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UNIVERSITY OF MYSORE

Estd. 1916

Vishwavidyanilaya Karyasoudha
Crawford Hall, Mysuru- 570 005

No.AC.2(S)/31/18-19

Dated: 15.06.2018

NOTIFICATION

Sub: Revision of syllabus for Biotechnology (UG) as per CBCS pattern from the academic year 2018-19.

Ref: 1. Decision of Board of Studies in Biotechnology (UG) meeting held on 28.02.2018.
2. Decision of the Faculty of Science & Technology Meeting held on 21.04.2018.
3. Decision of the Deans Committee meeting held on 22.05.2018.

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The Board of Studies in Biotechnology (UG) which met on 28th February, 2018 has recommended to revise the syllabus for B.Sc. Biotechnology as per CBCS pattern from the academic year 2018-19.

The Faculty of Science and Technology and the Deans committee meetings held on 21-04-2018 and 22-05-2018 respectively have approved the above said proposal with pending ratification of Academic Council and the same is hereby notified.

The CBCS syllabus of B.Sc. Biotechnology course is annexed. The contents may be downloaded **from the University Website i.e., www.uni-mysore.ac.in**.

Draft approved by the Registrar

15/6

Deputy Registrar (Academic)

To:

1. The Registrar (Evaluation), University of Mysore, Mysore.
2. The Dean, Faculty of Science & Technology, DOS in Physics, Manasagangotri, Mysore.
3. The Chairperson, BOS in Biotechnology, DOS in Biotechnology, Manasagangotri, Mysore.
4. The Chairperson, Department of Studies in Biotechnology, Manasagangotri, Mysore.
5. The Director, College Development Council, Moulya Bhavan, Manasagangotri, Mysore.
6. The Principals of the Affiliated Colleges where UG Program is running in Science stream.
7. The Deputy/Assistant Registrar/Superintendent, AB and EB, UOM, Mysore.
8. The P.A. to the Vice-Chancellor/Registrar/Registrar (Evaluation), UOM, Mysore.
9. Office file.

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UNIVERSITY OF MYSORE

CHOICE BASED CREDIT SYSTEM SEMESTER SCHEME

B.Sc. DEGREE

BIOTECHNOLOGY SYLLABUS

2018

Biotechnology Syllabus for Choice Based Credit System (CBCS) at Undergraduate Level

Proposed Semester-wise distribution of the course structure

Semester – I

Sl. No.	Code No.	Type of the Paper	Title of the Paper	Credit Pattern in L:T:P	Credit Value	Hours /Week L:T:P
1	BT-1.1	DSC	Biomolecules and Microbiology	4:0:2	6	4:0:4

Semester – II

1	BT-2.1	DSC	Enzymology and Cellular Metabolism	4:0:2	6	4:0:4

Semester – III

1	BT-3.1	DSC	Cell Biology and Genetics	4:0:2	6	4:0:4

Semester – IV

1	BT-4.1	DSC	Plant Cell and Tissue Culture and Animal Cell Culture	4:0:2	6	4:0:4

Semester – V

Any one of following						
1	BT-5.1	DSE 1.1	Molecular Biology and Genetic Engineering	4:0:2	6	4:0:4
2	BT-5.2	DSE 1.2	Immunology and Medical Biotechnology	4:0:2	6	4:0:4
Any one of following						
1	GE-1.1	Discipline specialization	Intellectual property rights	2:0:0	2	2:0:0
2	GE-1.2	Discipline specialization	Biophysics and Biochemical Techniques	2:0:0	2	2:0:0

Semester – VI

Any one of following						
1	BT-6.1	DSE 1.1	Microbial Technology and Agricultural Biotechnology	4:0:2	6	4:0:4
2	BT-6.2	DSE 1.2	Environmental Biotechnology and Bioinformatics	4:0:2	6	4:0:4
Any one of following						
1	GE-2.1	Discipline specialization	Molecular Biology Techniques	2:0:0	2	2:0:0
2	GE-2.2	Discipline specialization	Fermentation Technology	2:0:0	2	2:0:0

- DISCIPLINE SPECIFIC COURSE- DSC
- DISCIPLINE SPECIFIC ELECTIVE-DSE
- SKILL ENHANCEMENT COURSE -SEC

SCHEME OF VALUATION
MAXIMUM MARKS

COURSE TYPE	C1		C2		C3		TOTAL
	THEORY	LAB	THEORY	LAB	THEORY	LAB	
DSC	10	5	10	5	50	20	100
DSE	10	5	10	5	50	20	100
SEC	15	-	15	-	35		50

