ANDHRA PRADESH STATE COUNCIL OF HIGHER EDUCATION

MINOR

Subject: BIOTECHNOLOGY

w.e.f. AY 2023-24

COURSE STRUCTURE

Year	Semester	Course	Title of the Course	No. of Hrs /Week	No. of Credits
I	II	1	Biomolecules and Analytical Techniques – (T)	3	3
			Biomolecules and Analytical Techniques – (P)	2	1
II	III	2	Plant and Animal Biotechnology -(T)	3	3
			Plant and Animal Biotechnology – (P)	2	1
	IV	3	Immunology – (T)	3	3
			Immunology – (P)	2	1
		4	Bioinformatics and Biostatistics – (T)	3	3
			Bioinformatics and Biostatistics – (P)	2	1
III	V	5	Industrial Biotechnology – (T)	3	3
			Industrial Biotechnology – (P)	2	1
		6	Food & Nutritional Biotechnology – (T)	3	3
			Food & Nutritional Biotechnology – (P)	2	1

SEMESTER-II

COURSE 1: BIOMOLECULES AND ANALYTICAL TECHNIQUES

Theory Credits: 3 3 hrs/week

I. LEARNING OUTCOMES

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

1. Learn about classification, structure and properties of Carbohydrates, Proteins and Lipids.

2. Learn about structure and function of DNA, RNA, Vitamins and Bioenergetics.

3. Learn about basic principles of Centrifugation, Chromatography and Electrophoresis.

4. Learn about principles of Spectroscopy, Microscopy and Techniques.

5. Learn about basics of Biostatistics.

II. Syllabus

Unit-I-Carbohydrates, Protein and Lipids

1. Classification, structure, properties of carbohydrates, amino acids, peptide bond and peptides.
2. Classification, structure (primary, secondary, tertiary, quaternary) and functions of proteins. Denaturation and renaturation of proteins.
3. Classification structure and properties of saturated and unsaturated fatty acids.

Unit-II- Nucleic acid, Vitamins, and Bioenergetics

1. Structure and functions of DNA and RNA.
2. Source, structure, biological role, and deficiency manifestation of vitamin A, B, C, D, E, and K. Free energy, entropy, enthalpy, and redox potential.
3. High energy compounds, Electron-Transport System and Oxidative Phosphorylation.

Unit-III-Centrifugation, Chromatography, and Electrophoresis

1. Basic principles of sedimentation and types of centrifugations.
2. Principle, instrumentation, and application of partition, absorption, paper, TLC, ion exchange, gel permeation, and affinity chromatography.
3. Basic principles and types of electrophoresis, factors affecting electrophoretic migration. PAGE (Native, SDS-PAGE). Introduction to 2D & Isoelectric Focusing.

Unit - IV-Spectroscopy, Microscopy and Laser Techniques

1. Beer-Lambert law, light absorption and transmission. Extinction coefficient, Design and application of photoelectric calorimeter and UV-visible spectrophotometer. Introduction to crystallography and application.
2. Types and design of microscopes - compound, phase contrast, fluorescent electron microscopy (TEM, SEM).
3. Introduction to radioisotopes, measurement of radioactivity (scintillation counter and autoradiography

Unit –V- Biostatistics

1. Mean, median, mode, standard deviation,
2. One-way ANOVA, Two-way Anova
3. t-test, F-test and chi-square.

III . Skills Outcome

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

1. learn about basic instruments and their operation
2. learn about Qualitative and Quantitaive analysis of carbohydrates
3. Learn about estimations nucleic acids and protein by various methods
4. learn about the separation of molecules by chromatography and electrophoresis
5. Learn about problems on mean median mode

SEMESTER-II

COURSE 1: BIOMOLECULES AND ANALYTICAL TECHNIQUES

Practical Credits: 1 2 hrs/week

1. Introduction to basic instruments (Principle standard operation procedure) demonstration and record
2. Calculation of molarity, normality, and molecular weight of compounds.
3. Qualitative analysis of carbohydrates (sugars)
4. Quantitative analysis of carbohydrates
5. Quantitative estimation of protein - Lowery method
6. Estimation of DNA by diphenylamine reagent
7. Estimation of RNA by orcinol reagent
8. Assay of protease activity
9. Preparation of starch from potato and its hydrolyze by salivary amylase
10. Preparation of standard buffer and pH determination
11. Separation of amino acids by paper chromatography
12. Separation of lipids of TLC
13. Agarose gel electrophoresis
14. Calculation of mean, median and mode

