Syllabus

M. Sc. Biotechnology

2011-12

IV Semester Course

School of Environmental Biology

Awadhesh Pratap Singh University Rewa M. P.

M. Sc. Biotechnology

A. P. S. University Rewa M. P.

Syllabus for Session 2011-12

The Scheme of Examination

First Semester

Paper Code	Paper Name	E. A.	I. A.	Total Max. Marks.
101	Cell Biology	80	20	100
102	Biochemistry	80	20	100
103	Microbiology	80	20	100
104	Molecular Biology	80	20	100
105	Practical	150		150
106	Seminar	50		50
		Total		**600**

Second Semester

Paper Code	Paper Name	E. A.	I. A.	Total Max. Marks.
201	Biostatistics And Computer Applications	80	20	100
202	Immunotechnology	80	20	100
203	Environmental Biotechnology And Animal Cell Culture	80	20	100
204	Biophysical Chemistry – Techniques	80	20	100
205	Practical	150		150
206	Seminar	50		50
		Total		**600**

Third Semester

Paper Code	Paper Name	E. A.	I. A.	Total Max. Marks.
301	Genetic Engineering	80	20	100
302	Bioprocess Engineering And Technology	80	20	100
303	Metabolism: Basic Concept And Design	80	20	100
304	Plant Biotechnology	80	20	100
305	Practical	150		150
306	Seminar	50		50
		Total		**600**

Fourth Semester

Paper Code	Paper Name	E. A.	I. A.	Total Max. Marks.
401	Bioinformatics	80	20	100
402	Entrepreneurship In Biotechnology &Intellectual Property Rights	80	20	100
403	Dissertation and Presentation			200
		Total		**400**

Grand Total 2200

101: CELL BIOLOGY

Unit I

1. Cell membrane: physiochemical properties; Molecular Organization- asymmetric Organization of lipids, proteins and carbohydrates: Biogenesis and Functions
2. Transport of small molecules across cell membranes: types and mechanisms.
3. Active transport by ATP powered pumps: types, properties and mechanisms.
4. Transport of proteins into Mitochondria and Chloroplast.

Unit II

1. Protein targeting and Molecular mechanisms of Vesicular transport
2. Intracellular digestion: ultra structure and function of lysosomes Nutrient uptake and excretion. Transport by Vesicle formation: Endocytosis and Exocytosis.
3. Human physiology (digestive system, endocrinology, reproduction, stress and adaptation, nervous system, respiratory system).

Unit III .

1. Cell Motility and Shape I: Structure and function of microfilaments.
2. Cell motility and Shape II: Structure and Function of Microtubules and Intermediate Filaments.
3. Intra cellular communication through Cell Junctions: Occluding Junctions, Anchoring junctions and Communicating Junctions
4. Inorganic ions.

Unit IV

1. Molecular Mechanisms of Cell-Cell Adhesions: Ca dependent cell-cell adhesions.
2. Molecular Mechanisms of Cell-Cell Adhesions: Ca independent cell-cell adhesions.
3. Extracellular Matrix of animals: Organization and Functions.
4. Extracellular Matrix Receptors on animal cells: Integrins.

Unit V

1. Cell Signaling: Signaling via G-Protein linked and enzyme linked cell surface receptors, MAP kinase pathways, Interaction and Regulation of signaling pathways. Bacterial chemo taxis and quorum sensing.
2. Eukaryotic Cell Division Cycle: Different Phases and Molecular Events.
3. Control of Cell Division Cycle: In yeast and mammalian cells.
4. Apoptosis: Phases and significance, Morphological and Biochemical changes associated With apoptotic cells, Apoptotic Pathways and regulators
5. Cancer

102. Biochemistry

UNIT I

1. Biochemistry: The molecular logic of living organisms
2. The cell and its biochemical organization
3. Intra and inter molecular forces electrostatic interactions and Hydrogen bonding interactions
4. van der Waals and Hydrophobic interactions
5. Disulphide bridges
6. Role of water and weak interactions
7. Chemical foundations of Biology- pH, pK, acids, bases, buffers, weak bonds & Covalent bonds, Principles of thermodynamics

UNIT-2

1. Carbohydrates: classification, structure, functions; homo and hetero polysaccharides, animal, plant and microbe specific polysaccharides.
2. Lipids: Classification, nomenclature, structure and property of fatty acids,
Simple lipids- Triglisrids, fates and Waxes.
Compound lipids- classification, structure, distribution, and biological importance, role of prostaglandine,leukotrins and thromboxans.
3. Sterols- Cholestrol, role in biological system. Tarpenes and phenols.
4. Functions; Lipids associated with disease, diagnosis and treatment. Lipoproteins and biological membrane, micelles and liposomes.