NOTE;

1. **C1 AND C2 WILL BE CONDUCTED FOR 20 MARKS (THEORY) WITH 1 HOUR DURATION, 10 MARKS (LAB) WITH CONTINUOUS ASSESMENT THROUGH RECORD VALUATION AND MARKS REDUCED TO ASSIGNED MARKS.**
2. **C3 WILL BE CONDUCTED FOR 100 MARKS (THEORY) WITH 3HOUR DURATION, 40 MARKS (LAB) WITH 3 HOUR DURATION AND REDUCED TO ASSIGNED MARKS.**
3. **IN CASE OF GE, C1 AND C2 WILL BE CONDUCTED FOR 15 MARKS WITH 1 HOUR DURATION AND REDUCED TO ASSIGNED MARKS. C3 WILL BE CONDUCTED FOR 35 MARKS.**

DISCIPLINE SPECIFIC CORE - DSC

I SEMESTER

PAPER 1: BIOMOLECULES AND MICROBIOLOGY

4 hours/week x16= 64 Hours

BIOMOLECULES

Unit I

Carbohydrates: Definition, classification, Fischer and Haworth structure of monosaccharides - ribose, glucose, galactose and fructose. Reducing and non reducing sugars. Stereochemistry - Definition with examples. epimers, enantiomers, anomers, isomers concept. Fischer and Haworth structure of Disaccharides - sucrose, maltose, lactose. Polysaccharides- classification: homo and hetero polysaccharides, Structure of starch and glycogen. Biological importance of carbohydrates.

10hr

Unit II

Proteins: Amino acids- generalized structure, essential and non essential amino acids, classification based on polarity, zwitter ionic structure, pKa value. D-and L- amino acids, optical activity. Peptide bond, Structure of glutathione,oxytocin and insulin.

Classification of proteins with example.Primary, secondary, tertiary and quaternary structural organization of proteins.Structure of hemoglobin, myoglobin, keratin and collagen.

Protein stability- covalent and noncovalent interactions,

Biological importance of proteins. 1**0hr**

Unit-III

Lipids : Definition , Biological role. Classification & Properties .

Fatty acids- Unsaturated and saturated fatty acids and their nomenclature.Essential fatty acids and their biological importance, Biological role of different types of lipids- glycolipids, phospholipids, cholesterol.

Nucleic Acids: Nucleosides & Nucleotides - structure & nomenclature.

DNA-Types, secondary structure of DNA (Watson and Crick model), RNA- Types and biological functions, structure of t- RNA (Clover leaf model) **12 hr**

MICROBIOLOGY:

Unit I

General Introduction:Scope and relevance of microbiology, important contributions by Robert Koch, Leeuwenhoek, Jenner, Pasteur, Flemming, Ivanowsky

Concept of prokaryotes and eukaryotes. General account on structure, classification and reproduction of bacteria, virus and fungi

Microscopy

Light microscopy: Bright, Dark field, Phase contrast

Electron microscopy- SEM, TEM **10hr**

Unit II

Microbial nutrition: Nutritional classes of micro organisms, pure culture-types of pure culture techniques, methods of maintenance and preservation of culture- over layering with mineral oil and lyophilization.

Microbial growth pattern and methods of growth measurements- Growth curve,Counting by Plate counting, Coulter counter counting and Turbidometry.

Sterilization and Disinfection : a) Physical methods – Auto clave, Hot air oven, Laminar air flow, Seitz filter, sintered filter and membrane filter. Radiation-UV and Gamma Rays

b) Chemical methods – Alcohol, Aldehydes, Phenols, Halogens and gaseous agents. Biological methods- Antimicrobial agents -penicillin, streptomycin.**12 hr**

Unit III

Role of microbes in bio-geo cycles(N,C,S,and P cycle), Biological nitrogen fixation.

Microbial diseases: Important plant diseases-downy mildew, ergot, rust, bacterial leaf blight, TMV and Human diseases-Tuberculosis, rabies, dengue and candidiasis, symptoms causative agents and control.