V. REFERENCES

1. Outlines of Biochemistry, 5th Edition, (2009), Erice Conn & Paul Stumpf; John Wiley and Sons, USA
2. Principles of Biochemistry, 4th edition, (1997), Jeffory Zubey; McGraw-Hill College, USA
3. Principles of Biochemistry, 5th Edition (2008), Lehninger, David Nelson & Michael Cox; W.H. Freeman and Company, NY
4. Fundamentals of Biochemistry, 3rd Edition (2008), Donald Voet & Judith Voet; John Wiley and Sons, Inc. USA
5. Biochemistry, 7th Edition, (2012), Jeremy Berg & Lubert Stryer; W.H.Freeman and Company, NY
6. An Introduction to Practical Biochemistry, 3rd Edition, (2001), David Plummer; Tata McGraw Hill Edu. Pvt.Ltd. New Delhi, India
7. Biochemical Methods,1st Edition, (1995), S.Sadashivam, A.Manickam; New Age International Publishers, India
8. Textbook of Biochemistry with Clinical Correlations, 7th Edition, (2010), Thomas M. Devlin; John Wiley and Sons, USA
9. Proteins: biotechnology and biochemistry, 1st edition, (2001), Gary Walsch; Wiley, USA
10. Biochemical Calculations, 2nd Ed., (1997), Segel Irvin H; John Wiley and Sons, NY
11. Biophysical Chemistry Principles & Techniques Handbook, (2003), A. Upadhyay, K. Upadhyay, and N. Nath

12. Enzymes: Biochemistry, Biotechnology & Clinical chemistry, (2001), Palmer Trevor, Publisher: Horwood Pub. Co., England.
13. Analytical Biochemistry, 3rd edition, (1998), David Holmes, H.Peck, Prentice-Hall, UK
14. Introductory Biostatistics, 1st edition, (2003), Chap T. Le; John Wiley, USA.
15. Methods in Biostatistics, (2002), B. K. Mahajan –Jaypee Brothers.
16. Statistical methods in biology, (1995), Bailey, N. T.; Cambridge university press

VI. CO-Curricular Activities

a) **Suggested C0-Curricular Activities**

1. Assignments
2. Seminars, Group Discussions on related topics
3. Charts preparation on vitamins

SEMESTER-III

COURSE 2: PLANT AND ANIMAL 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 plant tissue culture techniques and secondary metabolites production.

2. Learn about transgenesis and molecular markers.

3. Learn about animal tissue culture techniques

4. Learn about transgenic animals and gene therapy.

5. Learn about Bioethics, Biosafety and IPR.

II. Syllabus

Unit – I Plant tissue culture techniques & secondary metabolites production

1. totipotency, media preparation – nutrients and plant hormones; sterilization techniques; establishment of cultures – callus culture, cell suspension culture
2. applications of tissue culture-micro propagation; Somatic embryogenesis
3. synthetic seed production; protoplast culture and somatic hybridization - applications. Cryopreservation, Plant secondary metabolites- concept and their importance

Unit – II Transgenesis and Molecular markers

1. Plant transformation technology—Agrobacterium-mediated Gene transfer (Ti plasmid), hairy root features of Ri plasmid, Transgenic plants as bioreactors.
2. Herbicide resistance – glyphosate, Insect resistance- Bt cotton
3. Molecular markers - RAPD, RFLP and DNA fingerprinting-principles and applications.

Unit – III Animal tissue culture techniques

1. cell culture media and reagents; culture of mammalian cells, tissues and organs; primary culture, secondary culture, cell lines,stem cell cultures;
2. Tests: cell viability and cytotoxicity, Cryopreservation.
3. Transfection methods (calcium phosphate precipitation, electroporation, Microinjection) and applications.