UNIT -3

1. Nucleic acids: Structure, Properties of purines and pyrimidine bases,DNA : Structure, conformation, prokaryotic and eukaryotic DNA, nucleotides,Chromosomal and extra chromosomal DNA
2. RNA: Structure, types and function of mRNA, tRNA, Ribozymes: structure and functions.
3. Amino acids- classification, structure, property, Zwitter ion, titration curve and biologically important amino acids
4. Polypeptides- Conformational properties of polypeptides, protein sequencing methods.
5. Proteins: Classification, Primary structure, nature of peptide bond, Ramchandran plot, and secondary structure, hydrogen bonding, salt bridge, disulphide bonds, hydrophobic and hydrophilic interaction in proteine and role of these bonds in protein folding, α-helix, β-sheet, and beta turns structures etc.Tertiary and quaternary structure. Biological role of proteins. Proteins associated with diseases, diagnosis and treatment. Separation, purification and criteria of homogeneity, End group analysis Folding-unfolding equilibrium and denaturation of proteins
6. Prions- Structure role and association with disease

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UNIT-4

1. Enzymes; General characteristics and Catalytic power of enzymes and their classification, Energy considerations, Factors affecting enzyme activity, Enzyme kinetics, Michaelis-Menten equation, Allosteric enzymes and their regulation.
2. Methods of enzyme assay: Continuous & Sampling techniques, coupled kinetic assays, Significance of enzyme turn over number, Specific activity.
3. Enzyme purification techniques, Criteria of purity and tabulation of data
Characterization of purified enzymes

4. Vitamins and cofactors: Structure, distribution, interaction and biological properties
5. Hormones- structure, distribution and function.
6. Phenols – structure and biological property
7. Alkaloids – structure and biological properties

UNIT -5

1. Enzyme immobilization: Experimental procedures and effect on kinetic parameters
2. Uses of enzymes in Industries, textiles, leather and food
3. Use of purified enzymes in Biosensors
4. Development of enzyme sensor for clinical diagnosis with specific examples

103. MICROBIOLOGY

Unit I

1 Microscopy (light microscopy, resolving power of different microscopes, ESR, ETR)
2. Classification of Microorganisms: Bacterial & Fungal Classification.
3. Morphology and fine structure of eubacteria, archebacterial cell wall and fungal cell Wall.
4. Cyanobacteria : General account and their economic importance
5. Mycoplasma and diseases caused by them

Unit II

1. Sterilization: Physical and chemical methods
2. Preparation of culture media, pure culture techniques and microbial staining
3. Microbial growth: Bacterial growth curve, Mathematical expression, measurement of growth and factors affecting growth.
3. Microbial Nutrition: Nutritional classification of Microorganisms, Different carbon and Nitrogen sources, mode of nutrition, transport of nutrition across the bacterial membrane.
4. Oxygen toxicity: Study of catalase, peroxidase, superoxide dismutase, mechanism of oxygen toxicity/ Taxonomic classification of microbes using molecular markers- 16 rRNA typing.

Unit III

1. Virus organization, Types, Isolation, cultivation, identification and viral replication.
2. Structure and morphology of bacteriophages, lytic and lysogenic cycle.
3. Life cycle of DNA viruses: SV 40, RNA viruses: Retroviruses.
4. Plant viruses: TMV, Gemini, CMV, Human Viruses: Influenza (SARS), Herpes Simplex virus, Rubella.

Unit IV

1. Infection and disease, types of infection, Mechanism of pathogenesis of bacterial and Viral disease.
2. Staphylococcal and Clostridial food Poisoning, Bacterial Diseases: Salmonellosis and Shigellosis.
3. Fungal Diseases: Histoplasmosis, Aspergillosis and Candidiasis.
4. Viral diseases: Chicken Pox, Hepatitis B and Poliomyelitis.

