ANDHRA PRADESH STATE COUNCIL OF HIGHER EDUCATION

Programme: B.Sc. Honours in Biotechnology (Major)

w.e.f. AY 2023-24

COURSE STRUCTURE

Year	*Semester*	*Course*	*Title of the Course*	*No. of Hrs /Week*	*No. of Credits*
I	I	1	Introduction to Classical Biology	5	4
		2	Introduction to Applied Biology	5	4
	II	3	Biomolecules and Analytical Techniques – (T)	3	3
			Biomolecules and Analytical Techniques – (P)	2	1
		4 5 6 7 8 9	Microbiology, Cell Biology – (T)	2	3
			Microbiology, Cell Biology – (P)	3	1
II	III	10 11 12 13 14	Plant and Animal Biotechnology -(T)	2	3
			Plant and Animal Biotechnology – (P)	3	1
			Molecular Biology – (T)	2	3
			Molecular Biology – (P)	3	1
			Genetic Engineering –(T)	2	3
			Genetic Engineering –(P)	3	1
			Metabolism – (T)	2	3
			Metabolism – (P)	3	1
	IV		Immunology – (T)	2	3
			Immunology – (P)	3	1
			Bioinformatics and Biostatistics – (T)	2	3
			Bioinformatics and Biostatistics – (P)	3	1
			Medical Biotechnology – (T)	2	3
			Medical Biotechnology – (P)	3	1
III	V		Industrial Biotechnology – (T)	2	3
			Industrial Biotechnology – (P)	3	1
			Food & Nutritional Biotechnology – (T)	2	3
			Food & Nutritional Biotechnology – (P)		1
			Gene Biotechnology (OR) Genomics & Proteomics – (T)		3
			Gene Biotechnology (OR) Genomics & Proteomics – (T)		1
			Nanotechnology & Pharmaceutical Biotechnology (OR) Applications of Biotechnology - (T)	3	3
		15	Nanotechnology & Pharmaceutical Biotechnology (OR) Applications of Biotechnology - (P)	2	1
	VI	***Internship***			
IV	VII	Courses will be available in due course of time			
	VIII	Courses will be available in due course of time			

SEMESTER-V

COURSE 12: INDUSTRIAL BIOTECHNOLOGY

Theory Credits: 3 3 hrs/week

I. LEARNING OUTCOMES

On successful completion of the course, the students will be able to

1. Learn about industrially important microorganisms
2. Learn about bioreactor and it types
3. Learn about production of different substances through fermentation
4. Learn about industrially enzymes
5. Learn about industrially produced amino acids and vitamins.

II. Syllabus

Unit I

1. Isolation, Screening, Preservation and Improvement of Industrially Important Microorganisms.
2. Synthetic and Natural Medium, Precursors, Antifoams,
3. Sterilization Methods and Inoculum Preparation.

Unit II

1. Definition of bioreactor, basic principles of bioreactor.
2. Classification of bioreactors.
3. Analysis of batch, continuous, fed batch and semi-continuous bioreactors.

Unit III

1. Ethanol Production by Fermentation using Molasses, Starchy Substances.
2. Production of Alcoholic Beverages like Beer and Wine.
3. Production of Citric Acid by Submerged and Solid State Fermentations.

Unit IV

1. Sources of Industrial Enzymes, Production of Microbial Enzymes like Amylase and protease.
2. Backer's Yeast and SCP Production.
3. Production of Antibiotics : Penicillin strepomycin

Unit V

1. Amino Acid Production
2. Vitamin Production- Vitamin B12
3. Production Of Recombinant Proteins Having Therapeutic And Diagnostic Applications

(Insulin, Growth Hormone, Recombinant Vaccines, Monoclonal Antibody).

III. Skills Outcome

On Successful Completion of this Course, Student shall be able to

1. Learn about different isolations of microorganisms from various sources
2. Learn about production of alcohol and wine
3. Learn about citric acid fermentation

SEMESTER-V

COURSE 12: INDUSTRIAL BIOTECHNOLOGY

Practical Credits: 1 2 hrs/week

1. Isolation of industrially important microorganisms from soil.
2. Isolation of amylase producing organisms from soil.
3. Production of α – amylase from ***Bacillus Spp.*** by shake flask culture.
4. Production of alcohol or wine using different substrates.
5. Estimation of alcohol by titrimetry.
6. Estimation of alcohol by calorimetric method .
7. Production of citric acid.
8. Citric acid production by submerged fermentation.
9. Estimation of citric acid by titrimetry.