Unit – IV Transgenic animals & Gene Therapy

1. Production of vaccines, diagnostics, hormones and other recombinant DNA products in medicine (insulin,somatostatin, vaccines),IVF,
2. Concept of Gene therapy,
3. Concept of transgenic animals – Merits and demerits -Ethical issues in animal biotechnology

Unit V Bioethics, Biosafety and IPR

1. Bioethics in cloning and stem cell research, Human and animal experimentation, animal rights/welfare.
2. Bio safety-introduction to biological safety cabinets; primary containment for biohazards; biosafety levels; GLP,GMP
3. Introduction to IP-Types of IP: patents, trademarks & copyright

III . Skills Outcome

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

1. Learn about different plant tissue media
2. Learn about the induction of callus from explants
3. Learn about plant propagation of through various tissue culture
4. Learn about cell lines
5. Learn about cell viability by various methods

SEMESTER-III

COURSE 2: PLANT AND ANIMAL BIOTECHNOLOGY

Practical Credits: 1 2 hrs/week

1. plant culture media and composition of MS media
2. Raising of aseptic seedlings
3. Induction of callus from different explants
4. Plant propagation through Tissue culture (shoot tip and Nodal culture)
5. Establishing a plant cell culture (both in solid and liquid media)
6. suspension cell culture
7. Cell count by hemocytometer.
8. Establishing primary cell culture of chicken embryo fibroblasts.
9. Animal tissue culture – maintenance of established cell lines.
10. Animal tissue culture – virus cultivation.
11. Estimation of cell viability by dye exclusion (Trypan blue).
12. ELISA – Demonstration

V. REFERENCES

1..Introduction to Plant Tissue Culture..M.K. Razdan ,2003,Science Publishers

2.Plant Tissue Culture, kalyan Kumar De,199 M7,New Central Book Agency

3.Plant Tissue Culture : Theory and Practice By S.S. Bhojwani and A. Razdan,1998

4. Biotechnology – By U. Satyanarayana ;1997

5. Plant Cell, Tissue and Organ Culture, Applied and Fundamental Aspects By Y.P.S. Bajaj and A. Reinhard ,2001

6. Introduction to Plant Tissue Culture,M. K. Razdan, 2003,Science Publishers

7. A Textbook of Biotechnology,R C Dubey,S. 2014,Chand Publishing

8. Elements of Biotechnology,P. K. Gupta, 1994,Rastogi Publications

9. R. Ian Freshney, "Culture of animal cells – A manual of basic techniques" 4th edition, John Wiley & Sons, 2000 ,Inc, publication, New York

10. Daniel R. Marshak, Richard L. Gardner, David Gottllieb "Stem cell Biology" edited by Daniel 2001,Cold Spring Harbour Laboratory press, New York

11. M.M. Ranga, Animal Biotechnology; Agrobios (India) ,2006.

VI. CO-Curricular Activities

a) **Suggested C0-Curricular Activities**

1. Assignments
2. Seminars, Group Discussions on related topics
3. Charts on different medias
4. Visit to plant tissue culture lab

SEMESTER-IV

COURSE 3: IMMUNOLOGY

Theory Credits: 3 3 hrs/week

I. LEARNING OUTCOMES

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

1. Learn about types of immunity and cells of immunity
2. Learn about Antigen and Antibody
3. Learn about cell , humoral immunity and MHC molecules
4. Learn about Hypersensitivity and vaccines
5. Learn about immunological techniques

II. Syllabus

UNIT I Immune system:

1. History and scope of immunology, cells of imthe mune system -Tcells , B cells
2. Immunity, innate immune mechanism, Acquired immune mechanism
3. Organs of the immune system (Bone marrow, spleen thymus MALT)

UNIT II Antibody and Antigen:

1. Antibody structure and classes(Ig G,Ig M Ig A Ig E I g D , Antibody diversity
2. Antigen -Types of Antigens Antigenicity (factors affecting antigenicity).
3. Antigenic determinants – adjuvants and haptens , epitopes

UNIT III Immunity:

1. Humoral immunity, cell-mediated immunity -TC-mediated immunity, NK cell-mediated immunity, ADCC,
2. brief description of cytokines , Interleukins
3. Major histocompatibility complex (MHC)-Structure and Functions of Class I ,II , MHC Molecules

UNIT IV Hypersensitivity and vaccination :

1. General features of hypersensitivity, various types of hypersensitivity,
2. Vaccination: Discovery, principles, significance,
3. Types of Vaccines -live, attenuated, killed , recombinant, subunit

UNIT V Immunological Techniques

1. Antigen-antibody reactions: Precipitation, agglutination, complement fixation, immunodiffusion, - Radial immune diffusion, ouchterlony , double immune diffusion
2. Hybridoma technology: Monoclonal antibodies and their applications in immunodiagnosis.
3. ELISA , RIA , immunoelectrophoretic , Rocket electrophoresis

