of cell organelles by differential centrifugation.
8. Temporary preparation of stained samples for: Mitosis (onion root tip).
9. Study of different stages of meiosis.
10. Study of morphology of wild type male and female drosophila and *Drosophila* mutants
11. Buccal smear- barr bodies
12. Study of normal and abnormal human karyotypes – [Turner's Syndrome, Down's Syndrome, Klienfelter's Syndrome]

II Semester – Paper II

DSC-2: MICROBIOLOGY, ENZYMOLOGY AND CELLULAR METABOLISM

4 hours per week x 16 weeks = 64 hours

Unit 1 **16 Hrs**

Generalized structure of virus, bacteria and fungus.

Microbial nutritional classification, Microbial growth curve

Basic microbiological techniques: Sterilization and Disinfection:

a) Physical methods – Autoclave, Hot air oven, laminar air flow and membrane filters.

b) Chemical methods – Alcohol, Aldehydes, Phenols, Halogens and gaseous agents.

c) Physical methods-UV rays and Gamma rays

Staining techniques: Types- Principles of simple (direct and indirect) and differential (Gram staining) staining techniques.

Pure culture techniques –media preparation, pure culture techniques, methods of maintenance and preservation of culture.

Genetic recombination in bacteria: Transformation, transduction and conjugation

Unit-II **16 Hrs**

Enzymes: Introduction, general characteristics ,nomenclature.

Units of enzyme activity, Concept of active sites and enzyme specificity. Energy of activation

Concept of Coenzyme (NAD) & Cofactors (FAD).

Factors affecting enzyme activity- Substrate concentration, pH, temperature, inhibitors and activators.

Significance of Michaelis Menton's equation (no derivation), Km and Vmax.

Enzyme inhibition- Competitive, non competitive and un- competitive inhibition

Allosteric enzymes- Definition and explanation with an example (Phosphofructokinase)

Isozymes- Definition and explanation with an example (LDH)

Multienzyme complex- Definition and explanation with an example (PDH)

Unit-III **16 Hrs**

Metabolism – Definition, catabolism and anabolism, overview of metabolic pathways.

Carbohydrate Metabolism: Glycolysis-Reactions of schematic pathway, Energetics and Stoichiometry.

Fates of Pyruvate under aerobic and anaerobic conditions.

TCA Cycle: Reactions & energetics.

Gluconeogenesis : Reactions and its significance.

Amino acid metabolism: Glucogenic and ketogenic aminoacids, general reactions of aminoacid metabolism- Transamination, Deamination(oxidative & nonoxidative) & Decarboxylation with suitable examples, urea cycle-Reactions and significance

Unit-IV **16 Hrs**

Bioenergetics: Concept of free energy and high energy compounds (ATP), Electron transport chain (representation only), and oxidative phosphorylation (Mechanism- any one).

Lipid Metabolism: α, β and ω oxidation of fatty acids (Definition only) , β oxidation of fatty acids containing even number of carbon atoms,

Metabolism of Nucleotides: Generalized Degradation pathway of Purines and Pyrimidines.

4 hours per week x 16 weeks = 64 hours

DSC-2 PRACTICALS

1. Preparation of media: Nutrient agar, nutrient broth and potato dextrose agar media.
2. Isolation of microorganism from air, water & soil
3. Pure culture techniques
4. Bacterial staining techniques-simple and differential (Gram's)
5. Effect of pH on enzyme activity.
6. Effect of Temperature on enzyme activity.
7. Effect of activator (Cl^-) on enzyme activity.
8. Effect of substrate concentration on enzyme activity
9. Isolation of cholesterol and lecithin from egg yolk.
10. Qualitative Tests for normal & abnormal constituents of urine
11. Isolation of enzymes from germinating seeds
12. Estimation of Urea by DAMO method.

III Semester – Paper III

DSC-3: BIOANALYTICAL TECHNIQUES, MOLECULAR BIOLOGY AND GENETIC ENGINEERING

4 hours per week x 16 weeks = 64 hours

Unit-I **16 Hrs**

Introduction to Molecular biology: Central dogma of molecular biology

Mechanism of DNA replication in prokaryotes- enzymes and proteins involved in replication Replication fork, Initiation, Elongation and Termination.