Food spoilage, food preservation, food poisoning **10 hr**

PRACTICAL 1: BIOMOLECULES AND MICROBIOLOGY – 2X 16=32 CREDITS

BIOMOLECULES

- Qualitative analysis of sugars
- Qualitative analysis of amino acids
- Reducing sugar estimation by DNS method
- Protein estimation by Biuret method and Lowry's method
- Separation of amino acids by circular paper chromatography
- Estimation of iodine value of lipids

MICROBIOLOGY:

- Preparation of media :nutrient agar, nutrient broth and potato dextrose agar
- Isolation and culture of micro-organisms from soil, air and water
- Inoculation Techniques: stab, point, streak, pour plate and spread plate.
- Microbial growth determination by turbidometry
- Bacterial Staining Techniques-simple and differential (gram's)
- Biochemical activity of Microbes: catalase test, starch hydrolysis, gelatin hydrolysis
- Demonstration of microbial disease: Plant-Downy mildew, Rust.

II SEMESTER

PAPER – 2: ENZYMOLOGY AND CELLULAR METABOLISM

4 hours/week x16= 64 Hours

Enzymology

Unit I

Protein as a biological catalyst, Characteristics of Enzymes, Chemical nature of enzymes, Apozyme, Holozyme,

Active sites and binding sites. Mechanism of enzyme action

Enzyme- substrate complex formation, lock and key and induced fit theory

Nomenclature of Enzymes-IUBMB and trivial, classification of enzymes with enzyme commission code **10 hr**

Unit II

Cofactors and coenzymes

Factors affecting enzyme activity- substrate concentration, pH, temperature, metal ions, inhibitors, allosteric inhibitors, activators,

Enzyme inhibition-competitive and non-competitive, energy of activation

Enzyme kinetics-Michaeli's and Menten equation.**11 hr**

Unit III

Localization of enzymes- membrane bound and soluble enzymes, isolation and purification of enzymes.

Special enzymes: Isoenzymes ,multienzyme complexes, abzymes

Ribozyme with example

Applications of enzymes: clinical analytical and biotechnological **11hr**

CELLULAR METABOLISM

Unit I.

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

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

Fates of Pyruvate under aerobic and anaerobic conditions.

TCA Cycle: Reactions, regulation and energetics.

Gluconeogenesis : Reactions and its significance. **10 hr**

Unit II

Bioenergetics: Biological oxidation, types of phosphorylation.

Electron transport chain- mechanism of oxidative phosphorylation, P:O ratio, uncouplers-definition and example.

Photosynthesis: efficiency of utilization of sunlight, photophosphorylation-cyclic and noncyclic photophosphorylation, Schemation of C3, C4 pathway CAM plants.

Amino Acid Metabolism: Glucogenic and ketogenic amino acids, general pathways of synthesis and degradation-: Transamination, deamination and decarboxylation.

Urea cycle. **12hr**

Unit III

Lipid Metabolism: activation of fatty acids, β- oxidation and stoichiometry of β- oxidation. biosynthesis of even chain fatty acids, stoichiometry of fatty acid synthesis.

Metabolism of Nucleotides: Synthesis and degradation of purines and pyrimidine nucleotides. **10hr**

PRACTICAL 2:ENZYMOLOGY AND METABOLISM – 2X 16=32 CREDITS

ENZYMOLOGY

- Assay of salivary amylase by DNS method, determination of specific activity.
- Effect of pH on enzyme activity
- Effect of temperature on enzyme activity
- Effect of metal ions.

METABOLISM

- Qualititative analysis of some metabolites in urine samples-urea, urea acid, creatinine, albumin, glucose, sterols, ketone bodies.
- Serum analysis-SGPT and SGOT.

III SEMESTER

PAPER 3: CELL BIOLOGY AND GENETICS

4 hours/week x16= 64 Hours

Cell Biology

Unit I

General Introduction: Historical perspectives., The cell theory, ultra structure of plant and animal cell, different types of cells

Cell organelles: structure and functions of cell wall, plasma membrane membrane proteins, cytoplasm, nucleus, mitochondria, chloroplast, golgi bodies, endoplasmic reticulum, ribosomes, lysosomes, peroxisomes, cytoskeleton **10 hr**

Unit II

Cell Division: Cell cycle, phases cell division. Mitosis and meiosis, regulation of cell cycles-cell cycle check points, and enzymes involved in regulation , Significance of cell cycle, mitosis and meiosis interphase nucleus, achromatic apparatus, synaptonemal complex **10hr**

Unit III

Cell interaction and motility: Cell signaling, cell junctions-septate, tight and gap junctions, cell motility, flagellar and ciliary motion,

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

Special cells: Blood cells, identification- structure and different types of blood cells, Cancer cells. Differentiation of stem cells and their application. **12hr**

Genetics

Unit-I History of genetics: Introduction and brief history of genetics.