V. REFERENCES

1. Industrial Microbiology by A.H.Patel,2009

2.Prescott & Dum (2002) Industrial Micrbiology, Agrabios (India) ,2005,Publishers

3. Creueger W. & Crueger A.A Text of Industrial Microbiology,2000, 2nd Edition, Panima Publishers corp.

VI. CO-Curricular Activities

a) ***Suggested Co-Curricular Activities***

1. Assignments
2. Seminars, Group Discussions on related topics
3. Industrial visit to nearby industries

SEMESTER-V

COURSE 13: FOOD & NUTRITIONAL BIOTECHNOLOGY

Theory Credits: 3 3 hrs/week

I. LEARNING OUTCOMES

On successful completion of the course, the students will be able to

1. Learn about food Preservation and microorganisms associated with it
2. Learn about packaging of different foods
3. Learn types of Foods and their nutritional values
4. Learn about components of foods and their deficiency disorders
5. Learn about Essential minerals , BMR and RDA

II. Syllabus

Unit I

1. Principles of food preservation. Microorganisms associated with foods.
2. Infection, food intoxication, definition of self-life, perishable foods .Food preservation by freezing, refrigeration.
3. Storage at high temperature: sterilization, pasteurization, blanching, drying, dehydration, evaporation and irradiation.

Unit II

1. Food packing, methods of cooking – dry, moist, frying and microwave cooking.
2. Advantages, disadvantages and effects of various cooking methods of food.
3. Canning, fermentations, pasteurization and adulteration. Food additives..

Unit III

1. Animal and sea foods - their importance, nutritional values, and preservation methods
2. Microbiology of milk, milk products – cheese, yoghurt, butter, ice – cream, milk powder and their preparation.
3. Food preservation by salting, smoking, curing and crystallization

Unit-IV

1. Components of food: Carbohydrates, Fats, Proteins and their importance in daily diet.
2. Deficiency disorders: Protein deficiency disorders, Calorie maintenance diet, Malnutrition, Kwashiarkar, Maranus, Starvation.
3. Vitamins: types of vitamins, sources of various vitamins. Essential vitamins and their biological role in metabolisms. Vitamin deficiency disorders

Unit V

1. Basal Metabolic Rate (BMR) and its determination. Calorific values of foods, Atherosclerosis and obesity. Body Mass Index (BMI).
2. Recommended dietary allowances, Food allergy and its importance in health, Controlling measures
3. Essential minerals: Ca, Mg, Fe, I, Co, Mo, Zn, Se & F. Their role and deficiency disorders. Nutrition for pregnant, lactating women and for infants

III . Skills Outcome

On Successful Completion of this Course, Student shall be able to

1. Learn about Qualitative analysis of food
2. Learn about preservation methods
3. Learn about isolation on food spoiling Microrganisms

SEMESTER-V

COURSE 13: FOOD & NUTRITIONAL BIOTECHNOLOGY

Practical Credits: 1 2 hrs/week

1. Quantitative analysis of food for a) Moisture b) ash c) Iron d) Calcium
2. Isolation of Glycogen from sheep liver
3. Preparation of chloroplast from green leaves / carotenes from carrots.
4. Determination of pH of different foods using pH meter.
5. Study of food preservation methods
6. Nutritional labeling of food
7. Preparation of yoghurt
8. Isolation and identification food spoiling microorganisms.

V. REFERENCES

1. "Food Biotechnology" by Elsayed Abdel-Aal and Andy Khatwa (2019)
2. "Introduction to Food Biotechnology" by Perry Johnson-Green (2016)
3. "Food Biotechnology" by Kalidas Shetty and Gopinadhan Paliyath (2005)
4. "Food Biotechnology, Second Edition" by Klaus Buchholz and Volker Kasche (2013)
5. "Nutritional Biochemistry and Metabolism: With Clinical Applications" by Maria Luz Fernandez and Jose M. Ordovas (2014)
6. "Biotechnology in Functional Foods and Nutraceuticals" edited by Debasis Bagchi and Francis C. Lau (2010)

VI. CO-Curricular Activities

a) ***Suggested C0-Curricular Activities***

1. Assignments
2. Seminars, Group Discussions on related topics
3. Charts on deficiency disorders

SEMESTER-V

COURSE 14: GENE BIOTECHNOLOGY

Theory Credits: 3 3 hrs/week

I. LEARNING OUTCOMES

On successful completion of the course, the students will be able to

1. Learn about history and concept of genetic material
2. Learn about Mendel laws and their deviations
3. Learn about chromosome alterations and mutations
4. Learn about microbial genetics
5. Learn about banding techniques

II. Syllabus

UNIT I

1. History of Classical and Modern Genetics, Concept and organization of Genetic material in Bacteria, Plant and Animal;
2. Structure, types, forms and functions of DNA and RNA.
3. Genetic model organisms and their significance (***E.coli, Arabidopsis thaliana, Caenorhabditis elegans***).