Modern Concept of genes: Generalized structure of Prokaryotic genes and eukaryotic genes

Transcription of Prokaryotic genes: Structure of RNA polymerase. Initiation, elongation and termination, Inhibitors of transcription.

Regulation of gene expression in prokaryotes- Lac operon

Genetic code: Features of genetic code and Wobble hypothesis.

Translation of Prokaryotic genes*: Mechanism of protein synthesis*- Activation of amino acids, initiation, elongation and termination.

Unit-II **16 Hrs**

Introduction and recent trends in Genetic Engineering.

Enzymes in Genetic Engineering - Restriction endonucleases- types with examples, Ligases, alkaline phosphatases, polynucleotide kinases, terminal deoxynucleotidyl transferases, S1 nuclease, DNA polymerases, Klenow fragment, Taq DNA polymerases, ribonuclease, reverse transcriptase.

Gene cloning vectors: Types –Cloning vector and expression vector.

Importance of plasmids as cloning vectors, types of plasmids, concepts of YAC and BAC

Structure and applications of derived vectors – plasmids (pBR322) and cosmids (pJB8) .

Properties of Cloning hosts: *E.coli*, yeast, plant cells and mammalian cells.

Unit-III **16 Hrs**

Recombinant DNA technology: Isolation of DNA, mRNA, preparation of complementaryDNA, DNA Probes- types and preparation

Construction of cDNA and genomic libraries.

Genetic Engineering Techniques : Principle and applications of PCR

Blotting techniques : Southern and Northern blotting

DNA sequencing : Maxam Gilbert and Sanger's methods

Electrophoresis: Principle and applications of Gel electrophoresis – Agarose & SDS PAGE.

Centrifugation: Principle and applications - differential centrifugation and density gradient centrifugation

Unit-IV **16 Hrs**

Chromatography: Principle and Applications of -

i) Partition chromatography: Paper chromatography (Ascending, Descending),

ii) Column chromatography – Adsorption, Ion exchange, Gel permeation, Affinity

Radioactivity: Introduction, Principle and applications of GM counter, scintillation counter, Application of radioisotopes in biology

Spectroscopy: Principle and applications of – UV, visible, IR,ESR,NMR and mass spectroscopy.

Microscopy: Working principle of light and electron microscopy (SEM and TEM).

4 hours per week x 16 weeks = 64 hours

DSC 3 - PRACTICALS

1. Preparation of buffers with different pH.
2. Verification of Beer's-Lambert's law and determination of ƛmax.
3. Identification of amino acids by circular chromatography.
4. Separation of sugars by TLC.
5. Isolation of Genomic DNA from Plant tissues.
6. Colorimetric estimation of DNA by DPA method.
7. Colorimetric estimation of RNA by Orcinol method.
8. Determination of purity of DNA and quantification by spectrophotometry .
9. Separation of isolated DNA by Agarose gel electrophoresis.
10. Isolation of Plasmid DNA from bacteria.
11. Restriction digestion of plasmid DNA.
12. DNA Ligation.

IV Semester – Paper IV

DSC-4: IMMUNOLOGY, IMMUNOTECHNOLOGY AND MEDICAL BIOTECHNOLOGY

4 hours per week x 16 weeks = 64 hours

Unit-I **16 Hrs**

Types of immunity: Mechanism of Innate & Adoptive immunity.

Antibodies: Definitions, classification, and structure of IgG.

Antigens: Definition - haptens, epitopes, blood group antigens.

Cells of immune system: B-cells, T-cells and Macrophages.

clonal selection, primary and secondary immune responses ,immunological memory

Organs of immune systems-Primary and secondary lymphoid organs –morphology and functions.

Immunological aspects of viral, bacterial and parasitic infections.

Immune disorders: Auto immune disorders- organ specific and systemic-

Grave's diseases, lupus erythematosus.

Hypersensitivity- Defnition and types

Major histocompatibility complex: Definition, structure of HLA, functions of MHC.

Role of complement proteins in immune response.