Mendelian theory: Laws of inheritance- dominance, segregation, incomplete dominance, codominance with an example.

Law of independent assortment, test cross, back cross. Deviations to Mendelian inheritance, complementary, supplementary and interaction of genes (13:3 ratio), epistasis.

Sex-linked inheritance, Chromosome theory of inheritance, linkage and crossing over. **12hr**

Unit-II

Mutation: Natural and induced mutations, mutagenesis- Chemical, physical and biological mutagens, molecular mechanisms, thymine dimmers.

DNA Repair: Mechanism of genetic repair- direct repair, photoreactivation, excision repair, mismatch repair, post-replicative recombination repair, SOS repair.

Eukaryotic chromosomes: Types, chromatin structure, nucleosomes, higher order chromatin organization. Special chromosomes- lampbrush, polytene and B - chromosome. **10 hr**

Unit-III

Chromosomal aberrations: Deletion, duplication, inversion, translocation and ploidy. Chromosomal disorders in humans.

Genetic recombination in bacteria: Transformation, transduction and conjugation **10hr**

PRACTICAL 3: CELL BIOLOGY AND GENETICS **– 2X 16=32 CREDITS**

Cell Biology

Cytological preparations

- Fixation, dehydration and staining
- Embedding and sectioning

Cell counting methods; haemocytometer

Measurements with the help of light microscope

Calibration of ocular micrometer

Finding out average cell size

Separation of cell organelles by differential centrifugation and assay of marker enzymes

Temporary preparation of Stained samples for Mitosis (onion root tips), Meiosis (grass hopper testis, pollen)

Genetics

- Morphological study of wild male and female *Drosophila.*
- Study of at least five simple mutants of *Drosophila*.
  a) Temporary preparation of polytene chromosomes from *Drosophila* salivary glands.
  b) Demonstration of laws of inheritance using colored beads.Law of segregation.Law of independent assortment.

IV SEMESTER

PAPER 4: PLANT CELL TISSUE CULTURE AND ANIMAL CELL CULTURE

4 hours/week x**16= 64 Hours**

Plant Cell & Tissue Culture

Unit I

Plant tissue culture introduction: Importance, history and developments of plant tissue culture Laboratory organization and culture techniques: general requirements, aseptic conditions, media preparation, culture media, sterilization, pre-treatment to explants. Problems and solutions associated with tissue culture. **10hr**

Unit II

Principles of tissue culture: callus culture-Definition of callus, initiation, maintenance sub culture and organogenesis. Organ culture-culture protocols and importance of root, meristem ovary and ovule culture. Factors affecting organogenesis, Cytodifferentiation, dedifferentiation differentiation and factors affecting differentiation. **10 hr**

Unit-III

Micropropagation in plants: Advantages, methods, stages of micropropagation, applications. Somaclonal variation for disease resistance and desired agronomic traits.

Somatic embryogenesis: Embryoid and embryogenesis. Protocol and importance of somatic embryogenesis. Synthetic Seeds and its applications.

Suspension culture: Batch and continuous cell suspension culture. Importance of suspension culture in production of secondary metabolites.

Protoplast culture and fusion: Definition of protoplast, isolation principle, culture protocol, action of enzymes, regeneration of plants, protoplast fusion, somatic cell hybridization and its application. **12 hr**

Animal Cell Culture

Unit-I

Introduction, importance, history and developments of animal cell culture.Advantages and disadvantages of tissue culture methods, laboratory facilities.

Culture procedures: preparation and sterilization of glasswares and apparatus, preparation and sterilization of reagents and media, preparation of animal material. **10 hr**

Unit-II

Animal tissue culture media: Culture media containing naturally occurring ingredients, blood plasma, blood serum, serum-free media, tissue extracts, complex natural media, chemically defined media**10 hr**

Unit-III

Definition of Primary culture, cell lines and cloning. Preparation of Primary culture and chick embryo culture.

