केंद्रीय जनजातीय विश्वविद्यालय आंध्रप्रदेश

CENTRAL TRIBAL UNIVERSITY OF ANDHRA PRADESH

(A CENTRAL UNIVERSITY ESTABLISHED BY AN ACT OF PARLIAMENT)

CURRICULUM & SYLLABUS

Ph.D.

[Duration: 3 years]

(As per National Education Policy 2020)

w.e.f. 2023-24 admitted batch

DEPARTMENT OF BOTANY

SCHOOL OF SCIENCES

CENTRAL TRIBAL UNIVERSITY OF ANDHRA PRADESH

VIZIANAGARAM – 535003, A.P.

SECTION- A

Research Methodologies (50 MCQs – 50 marks)

1.An overview of research methodology: Research concept, steps involved, identification, selection and formulation of research problem, justification, hypothesis; literature collection- textual and digital resources (internet)

2.Research design, data collection and interpretation: Research design; sampling techniques, collection and documentation, presentation, analysis and interpretation of data

3.Literature Review: Purpose and importance of reviewing existing literature, Methods for searching and reviewing literature, Developing theoretical and conceptual frameworks, Writing and presenting literature reviews effectively

4.Scientific writing: Structure and components of a research paper, Manuscript preparation and presentation, Forms of scientific writing- Article, notes, reports, review article, monographs, dissertations, popular science articles, Referencing styles and citation methods, Ethical considerations in research publication

5.Formulation of scientific communication: Outline preparation, drafting title, sub titles, tables, illustrations; Formatting tables- title, body footnotes, Figures & graphs- structure, Title and legends, Impact factor, Citation indices, Plagiarism

6.Computer application: MS office, excel, power point, graphics (Sigma plot), statistical software (SPSS)

7.Biostatistics: Statistical Methods, Measures of central tendency and dispersal, probability distributions (Binomial, Poisson and normal), Sampling distribution, Difference between parametric and non-parametric statistics,Descriptive statistics: mean, variance, standard deviation, standard errorConfidence Interval, Errors, Levels of significance, Regression and Correlation, t-test;chi-square tests, one-way and two-wayANOVA, Analysis of variance, Basic introduction to Multivariate statistics, etc.

8.Sampling techniques and data collection: Introduction to sampling and sample design, Types of sampling methods (random, stratified, cluster), Sampling errors and sample size determination, Primary data collection (surveys, interviews, questionnaires, case studies), Secondary data collection (existing data sources), Selection of appropriate data collection methods

9.Subject-Specific Research Methodology

Plant Tissue Culture Techniques (Media preparation, sterilization, callus induction, regeneration protocols), Herbarium Techniques (Collection, preservation, and identification of plant specimens), Microscopy Techniques (Light microscopy, electron microscopy, fluorescence microscopy), Biochemical Analysis Methods (Chromatography, electrophoresis, spectroscopy), Molecular Biology Techniques (PCR, gel electrophoresis, DNA/RNA extraction).

SECTION- B

Subject Specific Knowledge (50 MCQs – 50 marks)

1. MOLECULES AND THEIR INTERACTION RELAVENT TO BIOLOGY

A. Structure of atoms, molecules and chemical bonds.

B Composition, structure and function of biomolecules (carbohydrates, lipids, proteins, nucleic acids and vitamins).

C. Stablizing interactions (Van der Waals, electrostatic, hydrogen bonding, hydrophobic interaction, etc.).

D Principles of biophysical chemistry (pH, buffer, reaction kinetics, thermodynamics, colligative properties).

E. Bioenergetics, glycolysis, oxidative phosphorylation, coupled reaction, group transfer, biological energy transducers.

F. Principles of catalysis, enzymes and enzyme kinetics, enzyme regulation, mechanism of enzyme catalysis, isozymes

G. Conformation of proteins (Ramachandran plot, secondary structure, domains, motif and folds).

H. Conformation of nucleic acids (helix (A, B, Z), t-RNA, micro-RNA).

I. Stability of proteins and nucleic acids.

J. Metabolism of carbohydrates, lipids, amino acids nucleotides and vitamins.

2. CELLULAR ORGANIZATION

A. **Membrane structure and function :** Structure of model membrane, lipid bilayer and membrane protein diffusion, osmosis, ion channels, active transport, membrane pumps, mechanism of sorting and regulation of intracellular transport, electrical properties of membranes.