UNIT II

1. Mendelian laws of inheritance; Non-Mendelian inheritance;
2. Chromosomal theory of inheritance. Back cross and Test cross.
3. Linkage and crossing over. Epistasis. Concept of multiple alleles.

UNIT III

1. Structural and numerical alterations of chromosome - Deletion, inversion, duplication, translocation. Ploidy and their genetic implications.
2. Mutation- (Spontaneous and Induced) mutagen. Biochemical basis of mutation.
3. Light induced repair, excision repair and mismatch repair, post replication repair, Rec gene and its role in DNA repair SOS repair and SOS response.

UNIT IV

1. Microbial Genetics: Methods of Gene transfer – Transformation, Transduction
2. Mapping genes by interrupted Matting, fine structure analysis of genes.
3. Retroposans , repeated sequences

UNIT V

1. Human karyotype, Banding techniques, Human genetic diseases. Pedigree analysis
2. Karotype in man, in herited disorders: Allosomal & autosomal. Banding techniques
3. Structure and Molecular basis of AC-DS transposition in maize, “P” element of Drosophila and hybrid dysgenesis, Yeast “T7” element

III . Skills Outcome

On Successful Completion of this Course, Student shall be able to

1. Identify different stages of mitosis
2. Identify the chromosomal aberrations
3. Identify the pedigree charts

SEMESTER-V

COURSE 14: GENE BIOTECHNOLOGY

Practical Credits: 1 2 hrs/week

1. Study of different phases of mitosis in onion root tips.
2. Mutation of DNA by UV light
3. Problems and assignments in Mendilian genetics.
4. Chemical induced mutation in bacteria.
5. Induction of chromosomal aberrations by chemical mutagenesis in any plant.
6. Isolation of auxotrophic mutants (plants or insects).
7. Repair of DNA by Photo activation of Photolyase in bacteria.
8. Mutation of bacteria by UV.
9. Karyotype
10. Pedigree analysis

V. REFERENCES

1. Human Genetics: Concept and Application by Ricki Lewis 10th Edition
2. Vogel and Motulsky's Human Genetics: Problems and Approaches
3. The Principles of Clinical Cytogenetics by Steven L. Gersen, Martha B. Keagle 3rd edition.
4. Human Cytogenetics: Constitutional Analysis: a Practical Approach by Denise E. Rooney.

VI. CO-Curricular Activities

a) ***Suggested Co-Curricular Activities***

1 Assignments
2. Seminars, Group Discussions on related topics
3. Charts on pedigree analysis and karyotyping

SEMESTER-V

COURSE 14: GENOMICS & PROTEOMICS

Theory Credits: 3 3 hrs/week

I. LEARNING OUTCOMES

On successful completion of the course, the students will be able to

1. Learn about mapping techniques
2. Learn about sequencing analysis
3. Learn about ORF and Gene location
4. Learn about proteomics
5. Learn about determination of proteins

II. Syllabus

UNIT I

1. Introduction of Genomics , Studying the Genome, DNA data bases.
2. Genetic Mapping-Markers for Genetic Mapping; RFLP, SSLP - VNTR's, STR's, SNP's;
3. Physical Mapping - In situ hybridization, Sequence Tagged Sites Mapping.

UNIT II

1. Determination of nucleotide sequence: Chemical degradation method, Sanger's di-deoxynucleotide synthetic method.
2. Direct DNA sequencing using PCR,
3. Sequencing by conventional shotgun method, Whole genome shot gun method, Clone contig method.

UNIT III

1. ORF scanning – Codon bias, Exon-Intron boundaries - Exon trapping, CpG island,
2. Gene location – Southern and Northern blotting hybridization, Zoo blotting.
3. Studying a transcriptome – Microarray or chip analysis, SAGE.

UNIT IV

1. Proteomics - ID–SDS-PAGE, 2D-PAGE.
2. Detection and quantitation of proteins in gels.
3. Protein staining techniques. Affinity purification of proteins.

UNIT V

1. Basics of Mass Spectroscopy- MALDI-TOF
2. ESI and their applications in proteomics.
3. Tandem MS/MS spectrometry , De novo sequencing using mass spectrometric data

III . Skills Outcome

On Successful Completion of this Course, Student shall be able to

1. Carry out protein structure prediction experiments.
2. Search and analyze genomic sequence databases using tools.
3. Carry out sterility testing of commercial pharmaceuticals.