Tissue engineering and its applications, *In vitro* fertilization, cloning of Dolly, The legal and socio-economic impact of cloning **12 hr**

PRACTICAL 4: PLANT CELL & TISSUE CULTURE AND ANIMAL CELL CULTURE

– 2X 16=32 CREDITS

- Media preparation and sterilization
  - Callus cultures: Choice of explants, preparation of explants, callus induction, subculture and maintenance.
  - Regeneration of plants using growth regulators.
  - Suspension cultures: Initiation of suspension cultures from callus.
  - Preparation of synthetic seeds.
  - Meristem culture for pathogen free plants.
  - Preparation of primary cultures from a tissue.
  - Cell viability test using tryphan blue exclusion method.
  - Preparation of Hank's balanced salt solution.
  - Isolation of PMN leucocytes from Human peripheral blood sample.

DISCIPLINE SPECIFIC ELECTIVE - DSE

V SEMESTER

PAPER 5:MOLECULAR BIOLOGY AND GENETIC ENGINEERING

4 hours/week x16= 64 Hours

Molecular Biology

Unit-I

DNA as genetic material: Experiments of Griffith, Avery and Hershey & Chase.

Prokaryotic DNA synthesis: Semi conservative replication of DNA, DNA polymerases, Replication forks, replicosome. **10 hr**

Unit-II

Concept of gene: Functional units, Eukaryotic and Prokaryotic gene, promoter, introns and exons,

Regulation of gene expression in Prokaryotes: Importance of regulation, positive and negative regulation, operon concept-*lac.*

Transcription: Coding and noncoding strand, RNA polymerase, Initiation of transcription at promoter sites, elongation and termination, inhibitors of transcription. **10 hr**

Unit-III

Genetic code: Deciphering genetic code, major features of genetic code, Wobble hypothesis, universality of genetic code.

Translation: Activation of amino acids, ribosomes, formation of initiation complex, initiation, elongation and termination, fidelity of protein synthesis, inhibitors of protein synthesis.**12 hr**

Genetic Engineering

Unit I

Importance, history, concepts and developments of genetic engineering

Enzymes-Restriction endonucleases, Nomenclature of restriction endonucleases , types of restriction enzymes, ligases, alkaline phosphatases, polynucleotide kinase, terminal deoxynucleotidyltransferase, S1 nuclease, DNA polymerase, Klenow fragment, Taq DNA polymerase, High fidelity polyrmerases, ribonuclease, reverse transcriptase **10 hr**

Unit II

Gene cloning vectors: cloning vector- Characteristics and types of vectors,

Expression vector-components, importance of plasmids as cloning vectors, stability of plasmids, examples of plasmid types, different forms of plasmid, plasmids coding for phenotypic traits. Vector map for $_{P}$UC18,$_{P}$BR322,

Cloning host: *E.coli*, yeast, plant cells and mammalian cells. **10 hr**

Unit III

Recombinant DNA technology: isolation of gene, mRNA, preparation of complementary DNA genomic and cDNA libraries, probes and hybridization.

Genetic engineering techniques: Gel electrophoresis, Agarose gel electrophores, PAGE, Southern and Northern blotting, PCR ,Maxam and Gilbert method and Sanger's method of DNA sequencing,

Outline of gene transfer methods. **12 hr**

PRACTICAL 5: MOLECULAR BIOLOGY AND GENETIC ENGINEERING

– 2X 16=32 CREDITS

Molecular Biology

- Preparation of stock solutions for molecular biology
- Colorimetric estimation of DNA
- Colorimetric estimation of RNA
- Determination of Tm value of DNA
- Determination of purity of DNA

Genetic engineering

- Extraction of DNA from plant and animal sources
- Quantification of DNA by Spectrophotometry
- Linearization of plasmid DNA (pUC 18 with Sma I)
- Agarose gel electrophoresis of DNA
- Southern blotting (demonstration)
- Gel electrophoresis of circular and linearized plasmid

PAPER 6: IMMUNOLOGYANDMEDICALBIOTECHNOLOGY

4 hours/week x16= 64 Hours

Immunology

Unit-I

Historical account – Contribtions of Edward Jenner and Louis Pasteur
Types of immunity: Innate- mechanisms of innate immunity. Adaptive – active, passive and adoptive.
Antigens: Definition, haptens, epitopes, antigenicity, blood group antigens.

Antibodies: Definition, types, structure of IgG. **10 hr**

Unit-II

Immunization: passive and active, adjuvants, vaccines, primary and secondary responses.