Unit II **16 Hrs**

Transplantation Immunology: Types of grafts, graft rejection and graft acceptance.

Methods used in immunology: Preparation of antigens and antibodies, purification of antibodies by precipitation,dialysis,affinity chromatography .

Types of immunodiffusion methods, ELISA, RIA, and Western blot analysis, immunoElectrophoresis and .Immunofluoroscence.

Applications of antisera in the detection of various diseases. (Examples: syphilis, typhoid, streptococci infections, HIV).

Types and role of adjuvants, antibody immunotherapy.

Unit-III **16 Hrs**

Vaccine production : Introduction, types of vaccines. Production of vaccines using genetically engineered organisms (e.g., HBV), edible vaccines.

Enzymes in diagnosis: Enzymes used for diagnosis, immobilized enzymes as diagnostic tools.

Nucleic acid analysis: Features of DNA probe and its applications in diagnosis, diagnosis of infectious diseases- identification of *Mycobacterium tuberculosis* in clinical samples using PCR.

Antibiotics: Introduction, strain development and improvement of strain by genetic engineering.

Enzymes in therapy: List of enzymes and their therapeutic applications.

Unit-IV **16 Hrs**

Monoclonal antibodies: Introduction, production and applications of monoclonal antibodies - for infectious diseases and cancer.

Human gene therapy: Definition, somatic and germline gene therapy one example each for in vivo and ex -vivo gene therapy .

Antisense technology: Principle and applications.

Hormone therapy: List of hormone produced by recombinant DNA technology and their therapeutic applications, production of Humulin.

Therapeutic proteins: Cytokines as therapeutic proteins, Production of interferon by recombinant DNA technology and their therapeutic uses.

4 hours per week x 16 weeks = 64 hours

DSC-4 PRACTICALS

1. ABO Blood Grouping & Rh factor determination
2. ODD
3. Radial Immuno Diffusion
4. ELISA
5. Separation of serum from Blood and precipitation of Immunoglobulins
6. Osmotic fragility of RBC
7. Antibiotic sensitivity assay
8. Serum analysis: SGPT
9. Serum analysis : SGOT
10. Determination of serum urea and uric acid.
11. T- rosette assay
12. MIC assay

V Semester – Paper V

DSE 1A - PLANT CELL AND TISSUE CULTURE, ANIMAL CELL CULTURE AND ASSISTED REPRODUCTIVE TECHNOLOGY

4 hours per week x 16 weeks = 64 hours

Unit I **16 Hrs**

Plant tissue culture: Introduction, development of plant tissue culture.

Laboratory organization and culture techniques: General requirements, aseptic conditions, media preparation, sterilization, pre treatment to explants.

Growth regulators - Auxin, Cytokinin, Gibberrelic acid, Ethylene, Abscissic acid.

Callus culture- Definition of callus, initiation, sub culture and organogenesis. Cyto-differentiation, factors affecting differentiation.

Organ culture- Ovary and ovule culture, Embryo culture

Cyto-differentiation, factors affecting differentiation.

Haploid Culture: Anther culture and its applications.

Micro propagation: Stages and applications

Unit II **16 Hrs**

Germplasm conservation – Method and applications.

Somaclonal variations: Production of plants for disease resistance and desired agronomic traits

Somatic embryogenesis: protocol and importance of somatic embryogenesis.

Synthetic seeds – Types, production and applications.

Suspension cultures: Batch and continuous cell suspension culture,

Applications of suspension culture.

Protoplast culture and fusion: Enzymatic isolation, culture protocol, Testing of viability of isolated protoplasts , protoplast fusion and its application, regeneration of plants, cybridization.

Unit-III **16 Hrs**

Introduction: A brief account of importance and development of animal cell culture. Advantages and disadvantages of cell culture, laboratory facilities.

Animal Cell culture media: blood plasma, blood serum, serum free media and its advantages, tissue extracts, complex natural media, chemically defined media.

Preparation of animal material: isolation of explants.

Disaggregation of cells and tissues-enzymatic and mechanical methods

Primary culture: Defnition and types - anchorage dependent and anchorage independent cells.