Unit V

1. Host microbe interaction, Symbiosis, Antibiosis, Commensalisms, Competition, Mycorrhiza and its importance, Role of microbes in N, P and C cycle.
2. Bacterial Recombination: Transformation, conjugation, transduction, Plasmids and Transposons.
3. Chemotherapeutic agents: Classification of Antibiotics, Broad and narrow spectrum antibiotics; Antibiotics from prokaryotes.
4. Anti-fungal and antiviral antibiotics, mode of action of antibiotics and mechanism of drug resistance, origin of drug resistance.

104- MOLECULAR BIOLOGY

Unit I

1. Mendelian genetics-principles
2. Human genetics (pedigree analysis, karyotypes and genetic disorder).
3. Nature of Gene Concept, Chemical Nature of Gene, Gene cistron relationship in Prokaryotes and Eukaryotes
4. DNA Replication: General features of Chromosomal Replication: and its Enzymology
5. Regulation of DNA replication

Unit II

1. Transcription in prokaryotes: Initiation, elongation and termination
2. Structure and Function of prokaryotic promoter
3. Control of transcriptional initiation in prokaryotes: Structure and function of RNA Polymerase: Sigma factors- Types and functions
4. Control of transcriptional termination: Attenuation and antitermination

Unit III

1. Regulation of gene expression in prokaryotes: Operon concept, induction and Repression, Structure and regulation of lactose, arabinose and tryptophan operons
2. Initiation of transcription in Eukaryotes: RNA Polymerases Types and properties
3. Transcription factors- Types and properties; Enhancers- Structure and properties; Response Elements
4. Post-transcriptional Modification Eukaryotes- 5' and 3' modification of mRNA
5. Molecular recombination

Unit IV

1. Post- transcriptional Processing of pre mRNA, pre rRNA and pre tRNA transcripts
2. Genetic Code: Evidence and properties; Wobble hypothesis; Transcriptional adaptors and amino acyl tRNA synthases.
3. Translation: Successive stages of protein synthesis in prokaryotes and its comparison with eukaryotes
4. Post-translational Modification: Types and Significance

Unit V

1. Regulation of Gene Expression in Eukaryotes: cis- acting DNA elements; Chromatin Organization and regulation of gene expression; regulation at the level of processing of Transcripts, RNA editing; Gene Alteration; DNA methylation and gene regulation; Regulation of gene expression by hormones, regulation of gene expression at translational level.
2. Transposable elements in Prokaryotes and Eukaryotes: Types and Significance
3. Oncogenes and Tumor Suppressor Genes: Properties and Significance
4. Mutation and DNA repair, chromosomal aberration.

201- BIOSTATISTICS AND COMPUTER APPLICATIONS

Unit I

1. Introduction to Biostatistics, Common terms, notions and Applications
2. Statistical population and Sampling Methods
3. Classification and tabulation of Data
4. Diagrammatic and graphical presentation
5. Frequency Distribution, Measures of central value
6. Measures of variability; Standard deviation, standard Error, Range, Mean Deviation, Coefficient of variation, Analysis of variance

Unit II

1. Basic tests, Test of significance; t-test, chi-square test.
2. Regression; Basic of regression, regression analysis, Estimation, Testing, prediction, checking and residual analysis.
3. Multivariate Analysis.
4. Design of Experiments, randomization, replication, local control, complimentary Randomized, randomized block design

Unit III

1. Factor Analysis.
2. Path analysis
3. Introduction to data mining
4. Virtuous Cycle.

Unit IV

1. Classification and Discriminant Analysis Tools: CART, Random forests,
2. Fisher's discriminant functions.
3. Neural networks.
4. Multilayer perception, predictive ANN model building using back propagation algorithm, exploratory data analysis.