Cellular basis of immunity: T-cells, B-cells and macrophages, their role in antigen recognition, clonal selection, immunological memory.
Immunological aspects of viral (HIV), bacterial and parasitic infection. **10 hr**

Unit-III

Immune disorders: Autoimmune disorders- Grave's disease, Hashimoto's disease, Systemic Lupus erythromatosus. Hypersensitivity; Definition and types

Immunotechniques: Affinity and avidity, precipitation reaction, immunodiffusion, ELISA, Western blotting. **12 hr**

Medical Biotechnology

Unit-I

History and Importance of vaccines, Types of Vaccines, drawbacks of conventional vaccines, advantages of novel vaccines and their limitations.Production of vaccines using genetically engineered organisms (e.g., HBV), edible vaccines.

Enzymes in diagnosis: Enzymes used for diagnosis, immobilized enzymes as diagnostic tools, diagnostic proteins eg. AIDS diagnosis, market potential of diagnostics. **12 hr**

Unit-II

Nucleic acid analysis: Features of DNA probe and its applications in diagnosis, diagnosis of infectious diseases, and 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**. 10hr**

Unit-III

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

Therapeutic proteins: Cytokines as therapeutic proteins, preparation of interferon by recombinant DNA technology

Human gene therapy: Definition, differences between somatic versus germline gene therapy, one example each for *ex-vivo* and *in-vivo* gene therapy

Antisense technology: Principle and applications

Transgenic animals and plants for production of biopharmaceuticals **10 hr**

PRACTICAL; IMMUNOLOGY AND MEDICAL BIOTECHNOLOGY

– 2X 16=32 CREDITS

Immunology

- Blood grouping
- Diffusion test - ODD
- ELISA
- WIDAL

Medical Biotechnology

- Culturing of antibiotic resistant strains of bacteria and verification for resistance
- Demonstration of PCR for diagnosis of a disease

PAPER 7: MICROBIAL TECHNOLOGY AND AGRICULTURAL BIOTECHNOLOGY4 hours/week x16= 64 Hours

Microbial Technology

Unit-I

Introduction to biotechnological importance of microorganisms

Metabolic pathways involved in microbial products, primary and secondary metabolites, enzymes and microbial biomass-single cell proteins and their applications

Microbial production: Production of vitamins, enzymes, organic acids, aminoacids, polysaccharides, colorants, flavors, emulsifiers, proteins, lipids and antibiotics. Process for production of Vit-C and Penicillin. **10hr**

Unit-II

Kinetics of microbial growth and product formation: Phase of cell growth in batch cultures and continuous culture. Growth associated (primary) and non-growth associated (secondary) product formation kinetics, Leudeking-piert models, substrate and product inhibition on cell growth and product formation, Introduction to structured models for growth and product formation **12hr**

Unit-III

Microbial biocides, pesticides: Fungicides and herbicides. Bacterial, fungal and viral bioagents- *Bacillus thuringensis* (Bt), *Beauveriabassiana*, baculoviruses. Mechanism of biological control of plant diseases – induced resistance, systemic acquired resistance, hypovirulence, competition, antibiosis, mycoparasitism. **10hr**

Agricultural Biotechnology

Unit-I

Introduction: Conventional crop improvement techniques and their limitations, biotechnology for crop improvement, future prospects of biotechnology for agriculture.

Biological nitrogen fixation: Nitrogen fixing microorganisms, structure of nitrogenase, role of nitrogenase, genetics of nitrogen fixation, *nif* gene organization, regulation of *nif* gene expression. **10hr**

Unit-II

Genetic engineering of crop plants: Gene transfer techniques for desirable traits in crop plants – *Agrobacterium* mediated gene transfer, Direct gene transfer to protoplasts, Biolistic gene transfer, Few examples of transgenic plants obtained through gene transfer techniques- Bt-cotton, herbicide tolerant soybean, virus resistance (Papaya ringspot). **12hr**

Unit-III

Food biotechnology: Food processing- biotechnological approaches, Fruit ripening and its manipulation, role of ACC synthase, genetically modified foods, transgenic fish, biotechnology in dairy industry.**10 hr**

PRACTICAL :

- Identification of important microorganisms relevant to biotechnology: *E. coli,Saccharomyces cerevisiae, Spirulina*
- Demonstration of commercial microbial products – single cell proteins, microbial flavours
- Entrapment of yeast for enzyme production
- Preparation of wine