Secondary culture: Cell lines, maintenance and culture of cell lines.

Established cell lines – characteristic, features and examples.

Growth factor and their functions - EGF, NGF, Erythropoietin and PDGF.

Unit-IV **16 Hrs**

Organ culture: Isolation of embryo from mouse and hens egg.

Whole embryo culture eg: Chick embryo culture, plasma clot method, agar gel method, liquid culture.

Cloning techniques - cloning in cow and sheep.

Somatic cell fusion and its applications.

Examination of semen, Artificial insemination, superovulation, embryo transfer, invitrofertilization, GIFT, ZIFT.

4 hours per week x 16 weeks = 64 hours

DSC-5 PRACTICAL

1. Preparation of stock solution for MS Media and sterilizing agents.

2.Callus cultures: Choice of explants, preparation and sterilization of explants and callus induction

3.Subculture of callus and maintenance.

4.Regeneration of plants by growth regulators.

5.Suspension culture

6.Preparation of Synthetic seeds

7.Haploid culture

8.Meristem culture

9. Cell viability test by tryphan blue exclusion method

10. Isolation and staining of PMN leucocytes

11. Study of modern contraceptive devices

12. Visit to Assisted Reproductive Technology lab**.**

V Semester – Paper VI

DSE 1B : BIOINFORMATICS AND COMPUTER APPLICATIONS IN BIOLOGY
4 hours per week x 16 weeks = 64 hours

Unit I **16 Hrs**

Introduction, Branches of Bioinformatics, Aim, Scope and Research areas of Bioinformatics.

Biological Databases: Classification format of Biological Databases and Biological Database Retrieval System.

National Center for Biotechnology Information (NCBI): Tools and Databases of NCBI, Database Retrieval Tool, Sequence Submission to NCBI, Basic local alignment search tool (BLAST), FASTA.

Unit II **16 Hrs**

Nucleotide Database, Protein Database, Gene Expression Database. Database (EMBL): Introduction, Sequence Retrieval, Sequence Submission to EMBL, Sequence analysis tools.

DNA Data Bank of Japan (DDBJ): Introduction, Resources at DDBJ, Data Submission at DDBJ.

Protein Information Resource (PIR): About PIR, Resources of PIR, Databases of PIR,

Data Retrieval in PIR.

Swiss-Prot: Introduction and Salient Features.

Unit III **16 Hrs**

Sequence Alignments : Introduction, Concept of Alignment, Multiple Sequence Alignment (MSA), MSA by CLUSTALW, Scoring Matrices, Percent Accepted Mutation (PAM), Blocks of Amino Acid Substitution Matrix (BLOSUM).

Molecular Phylogeny: Methods of Phylogeny, Software for Phylogenetic Analyses, Consistency of Molecular Phylogenetic Prediction.

Unit IV **16 Hrs**

Applications of Bioinformatics in various fields.

Structural Bioinformatics in Drug Discovery, Quantitative structure-activity relationship (QSAR) techniques in Drug Design, Microbial genome applications.

Human Genome Project, Bacterial Genome Project.

DSE 1 B - PRACTICAL

4 hours per week x 16 weeks = 64 hours

1. Nucleic acid and protein databases.
2. Sequence retrieval from databases.
3. Sequence alignment.
4. Sequence homology
5. Construction of phylogenetic tree.
6. Visit to Biotechnology related industry/ bioinformatics centre.
7. Navigating to NCBI website and search of research papers through internet.

DSE-2A: ENIVIRONMENTAL BIOTECHNOLOGY, AGRICULTURAL BIOTECHNOLOGY AND FOOD BIOTECHNOLOGY

4 hours per week x 16 weeks = 64 hours

Unit-I **16 Hrs**

Introduction: Pollution, types and pollutants. Major issues in environmental pollution.

Biotechnological methods of Pollution detection: General bioassay, cell biological methods, immunoassays, DNA- based methods and use of biosensors.

Biotechnological methods in pollution abatement: Reduction of CO_2 emission, use of algae, eutrophication, use of cell immobilisation.

Wastewater management - Conventional wastewater treatment methods.