Unit V

1. Introduction to computer basics, concept of hardware windows XP and LINUX
2. Concept of file, folders, directories and their management by windows XP and LINUX
3. Office applications : MS- Office, MS- Word, MS- Excel and MS- PowerPoint
4. Open Office on Linux: Word Processor, spread sheets, Impress
5. Statistical Packages: Sigma plot etc.
6. Introduction to bioinformatics
7. Internet- introduction and application
8. Statistical analysis software

202--IMMUNOTECHNOLOGY

UNIT I

1. Immune response: Innate immune mechanisms and characteristics of adaptive immune responses, Hematopoiesis.
2. Anatomical organization of Immune System: Primary Lymphoid Organs, Secondary Lymphoid Organs, Ontogeny and Phylogeny of lymphocytes, Lymphocyte traffic.
3. Cell of immune system: Mononuclear cells and granulocyte, Antigen presenting cells, lymphocytes and their subsets. Antigens, Heptanes: Factor affecting immunogenecity, Super antigen.
4. Inflammation: its mediator and the process, cell-adhesion molecules and their role in inflammation, lymphocyte homing, tissue injury and immune response leading to an inflammatory reaction, role of anaphylatoxins, granulocyte in inflammatory process.

UNIT II

1. Major histocompatibility systems: Structure of MHC I and II molecules, polymorphism, distribution variation and function. Organization of MHC complex in mouse and humans. Association MHC with disease.
2. Recognition of antigens by T and B cells: Antigen processing, Role of MHC molecules in Antigen presentation and co stimulatory signals.
3. T-Cell receptor complex, T- Cell accessory membrane molecules, activation of T –cells, organization and arrangement of T-receptor genes.
4. B-cell receptor complex, activation of B-cells, Immunoglobulins: molecular structures, types and function. Antigenic determinants on immunoglobulins.

UNIT III

1. Molecular mechanism of antibody diversity: Organization of genes coding for constant and variable regions of heavy chain and light chain. Mechanism of antibody diversity, Class Switching.
2. Antigen-Antibody interaction avidity and affinity measurement.
3. Monoclonal antibodies: production, characterization and application in diagnosis, therapy and basic research.
4. Compliment System, components, Activation pathway and regulation of activation pathway, complement deficiency, role of complement system in immune responses.

UNIT IV

1. Cytokines: Structure and functions, cytokine receptors, signal transductions mediated by cytokine receptors, cytokine regulation of immune responses, cytokine related diseases and therapeutic applications of cytokines.
2. Cytotoxic T-cell and their mechanism of action, NK cell and mechanism of target cell destruction. Antibody dependent cell mediated cytotoxicity, delayed type hypersensitivity. Techniques of Cell-mediated immunity.
3. Immunoregulation by Antigens, Antibodies, immune complexes, MHC and cytokines.
4. Hypersensitivity: definition, IgE mediated hypersensitivity, mechanism of mast cell degranulation, mediators of type I reactions and consequences. Type II reactions, immune complex mediated hypersensitivity and delayed type hypersensitivity.

UNIT V

1. Autoimmunity: Organ specific diseases, systemic disease, mechanism of autoimmunity.
2. Immunodeficiency Syndrome: Primary Immunodeficiencies and Secondary Immunodeficiencies and their diagnosis and therapeutic approaches.
3. Vaccines: Active and passive immunization, whole organism vaccines, macromolecules as vaccines, Recombinant vector Vaccines, DNA Vaccines, synthetic peptide Vaccines and sub-unit Vaccines.
4. Immunodiagnostics: development of Immunodiagnostic Kits for infectious and non-Infectious disease with examples. Precipitation techniques, Agglutination, Fluorescence Techniques, ELISA, RIA, Western Blotting and immuno-histochemical techniques.

203- Environmental biotechnology and animal cell culture

UNIT I

1. Environment: basic concepts, Environment pollution: types, methods for measurement of pollution
2. Population ecology(R & K selection).
3. Waste treatment & Utilization:
4. Biomedical waste and its management
5. Xenobiotics and its degradation
6. biosurfactants and biofilms

UNIT II

1. Integrated pest management- An ecological approach
2. Bioremediation: In -situ and ex -situ techniques, advantages of bioremediation, Applications of genetically engineered microbes (GEM) in bioremediation.
3. Phytoremediation: Types and its applications
4. Environmental monitoring: Bioindicators
5. Biogeography
6. Global environmental problems
7. Petroleum biotechnology

UNIT III

1. Biotransformation: Steroids
2. Mushroom Cultivation
3. Biofertilizers and its applications
4. Immobilization of microbial cells and their applications
5. Conservation biology(principle of conservation , Indian case studies on conservation ,project tiger and biosphere reserve)
6. Biopesticide and its applications.
7. Microbial production of SCP

Animal cell culture

UNIT IV

1. Introduction and organization of animal cell and tissue culture laboratory
2. Primary and established cell line cultures
3. Serum and protein free defined media and their applications
4. Introduction to balanced salt solutions and simple growth medium: rationale of composition of medium, role of CO2 and supplements
5. Stem cell basics , culture and their application.