- Test on *in vitro* antagonism
- Visit to biotechnology related industries and institutions

PAPER 8: ENVIRONMENTAL BIOTECHNOLOGY AND BIOINFORMATICS

4 hours/week x16= 64 Hours

Bioinformatics

Unit I

Bioinformatics and the internet: Introduction, internet basics, connecting to the internet, electronic mail, File transfer protocol, the World Wide Web.
DNA databases, Genbank, EMBL,DDBJ,protein sequence databases, PIR-PSD,SWISSPROT, dendrograms, gene families phylogenetic and mutation studies databases, literature databases (searching and downloading). **10 hr**

Unit II

Information retrieval from databases: Database similarity searching, FASTA,BLAST search, sequence alignment global alignment, local alignment, sequence aligning ClustalW, ClustalX, DIALIGN2, Multalin, Navigating the NCBI website OMIM,PubMed.
proteomics, protein
Identity based on composition, physical properties based on sequence, motifs and patterns, secondary structure and folding classes, special structures or features, tertiary structure.**12 hr**

Unit III

Predictive methods using protein sequences
Genomics: genome analysis, bacterial genome sequence project, Human Genome Project

Microarray technologies: Expression, Profiles and protein functions and applications.**10hr**

Environmental Biotechnology

Unit-I

Introduction: Major issues in environmental pollution – role of biotechnology to solve the problems.
Biotechnological methods of pollution detection: general bioassay, cell biological methods, immunoassays, DNA-based methods, use of biosensors.
Biotechnological methods in pollution abatement: Reduction of CO_2 emission. Waste water treatment – conventional wastewater treatment, use of algae, Bioreactors for waste-water treatment,eutrophication, use of cell immobilization **10 hr**

Unit-II

Renewable and non-renewable resources; current status of biotechnology in environment protection.

Bioremediation: Concepts and principles, bioremediation using microbes, in situ and ex situ bioremediation, biosorption and bioaccumulation of heavy metals.
Xenobiotics: Degradation by microorganisms with reference to pesticides, herbicides, polyaromatic hydrocarbons.
Renewable energy: Relevance of GMO to the environment.

Solid waste management: Waste as a source of energy, biotechnology in paper and pulp industry, production of oil and fuels from wood waste, anaerobic and aerobic composting, vermiculture, biofuels.
Biotechnology and Biodegradation: Degradation of xenobiotic compounds- Simple, aromatic, chlorinated, poly aromatic, petroleum products, pesticides and surfactants.

Biohydrometallurgy and biomining: Bioleaching, biosorption, oil degradation, creation of superbug. **12 hr**

Unit-III

Treatment of Industrial wastes: Dairy, pulp, dye, leather and pharmaceutical industries. Solid waste management. Genetically engineered microbes for waste treatment
Ecofriendlybioproducts: Biomass resources, Biogas, alcohol as fuel, biological hydrogen generation, biodegradable plastics. **10 hr**

PRACTICAL : – 2X 16=32 CREDITS

- Seed inoculation with *Rhizobium* culture and observation for root nodulation
- Photographic demonstration of transgenic crop plants/animals and agriculture biotechnology innovations
- Preparation of bio control formulations
- Biofertilizer formulation
- Analysis of sewage water for 1. BOD
  2. Toxic chemicals
  3. Microbial flora
- Visit to National Bioinformatics Centre

SKILL ENHANCEMENT COURSE -SEC

V Semester

SEC 1.1 Molecular Biology Techniques 16X2=32 HRS

Unit I

Recombinant DNA and Molecular probes:

Recombinant DNA: Restriction enzymes for cloning, Technique of restriction mapping, construction of chimeric DNA: cloning in plasmid, Phage and cosmid vectors, hosts for cloning vectors.

Molecular probes: preparation, labelling, amplification, techniques of molecular probing, applications, and Molecular markers. **10 hr**

Unit-II

Gene Analysis and Library Construction;

Gene analysis techniques: Nucleic acid hybridization, Southern and Northern blotting, mapping genes to chromosomes, *in situ* hybridization, Polymerase chain reaction- Types, RAPD, AFLP, RT-PCR, realtime PCR, microsatellites, applications.

Gene libraries: Construction and screening of genomic and cDNA libraries, chromosome walking, chromosome jumping, BAC libraries. **10 hr**

Unit-III

Isolation, Sequencing and synthesis of genes:

Isolation of Gene; Isolation of genes for specific proteins, proteins having tissue-specific expressions, isolation of genes using DNA or cDNA probes.