SEMESTER-V

COURSE 14: GENOMICS & PROTEOMICS

Practical Credits: 1 2 hrs/week

1. Genome Viewers, SNP Analysis
2. Microarray Analysis
3. Protein Structure Prediction
4. Proteome Analysis
5. Network & Pathway Analysis
6. Calculation of phi and psi angles in proteins.
7. Structure validation and Protein Data Bank
8. Structural and functional motifs in proteins

V. REFERENCES

1. Discovering Genomics, Proteomics, & Bioinformatics (2003). Campbell & Heyer Pearson Education,
2. Bioinformatics, Methods of Biochemical Analysis (2001), Series Vol. 43, Baxevanis & Ouellette, John Wiley & Sons,
3. Computational Molecular Biology. Pevzner, P.A. (2000) MIT Press
4. Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins(2004). Andreas D. Baxevanis & B. F. Francis Ouellette. 3rd Edition. Wiley & Sons,

VI. CO-Curricular Activities

a) ***Suggested Co-Curricular Activities***

1. Assignments
2. Seminars, Group Discussions on related topics
3. Charts on molecular markers

SEMESTER-V

COURSE 15: NANOTECHNOLOGY & PHARMACEUTICAL

Theory Credits: 3 3 hrs/week

I. LEARNING OUTCOMES

On successful completion of the course, the students will be able to

1. Learn about concept and types of nanoparticles
2. Learn about methods of nanobiotechnology
3. Learn about bio nanoelectronics and applications of nanobiotechnology
4. Learn about Pharmacology and drugs &its types
5. Learn about tissue engineering and production of biological substances

II. Syllabus

UNIT I

1. Nanobiology – concepts, definitions, prospects; nanoparticles – size, shape, properties.
2. Bio nanoparticles – nano starch, nano composites – dendrimers.
3. Hot – Dot nanoparticles. Types of biomaterials. Biodegradable polymers.

UNIT II

1. Methods of nanobiotechnology – Analysis of bimolecular nanostructures by Atomic Force Microscopy, Scanning Probe Electron Microscopy.
2. Nanofabrication - lithography. Drug nanoparticles - structure and preparation ,Liposomes, Cubosomes and hexosomes.
3. Lipid based nanoparticles-liquid nano dispersion, solid liquid nanoparticles

UNIT III:

1. Nanotubes, Nanorods, Nanofibers and Fullerenes for nanoscale drug .
2. Bio nanoelectronics. Applications of nanobiotechnology in medicine, drug designing and cancer treatment.
3. Medical, social and ethical considerations of nanobiotechnology.

UNIT-IV

1. History & principle of pharmacology. Drug names & classification systems.
2. General principle of drug action – Pharmacokinetics, Pharmacodynamics. Measurement of drug action.
3. Chemotherapeutic drugs – Protein Synthesis Inhibitors, Anti-Inflammatory, Antibacterial, Antifungal, Antiviral, Antihelminthic, Anticancer Drugs.

UNIT-V

1. Production of biological – Human insulin, HGH, Erythropoietin's, IFN, TNF, IL, Clotting factor VIII
2. Synthetic therapy: Synthetic DNA, therapeutic ribozymes, synthetic drugs.
3. Tissue Engineering: Skin, Liver, Pancreas. Recombinant vaccines, Cell adhesion based therapy: Integrins, Inflammation

III . Skills Outcome

On Successful Completion of this Course, Student shall be able to

1. Learn about biological assays of antibiotics
2. Learn about Minimum Inhibitory Concentration (MIC) of Antibiotic
3. Learn about Sterility testing of commercial pharmaceuticals

SEMESTER-V

COURSE 15: NANOTECHNOLOGY&PHARMACEUTICAL

Practical Credits: 1 2 hrs/week

1. Estimation of penicillin/streptomycin by biologicalassay.
2. Estimation of penicillin/streptomycin by chemicalassay.
3. Assay of antimicrobial activity of Penicillin, Chloramphenicol,streptomycin
4. Determination of Minimum Inhibitory Concentration(MIC)ofAntibiotic
5. Determination of shelf life of antibiotics (Expired drugs)
6. Sterility testing of commercial pharmaceuticals.
7. Study of microbial spoilage of pharmaceuticals.
8. Sterility testing of injectable as per IP.
9. Effect of chemical disinfectant on growth of bacteria

V. REFERENCES

1. Buddy D. Ratner, Allan S. Hoffman, Frederick J. Schoen and Jack E.Lemons. Biomaterials Sciences: An Introduction to Materials in Medicine 2nd Edition.