UNIT V

1. Measurement of parameters of growth
2. Scaling up of animal cell culture, Cell synchronization
3. 3-D animal cell culture
4. FISH and applications of animal cell culture

204- Biophysical chemistry – Techniques

Unit-1

1. Concept of free energy of molecules. Introduction to various force fields and their relative merits and demerits. Techniques for Molecular energy minimization, Monte Carlo and Molecular Dynamics simulation

2.Water, PH, Buffer, Handerson and Hasselblach equation,

3. Titration of weak acid and weak bases

4. Basic calculation of concentration of deferent unit

8. Mass Spectrometry

Unit-2

2. Micro calorimetry (DSC and ITC) and its application

3. Circular Dichroism spectroscopy

4. UV, visible and Fluorescence spectroscopy, IR and Raman Spectroscopy

5. X-ray Diffraction

6. Nuclear Magnetic Resonance (NMR)

7. ESR

8. Mass Spectroscopy

Unit-3

1.Ion exchange chromatography

2. Affinity Chromatogrophy,

3. Paper chromatography

4. Thin layer chromatography

5. Gas liquid chromatography

6. Gas chromatography

7. Column chromatography

8. HPLC

9. Exclusion chromatography

10. Isoelectrofocusing

Unit - 4

1Analytical Ultracentrifugation: Sedimentation velocity and equilibrium, determination of molecular weights

1. Electrophoresis of DNA, proteins and enzymes.
2. Southern, northern and western blotting
3. DNA Fingerprinting
4. Tracer Techniques – Nature and types, Decay units and preparation of labeled biological compounds.

Unit-5

1. DNA sequencing
2. Gene mapping techniques
3. Functional genomics (expression profiling, transcriptome, DNA array, gene function determination , protein interaction)
4. EMSA and FACS and Flow cytometry
5. PCR and its different variations, Analysis of molecular markers(SSLP , RFLP, AFLP, RAPD, ISSR, STS)

301- GENETIC ENGINEERING

Unit I

1. The recombinant DNA Technology : General concept and principle of cloning
2. Enzymes: Nucleases and restriction endonucleases- properties and types; phosphomonoesterases; polymerase; terminal deoxynucleotidyl transferase; poly A polymerase, Linkers, adaptors and homopolymer tailing.
3. prokaryotic host- vector system: Characteristics of E.coli as host; vectors for cloning in E.coli (plasmid, bacteriophage- EMBL, DASH, gt10/11, ZAP etc and plasmid-phage)
4. Other Prokaryotic host vector systems: BAC ,Characteristics of Gram positive and Gram negative organism as host and suitable vectors for cloning; Shuttle Vectors

Unit II

1. Design and characteristics of expression vectors for cloning in prokaryotes and factors that affect expression.
2. Cloning in Yeast: Properties of yeast as host for cloning and different types of vectors designed for cloning in yeast
3. Cloning in animal system: Animal system as a model host, Methods of introduction of foreign DNA in animal system; Vectors for cloning in animal system- SV-40, vaccinia virus, baculovirus and retrovirus vectors ,pMal, GST, pET based vectors, Pichia based vectors.
4. Plant transformation technology: Features of Ti and Ri plasmids, mechanism of DNA transfer.