Sequencing of Gene; Sequencing by Maxam and Gilbert's methods, Sangers dideoxy method, automatic DNA sequencers by PCR, DNA sequencing through transcription, sequencing using DNA chips, sequencing by DE-MALDI-TOFMS.

Gene Synthesis; Gene synthesiser, gene amplification using PCR. **12 hrs**

SEC1.2 Biophysics and Biochemical techniques 16X2=32 HRS

Unit I

Basic biophysics: Structure of atoms, molecules and chemical bonds Stablizing interactions (Van der Waals, electrostatic, hydrogen bonding, hydrophobic interaction, etc.). Principles of biophysical chemistry (pH, buffer, reaction kinetics, thermodynamics, colligative properties). **10hr**

Unit II

Basic principle of chromatography, principle, procedure and application of- paper chromatography, TLC, Gel permeation chromatography, Ion-exchange chromatography HPLC and GC.

Seperation techniques: Homogenization, Membrane filtration and Dialysis, Solvent fractionation, Centrifugation, Electrophoresis-paper electrophoresis, gel electrophoresis, SDS-PAGE, Disc gel, gradient gel, isoelectric focusing,

Spectroscopy –Electromagnetic spectrum, properties of the electromagnetic radiations, Basic principle and applications of Absorption spectroscopy, Colorimetry and UV-visible spectrophotometry, fluorescence spectroscopy, circular dichroism, and NMR **12hr**

Unit III

Microscopy – Light Microscopy: Bright, Dark Field and Phase contrast Microcopy, fluorescence and confocal microscopy. Resolving power and Magnification Electron Microscopy – Working principle, Sample preparation and contrast enhancement techniques. Comparison between SEM, STEM, STM, Atomic force microscopy (AFM). Instrumentation and applications. **10 hr**

VI Semester

SEC 2.1 Intellectual Property Rights and Entrepreneurship

Unit 1

Overview of intellectual property; Introduction and the need for intellectual property right (IPR) IPR in India – Genesis and Development of IPR in abroad. Some important examples of IPR.

Definition of copyright, patents, trade marks, geographical indications, industrial designs and biological inventions. **10 hr**

Unit II

Enforcement of Intellectual property rights; Infringement of intellectual property rights Enforcement Measures

Emerging issues in Intellectual property; Overview of Biotechnology and Intellectual Property Biotechnology Research and Intellectual Property Rights Management Licensing and Enforcing Intellectual Property Commercializing Biotechnology Invention

Unfair competation; What is unfair competition? relationship between unfair competition and intellectual property laws? **12hrs**

Unit III

Entrepreneurship in bio-business:

Introduction and scope in Bio-entrepreneurship, Types of bio-industries Entrepreneurship development programs of public and private agencies (MSME, DBT, BIRAC, Make In India), Negotiating the road from lab to the market (strategies and processes of negotiation with financiers, government and regulatory authorities), Business plan preparation including statutory and legal requirements, Technology – assessment, development & Upgradation. **10 Hr**

SEC 2.1 Fermentation Technology **16X2=32 HRS**

Unit-I

General introduction: History and Scope of Fermentation Technology. Fermentation Methodology.

Types of Fermentors; External Recycle Airlift fermentor, Internal recucle airlift fermenters, Tubular Tower fermentor, Nathan Fermentor, Stirred Fermentor

Design of bioreactors, control systems, operation, optimization, control and monitoring of variables such as temperature, agitation, pressure, pH, online measurements and control**,** useof biosensors in bioreactors. **12 hours**

Unit II

Types of Fermentation Process; Batch, Fed Batch and Continuous.

Transport phenomena in bioprocess; Scale up of bioreactors, mass transfer resistance, oxygen transfer coefficients, biological heat transfer, heat transfer coefficients.

Categories of fermentation Technology; Microbial biomass production, Microbial metabolite production- Primary and secondary, Microbial enzymes, Bioconversion and biotransformation with two examples each. **10 hours**

Unit-III

Downstream processing of biologicals: Separation of cells, foam separation, flocculation, filtration, centrifugation, mechanical and non-mechanical methods, membrane filtration, ultra filtration and reverse osmosis, chromatographic techniques, absorption, spray drier, drum dryers, freeze dryers. **10 hours**

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