III . Skills Outcome

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

1. Learn about the determination of blood group
2. Learn about immunodiffusion methods
3. Learn about production of antibodies

SEMESTER-IV

COURSE 3: IMMUNOLOGY

Practical Credits: 1 2 hrs/week

IV . Practical Syllabus: Hours 2 hours per week = 30 hours

1. Antigen – antibody reaction – determination of Blood group , Cross reactivity
2. Pregnancy test
3. Widal test
4. Ouchterloney immunodiffusion
5. Radial immunodiffusion
6. ELISA
7. Isolation of casein by isoelectric precipitation
8. Production of antibodies and their titration

V. REFERENCES

1. Kuby immunology, Judy Owen, Jenni Punt, Sharon Stranford., 7th edition (2012), Freeman and Co., NY
2. Textbook of basic and clinical immunology, 1st edition (2013), Sudha Gangal and Shubhangi Sontakke, University Press, India
3. Immunology, 7th edition (2006), David Male, Jonathan Brostoff, David Roth, Ivan Roitt, Mosby, USA.
4. Immuno diagnostics, 1996, By S.C. Rastogi, Publ: New Age
5. Introduction to Immunology- 2002, C. V. Rao- Narosa Publishing House

VI. CO-Curricular Activities

a) **Suggested C0-Curricular Activities**

1. Assignments
2. Seminars, Group Discussions on related topics
3. Charts on cell mediated immunity
4. Models on antibodies

SEMESTER-IV

COURSE 4: BIOINFORMATICS AND BIOSTATISTICS

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 branches of bioinformatics
2. Learn about searching sequences using databases
3. Learn about computer phylogenetics
4. Learn about the measurement of central tendency
5. Learn about test hypothesis

II. Syllabus

UNIT – I

1. Scope of computers in biological research, Introduction to Bioinformatics: Definition, nature and scope of bioinformatics.
2. Bioinformatics versus computational biology.
3. Branches of bioinformatics. Basic concepts in bioinformatics.

UNIT – II

1. Basic concepts of system biology. Protein Data Bases -visualization of proteins using database
2. Overview of computer-aided drug design.
3. Searching sequence database using BLAST. Concept of genomics and proteomics

UNIT – III

1. Computational phylogenetics – various applications.
2. Phy lip software. Microarray,
3. Bio informatics – Experimental design & Over view of data analysis.

UNIT – IV

1. Measurement of central tendency (mean, mode and range)
2. Dispersion (standard error and standard deviation).
3. Probability and distribution. Poisson and binomial distributions. Normal distribution

UNIT – V

1. Population and sampling test of significance. Test hypothesis.
2. Student t-test for small samples. ANOVA ,Chi^2 test for analysis, correlation and regression.
3. Computer applications in Biotechnology

III . Skills Outcome

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

1. Learn about problems of mean median mode
2. Learn about test hypothesis
3. Learn about sequence Retrieval from NCBI

SEMESTER-IV

COURSE 4: BIOINFORMATICS AND BIOSTATISTICS

Practical Credits: 1 2 hrs/week

1. Mean, Median, Mode
2. Standard deviation, variance and coefficient of variation
3. Testing of hypotheses regarding population mean
4. Testing of hypotheses about the difference between population means
5. Chi-square test
6. Testing of Correlation Coefficient
7. Fitting of simple linear regression
8. Sequence retrieval (protein and gene) from NCBI, Structure download (protein and DNA) from PDB

V. REFERENCES

1. Fowler, J., Cohen, L. and Jarvis, P. (1998). Practical Statistics for Field Biology. John Wiley and Sons, 2nd ed. .
2. Bland, M. (2006). An Introduction to Medical Statistics. Oxford University Press, 3rd ed.
3. Finney, D.J. (1980). Statistics for Biologists.Chapman and Hall Ltd.
4. Wayne, W, Daniel (1999). Biostatistics: A Foundation for Analysis in Health Sciences. John Wiley and Sons, 7th ed.

VI. CO-Curricular Activities

a) **Suggested C0-Curricular Activities**

1. Assignments
2. Seminars, Group Discussions on related topics
3. Charts on data bases

SEMESTER-V

COURSE 5: 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 5: 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 6: 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 6: 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