Biohydrometallurgy and biomineralization: Bioleaching – copper, lead, uranium.

Bioremediation and Biodegradation: Degradation of xenobiotic compounds - simple aromatic, chlorinated, pesticides, Creation of super bug for oil degradation

Solid waste management and its importance

Treatment of industrial wastes: Dairy, leather and pharmaceutical industries.

Ecofriendly byproducts: Biomass resource, Biogas, alcohol as fuel and biodegradable plastics.

Unit II **16 Hrs**

Introduction: Conventional crop improvement techniques and their limitations.

Future prospects of biotechnology for agriculture.

Biological nitrogen fixation: Nitrogen fixing microorganisms, role of nitrogenase. Mechanism of nitrogen fixation in Symbiotic and non- symbiotic organisms. Genetics of nitrogen fixation.

Biofertilizers: - Mass production and applications of microbial inoculants- *Rhizobium, Azospirillum, Azotobacter, Mycorhizae* ,

Bioagents: Introduction, production and applications - *Beauveria bassiana,Baculoviruses*

Biological control of plant disease: Hypovirulence, competition, antibiosis, mycoparasitism**.**

Unit III **16 Hrs**

Genetic engineering of crop plants: Gene transfer techniques - Agrobacterium mediated, Electroporation, Lipofection, Microinjection, Biolistic, Ultrasonication.

Transgenic plants – Production of BT cotton, herbicide tolerant and virus resistance plants

Transgenic animals for the production of biopharmaceuticals.

Principles of Integrated Pest Management (IPM).

UNIT IV **16 Hrs**

Food preservation - Definition, types and conventional methods.

Food spoilage – Definition and types.

Food processing: enzymes involved in food processing.

Biotechnology in diary industry- Cheese production, yogurt, kefir, koumis.

Biotechnological approaches of fruit ripening and its manipulation, Role of ACC synthase.

Genetically modified food- golden rice, transgenic potatoes and transgenic fish.

Agro food processing: forming village clusters and establishing food storage.

Green , white, yellow and blue revolutions.

Post –harvest technology and value edition.

Food safety and microbial standards of food.

Social, legal and ethical aspects of GM food.

DSE-2A: PRACTICALS

4 hours per week x 16 weeks = 64 hours

1. Analysis of Sewage water sample for BOD.
2. Estimation of Toxic chemicals in sewage water sample for - CO_2 , H_2S.
3. Estimation of Toxic chemicals in sewage water sample for - Residual Chlorine, Chloride.
4. Invitro antagonism.
5. Identification of microbial flora in sewage sample.
6. Inoculation with Rhizobium and observation for root nodulation.
7. Biofertilizer and biocontrol formulations.
8. Preparation of wine.
9. Estimation of percentage of alcohol.
10. Isolation of casein, lactalbumin, lactose from milk.
11. Qualitative analysis of some common food adulterants.
12. Entrapment of yeast for enzyme action and estimation of invertase activity.

VI Semester – Paper VIII

DSE 2B: INDUSTRIAL BIOTECHNOLOGY

4 hours per week x 16 weeks = 64 hours

Unit I **16 Hrs**

Introduction to industrial Biotechnology, basic principles of fermentation technology.

Screening and Isolation of Microorganisms, maintenance of strains, strain improvement (Mutant Selection, Recombinant DNA methods).

Fermentation Media: Natural and Synthetic Media, Sterilization techniques- Heat, Radiation and Filtration methods.

Fermentation Process: Aeration, Agitation, Temperature regulation and Foam control.

Unit II **16 Hrs**

Types of Fermenters - Typical, Airlift, Tower and Bubble-up Fermenters.

Type of Fermentation: Solid State, Submerged fermentation and continuous fermentation.

Immobilized enzyme and cell bioreactors.

Production of Microbial products - Brief account of the following products obtained by industrial Microbiological fermentation- Alcohol, Alcoholic Beverage-Beer, Organic acid-Citric acid, Antibiotic-Penicillin, Amino acids-Glutamic acid and Vitamin-B12.

UNIT III **16 Hrs**

Brief account of steroid biotransformation.