Unit III

1. Methods for Constructing rDNA and cloning: Inserts; vector insert ligation; infection, transferring and cloning
2. Methods for screening and selection of recombinant clones
3. DNA Libraries: types, advantages and disadvantages of different types of libraries; Different methods for constructing genomic and full length cDNA libraries
4. Gross anatomy of cloned insert- size, restriction mapping and location

Unit IV

1. Fine anatomy of DNA segment- General principle of chemical and enzymatic methods of nucleotide sequence analysis and advantages of automatic gene sequencers.
2. Localization of cloned segments in genomes- molecular and chromosomal location
3. Methods for determination of copy number of a cloned gene in genome
4. Mutant construction: Introduction, deletion, insertion and point mutation

Unit V

1. Principles and applications of Blotting techniques- Southern, Northern, Western and Eastern blotting; Polymerase Chain reaction and types (multiplex, nested, RT, real time, touch down PCR, hot start PCR, colony PCR), Oligonucleotide
2. Principle and applications of gel mobility shift assay, DNA fingerprinting and DNA Foot printing, restriction fragment length polymorphism, Chromosome mapping and chromosome painting
3. Application of Recombinant DNA technology in Medicine & Industry
4. Si RNA and si RNA technology: Micro RNA Construction of si RNA vectors: Gene silencing and its applications in agro industry.

302 BIOPROCESS ENGINEERING AND TECHNOLOGY

UNIT I

1. Introduction to bioprocess engineering
2. Isolation, preservation and Maintenance of Industrial microorganisms.
3. Kinetics of microbial growth and death,
4. Media for industrial fermentation. Air and media sterilization

UNIT II

1. Aeration and Agitation systems for bioreactor
2. Safety in fermentation laboratory
3. Strain improvement of industrially important microorganism.
4. Bioreactors: Principle, Kinetics, types, design, and application.

UNIT III

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1. Flow behaviour of fermentation fluids
2.. Gas-Liquid mass transfer, significance of Ka, and Heat transfer.
3. Automation for monitoring and control.

UNIT IV

1. Downstream processing: Introduction, removal of microbial cells and solid matter, foam reparation, precipitation, centrifugation, cell disruption, chromatography
2. Extraction:-solvent, two phase, liquid extraction
3. Product recovery processes
4. Crystallization, packaging and quality assurance.
5. Classification of product formation
6. Product synthesis kinetics

UNIT V

1.Microbial Production of antibiotics: Penicillin;
2. Microbial Production of Vitamins & amino acids (Vit B12 & Glutamic acid)
3.Microbial production of enzymes: Amylase,
4. Microbial production of alcoholic beverages: Distilled alcoholic beverages-Beer, microbial production of Vinegar.
5. Microbial production of Organic acids: Citric acid & Acetic acid
6. Microbial production of solvents: Ethanol and acetone
7 Microbial production of food –SCP

303- Metabolism: Basic concept and design

Unit-1

1. Mechanism of Enzyme catalysis and action, Enzyme inhibition, activation of enzymes Immobilized enzymes
2. Different mechanisms of enzyme catalysis acid base and covalent catalysis
3. Molecular mechanism of action of chymotrypsin, Lysozyme and carboxy peptidase
4. Structure-function relationship of enzymes
5. Basic concept, laws of thermodynamics, ATP role in metabolism, oyher high energy phosphate molecule.

Unit-2

1. Glycolysis: Key structure and reactions, formation of1,6 bisphosphate, formation of glyceraldehyde 3-phosphate, formation of pyruvate and generation of second ATP, entryof fructose and galactose into glycolysis, phosphofructokinase as key enzyme in glycolysis,hoxokinase and pyruvate kinase as regulatory enzymes, conversion of pyruvate into ethanol lactate or acetyl CoA.
2. Gluconeogenesis: Synthesis of carbohydrates by non carbohydrate precursors, gluconeogenes is not a reversal of glycolysis, activation of pyruvate carboxylase by acetyl CoA, oxaloacetate shuttle, energy consumption in the synthesis of glucose from pyruvate, reciprocal regulation of gluconeogenesis and glycolysis, conversion of lactate and alanine into glucose
3. Krebs cycle
4. Pentose phosphate pathway : Generation of NADPH and interconnection of glycolysis and pentose phosphate pathway, control of rate of pentose phosphate pathway by NADPH+, regulation of flow of glucose 6 phosphate by the need of NADPH, ribose 5 phosphate and ATP, glucose 6 phosphate dehydrogenase defficiency.
5. Carbohydrate Biosynthetic Pathways- Gycogenesis, Glycogenolysis, Glucose synthesis by autotrophs (C2, C3, C4, Cycle, CAM)