2. David L. Nelson and Michael M. Cox, 2006 Lehninger's Principles of Biochemis try, 4th Edition.

3. M.Niemayer, Chad A. Mirkin, 2004. Nanobiotechnology: Concepts, applications and perspectives, Wiley VCH publishers.

4. David. S. Goodsell., 2006. Bionanotechnology: Lessons from Nature, Jhonwiley.

5. K.K. Jain, Naobiotechnology: Molecular Diagnosis, Tailor L. Francis Group.

VI. CO-Curricular Activities

a) ***Suggested C0-Curricular Activities***

1 Assignments 2. Seminars, Group Discussions on related topics 3. Charts on drug action, chemotherapeutic drugs

SEMESTER-V

COURSE 15: APPLICATIONS OF BIOTECHNOLOGY

Theory Credits: 3 3 hrs/week

I. LEARNING OUTCOMES

On successful completion of the course, the students will be able to

1. Learn about concept of culturing of stem cells and tissues
2. Learn about Applications of recombinant DNA technology
3. Learn about Intellectual Property Rights and Patenting issues
4. Learn about energy resources
5. Learn about Microbial treatment and degradation

II. Syllabus

UNIT-I

1. Culture of cells and tissues (including Stem cells and their application)
2. In vitro fertilization and embryo transfer technology, Methods of gene transfer – Microinjection and viral mediated gene transfer techniques
3. Production of transgenic animals and molecular pharming, Principles of Ex vivo and In vivo gene therapy

UNIT-2

1. Mass cultivation of cell cultures and process engineering – batch and continuous cultures, Bioreactors
2. Production of commercially useful compounds by plant cell culture, Methods of gene transfer techniques (***Agrobacterium***, Microprojectile bombardment)
3. Applications of recombinant DNA technology in agriculture, Production of therapeutic proteins from transgenic plants

UNIT-III

1. Primary and secondary metabolic products of microorganisms
2. Commercial production of fuels and chemicals by microbial fermentations
3. Animal cells as bioreactors, Intellectual Property Rights and Patenting issues

UNIT-IV

1. Renewable and non-renewable energy resources
2. Conventional energy sources and their impact on environment.
3. Non-conventional fuels and their impact on environment

UNIT-V

1. Microbiological treatment of municipal and industrial effluents
2. Microbial degradation of pesticides and toxic chemicals
3. Biopesticides and Biofertilizers (Nitrogen fixing, phosphate solubilizing microorganisms), Microbial ore leaching

III . Skills Outcome

On Successful Completion of this Course, Student shall be able to

1. Learn about different isolations of microorganisms from various sources
2. Learn about production of alcohol and wine
3. Identify the purity of sample
4. Identify the DO/ BOD/COD in different sample
5. Learn about isolation on food spoiling Microorganisms

SEMESTER-V

COURSE 15: APPLICATIONSOFBIOTECHNOLOGY

Practical Credits: 1 2 hrs/week

1. Isolation of industrially important microorganismsfromsoil.
2. Production of alcohol or wine using different substrates.
3. Detection of coliforms for determination of thepurityofpotablewater.
4. Determination of dissolved oxygen concentrationofwatersample
5. Determination of biological oxygen demand ofsewagesample
6. Determination of chemical oxygen demand (COD)ofsewagesample.
7. Quantitative analysis of food for a) Moisture b)ashc)Irond)Calcium
8. Isolation and identification food spoiling microorganisms.

V. REFERENCES

1. Industrial Microbiology by A.H.Patel,2009
2. Prescott & Dum (2002) Industrial Micrbiology, Agrabios (India) ,2005,Publishers
3. Creueger W. & Crueger A.A Text of Industrial Microbiology,2000, 2nd Edition, Panima Publishers corp.
4. K. Vijaya Ramesh, Environmental Microbiology, 2004,MJP Publishers, Chennai.
5. A.G. Murugesan, C. Raja Kumari, Environmental Science & Biotechnology - Theory &
6. Techniques, 2005,MJP Publishers
7. "Food Biotechnology" by Elsayed Abdel-Aal and Andy Khatwa (2019)
8. "Introduction to Food Biotechnology" by Perry Johnson-Green (2016)

VI. CO-Curricular Activities

a) ***Suggested Co-Curricular Activities***

1. Assignments
2. Seminars, Group Discussions on related topics
3. Awareness on waste water management