Enzyme Biotechnology: Characteristics of enzymes, Industrially produced enzymes-amylases.

Industrial enzymes - Detergents, Leather, Beverage, food and pharmaceuticals.

Bioreactors for enzyme production-stirred tank, membrane reactors and continuous flow reactors.

Fermented Foods: Yoghurt, Buttermilk, Idli, Dosa, Cheese, Tempeh.

Microbial Foods: Single cell proteins (SCP), Single cell oils (SCO) .

Unit 1V **16 Hrs**

Plant cell suspension culture for the production of food additives-Saffron and Capsaicin .

Technique: of mass culture of Algae-Spirulina, Chlorella.

Microbial polysaccharides and polyesters: production of xanthenes gum and polyhydroxyalkanes (PHA).

DSE 2B PRACTICALS

4 hours per week x 16 weeks = 64 hours

1. Algal and fungal culture- Spirulina, Agaricus, Yeast and Aspergillus.
2. Estimation of citric acid from Aspergillus.
3. Estimation of lactic acid.
4. Immobilization of Yeast cells.
5. Preparation of wine.
6. Estimation of Alcohol by Specific gravity method.
7. Immobilization of enzymes-

   (Invertase can be obtained from yeast cells and observed for its activity).
8. Mushroom cultivation- Oyster Mushroom cultivation.

SEC 1: MICROBIAL TECHNOLOGY

2 hours per week x 16 weeks = 32 hours

Unit-I **8hrs**

Introduction to Biotechnological importance of microorganisms.
Outline of metabolic pathways involved in microbial products, primary and secondary metabolites and their applications.
Biomass production – Bacteria, fungi and algae.

Unit-II **8 Hrs**

Kinetics of microbial growth and product formation: Phase of cell growth in batch cultures and continuous culture, Substrate and product inhibition on cell growth and product formation.
Use of Immobilized cell: Introduction, methods of immobilization of microbial cells and applications
Bioreactors: Types and Uses.

Unit-III **8Hrs**

Microbial Production: vitamins (vit-C), enzymes (Amylase), organic acids (citric acid),amino acids (glutamicacid),polysaccharides (xanthan),growth regulators (auxins), antibiotics (penicillin), Alcohol (ethanol).
Mushroom cultivation –Oyster mushroom cultivation by paddy straw cultivation method.

Unit-IV **8Hrs**

Downstream processing : Introduction , Cell disruption– mechanical, enzymatic and chemical methods.
Isolation of products -Adsorption, liquid-liquid extraction, membrane separation – ultrafiltration and reverse osmosis, dialysis, precipitation of proteins by different methods.
Principles and types of different methods of drying. Outline of Chromatographic methods.

SEC 1: PRACTICALS

2 hours per week x 16 weeks = 32 hours

1. Identification of Biotechnologically important microbes: E coli, Yeast, Spirulina.
2. Lab cultivation of Mushroom.
3. Estimation of total acids in wine sample or proximate analysis of wine sample.
4. Lab cultivation of spirulina.
5. Study of commercial microbial products – SCP, Microbial flavours, antibiotics
6. Visit to Biotechnology related industry or Research institution.

SEC 2: BIOSTATISTICS

2 hours per week x 16 weeks = 32 hours

UNIT I **8 Hrs**

Introduction to Biostatistics.
Collection of data.
Processing of data.
Diagrammatic presentation of data.
Biostatistics problems related to above topics.

UNIT II **8 Hrs**

Graphic presentation of data
Measures of central tendency
Measures of dispersion or deviation
Correlation of analysis
Biostatistics problems related to above topics

UNIT III **8 Hrs**

Regression analysis
Probability
Theoretical distribution
Biostatistics problems related to above topics

UNIT IV **8 Hrs**

Sampling and test of significance
Chi-Square test and goodness of fit
Analysis of variance
Biostatistics problems related to above topics

SEC 2: PRACTICALS

2 hours per week x 16 weeks = 32 hours

1. Histogram
2. Pie chart
3. Bar graph
4. Problems on mean, median, mode.
5. Standard Deviation
6. Coefficient of Variation.