Unit-3

1. Electron transport and oxidative phospherylation, energetics of oxidative phosphorylation, enrgy yield by complete oxidation of glucose.
2. Citric acid cycle: Formation of acetyl CoA from pyruvate, condensation of oxaloacetate with acetyl CoA to form citrate, isomerization of citrate intoisocitrate, oxidative decarboxylation of succinyl CoA, generation of high energy phosphate from succinylCoA, regeneration of oxalate, sloichiometry of citricacid cycle, pyruvate dehydrogenase complex, citricacid cycle as a source of biosynthetic precursors, control of pyruvate dehydrogenase complex, controlof citric acid cycle, citric acid cycle and its high energy yield.

Unit-4

1. Fatty acid oxidation
2. Digestion, mobilization and transport of fatty acids, Mobilization of stored triglycerides by hormones, activation of fatty acids and their transport tomitochondria, oxidation of saturated fatty acids, Oxidation of unsaturated fatty acids, and oxidation of odd chain fatty acids. Ketone bodies, over production of kelone bodies.
3. Biosynthesis of fatty acids
4. Formation of malony CoA, fattyacid synthase complex, fattyacid synthase multifunctional proteins, shuttling of acitate out of mitochondria as citrate, Reactions of fatty acidsynthase, regulation of fatty acid biosynthesis, Biosynthesis of triglycerols, membrane phospholipids and prostaglandins.

Unit-5

1. Amino acid degradation oxidative deemination, conversion of NH4+ into urea, linkage between ureacycle and citirc acid cycle, conversion of alanine serine and cystein into pyruvate, conversion of aspartate and asparagine into oxalocetate, conversion of several amino acid into alpha ketoglutarate through glutamate, succinyl CoA as a point of entry for some amino acids, leucine degradation to acetylCoA and acetoacetyl CoA, phenyl alanine degradation to acetoacetate and fumarate.
2. Biosynthesis of amino acids : Conversion of nitrogen to NH4 by micro-organisms, conversion of amonia into amino acids by way of glutamata and glutamine,conversion of citric acid Intermediates to amino acids,glutamate as precursor of glutamine, proline and arginine, conversion of 3-phosphoglycerate to serine, synthesis of cystein from serine and homocysteine,feed back regulation of amino acid biosynthesis.
3. Biosynthesis and degradation of Nucleotides:
   Purine biosynthesis : formation of PRPP, Biosynthesis of IMP, Purine nucleotide interconversions, regulation of purinebiosynthesis.
   Pyrimidine Biosynthesis : Assembly of the pyrimidinenucleus, synthesis of di & tri phosphates, formation of deoxyribonucleotides, thymine biosynthesis salvage pathway for purine and pyrimidine nucleotides, Degradation of purines and pyrimidines to uric acid and urea.

304 PLANT BIOTECHNOLOGY

Unit I

1. Objectives, roles and landmarks in plant breeding.
2. Plant breeding techniques: Mutational breeding and distant hybridization.
3. Generation of genetically modified crops for resistance against biotic and abiotic stresses and nutritional quality.
4. Seed production techniques: release of new varieties.

UNIT II

1. Introduction to plant tissue culture: Tissue Culture Media preparation.
2. Initiation of callus culture and its maintenance.
3. Cell synchronization
4. Organogenesis: Somatic embryo hybridization.

UNIT III

1. Somaclonal variation and its application for plant improvement
2. Anther culture: haploid and Diploid plant cell production and their applications
3. Protoplast isolation and fusion, selection of hybrid cell and cybrids
4. Cryopreservation techniques and application
5. GM crops (development and future aspects.)

UNIT IV

1. Plant cloning vectors: ti Plasmid and viral vectors (CaMV based vectors, Gemini viruses,
2. TMV based vectors, Antisense RNA and ribosome technology
3. Transgenics in crop improvement: Methods for gene transfer field, Chloroplast transformation, testing and commercialization.
4. Plant physiology , plant hormones, stress physiology, secondary metabolites, photoperiodism and vernalization,solute transport and translocation.

UNIT V

1. Plant Genome mapping: Physical and molecular maps , Gene tagging
2. Insect resistance, Bt genes, Non-Bt like protease inhibitors, alpha amylase inhibitor, green House technology
3. Seed production techniques, release of new varieties and plant breeders' right: UPOV 369, 370,372.
4. Germplasm maintenance
5. Intellectual property right (IPR) and protection (IPP, Patenting of Biological material .

401 : BIOINFORMATICS

Unit I

1. Over view of Bioinformatics: Merger of life sciences with computers.
2. Search engines: Google, Pub Med, NCBI, EMBL,
3. Protein and DNA databases: Swiss port, PIR, OMIM, Embank, ENTREZ, DDJB, MIPS, Hovered, ECDC, Cambridge small molecular crystal structure data bank.
4. Analysis packages: Commercial databases and packages, GPL software for bioinformatics, web based analysis protocol.

Unit II

1. Sequence Databases: Contents, Structure, and annotation for Human Genome
2. Databases, Plant Genome Databases, Retrieving and installing a programme (Tree Tool), Multiple sequence alignment programme - Clustal W , X. Genome analysis programs; BLAST, FASTA, CGC, Motif and profile Sequence search.
3. Phylogenetic analysis: Phylogenetic reconstruction, distance matrices, Parsimony, Philip.
4. Data models: Instances and schemes; E-R Model, E-R diagrams, reducing E-R diagrams to tables, network data model.

Unit III

1. Methods of prediction of Proteins, DNA, RNA, fold recognition , Ab initio methods for structure prediction
2. Computer aided drug designing: Basic principles, docking, ADME/TOX
3. Genome mapping applications: EST and Functional genomics, EST clustering gene discovery, ORF prediction.
4. Use of genome analysis programs, primer designing tools.

Unit IV

1. Cluster analysis; Phylogenetic clustering by simple matching coefficients
2. Sequence Comparison; Sequence pattern; Regular expression based pattern; Theory of profiles and their use in sequence analysis Markov models;
3. Concept of HMMS; Baum-Welch algorithm; Use of profile HMM for protein family classification; Pattern recognition methods
4. Structure determination: X-ray crystallography; NMR spectroscopy; PDB (protein data bank) and NDB (nucleic acid data bank); File formats for the storage and dissemination of molecular structure

Unit V

1. Drug Design: General ideas of drug designing, 2D and 3D QASR, concept of a pharmacophore and pharmacophore based searches of ligand databases. Concepts of COMFA. Methods for simulated docking.
2. Modeling and conformational analysis: Homology modeling; Threading and protein, structure prediction , Force fields;
3. Molecular energy minimization Monte Carlo and molecular dynamics simulation Tagging of genes and molecular modeling, Modeling & Drug design

402: ENTREPRENEURSHIP IN BIOTECHNOLOGY &INTELLECTUAL PROPERTY RIGHTS

Unit 1

1. Creativity & Entrepreneurial personality and Entrepreneurship in Biotechnology Organizational structure & Management, Capital Management, Product innovation and management Government schemes for commercialization of technology (E.g. Biotech Consortium)

Unit 2

1. Basics of production management: Methods of manufacturing-Project/Jobbing, Batch Production, Flow/Continuous production, process production-Characteristics of each method . Plant location-Importance-Factors affecting location-factory Building-Plant Layout-Installation of Facilities.

2. Operational Research: Linear Programming, PERT and CPM; Production Planning & Control-Scheduling-Gantt Charts-Documentation-Production Work Order.
3. Basics of material management
4. Personnel management E.g., Communication skills; Managerial and personal, training ,etc.

Unit 3

1. Kaizen (Continuous improvement in product & management)
2. Six Sigma
3. Biotech enterprises: Small, Medium & Large
4. Quality control in Biotech industries

Unit 4

1. Govt. regulations for biotech products
2. Public policy, regulatory and ethical challenges facing the biotechnology entrepreneurship
3. Business development for medical products
4. Business development for consumable products

Unit 5

1. Patenting System: WTO, Paris Convention, Indian Legislations
2. Intellectual Property: A. Copy Right & Industrial Properties, Trademarks, Designs, Geographical Indications
3. IPR & Technology transfer, Role of patentee & Licensor
4. Patent process & Patent laws & e-filing