B. **Structural organization and function of intracellular organelles :** Cell wall, nucleus, mitochondria, Golgi bodies, lysosomes, endoplasmic reticulum, peroxisomes, plastids, vacuoles, chloroplast, structure & function of cytoskeleton and its role in motility.

C. **Organization of genes and chromosomes :** Operon, unique and repetitive DNA, interrupted genes, gene families, structure of chromatin and chromosomes. heterochromatin, euchromatin, transposons.

D. **Cell division and cell cycle :** Mitosis and meiosis, their regulation, steps in cell cycle, regulation and control of cell cycle.

E. **Microbial Physiology** :Growth yield and characteristics, strategies of cell division, stress response

3. **FUNDAMENTAL PROCESSES**

A. **DNA replication, repair and recombination,** Unit of replication, enzymes involved, replication origin and replication fork, fidelity of replication, extrachromosomal replicons, DNA damage and repair mechanisms, homologous and site-specific recombination.

B. **RNA synthesis and processing** transcription factors and machinery, formation of initiation complex, transcription activator and repressor, RNA polymerases, capping, elongation, and termination, RNA processing. RNA editing, splicing, and polyadenylation, structure and function of different types of RNA, RNA transport.

C. **Protein synthesis and processing** Ribosome, formation of initiation complex, initiation factors and their regulation, elongation and elongation factors, termination, genetic code. aminoacylation of tRNA, RNA-identity, aminoacyl tRNA synthetase, and translational proof-reading, translational inhibitors, Post- translational modification of proteins.

D. **Control of gene expression** at transcription and translation level (regulating the expression of phages, viruses, prokaryotic and eukaryotic genes, role of chromatin in gene expression and gene silencing.

4. **DEVELOPMENTAL BIOLOGY**

A. **Basic concepts of development**: Potency, commitment, specification, induction, competence, determination and differentiation; morphogenetic gradients; cell fate and cell lineages; stem cells: genomic equivalence and the cytoplasmic determinants; imprinting: mutants and transgenics in analysis of development

B. **Morphogenesis and organogenesis** in plants: Organization of shoot and root apical meristem; shoot and root development; leaf development and phyllotaxy; transition to flowering. floral meristems and floral development in Arabidopsis and Antirrhinum

C. **Programmed cell death, aging and senescence** : Molecular mechanisms and importance in development.

5. SYSTEM PHYSIOLOGY - PLANT

A. **Photosynthesis**: Light harvesting complexes, mechanisms of electron transport, photoprotective mechanisms; CO_2 fixation-C3, C4 and CAM pathways.

B. **Respiration and photorespiration**: Citric acid cycle; plant mitochondrial electron transport and ATP synthesis; alternate oxidase; photorespiratory pathway

C. **Nitrogen metabolism**: Nitrate and ammonium assimilation; amino acid biosynthesis

D. **Plant hormones**: Biosynthesis, storage, breakdown and transport, physiological effects and mechanisms of action.

E.**Sensory photobiology**: Structure, function and mechanisms of action of phytochromes, cryptochromes and phytotropins; stomatal movement, photoperiodism and biological clocks.

F.**Solute transport and photoassimilate translocation**: uptake, transport and translocation of water, ions, solutes and macromolecules from soil, through cells, across membranes, through xylem and phloem; transpiration; mechanisms of loading and unloading of photoassimilates.

G.**Secondary metabolites** Biosynthesis of terpenes, phenols and nitrogenous compounds and their roles.

H. **Stress physiology** - Responses of plants to biotic (pathogen and insects) and abiotic (water, temperature and salt) stresses.

6. GENETICS

A. **Mendelian principles**: Dominance, segregation, independent assortment.

B. **Concept of gene**: Allele, multiple alleles, pseudoallele, complementation tests

C. **Extensions of Mendelian principles**: Codominance, incomplete dominance, gene interactions, pleiotropy, genomic imprinting, penetrance and expressivity, phenocopy. linkage and crossing over, sex linkage, sex limited and sex influenced characters.

D. **Gene mapping methods**: Linkage maps, tetrad analysis, mapping with molecular markers. mapping by using somatic cell hybrids, development of mapping population in plants.

E. **Extra chromosomal inheritance**: Inheritance of Mitochondrial and chloroplast genes. maternal inheritance.

F. **Microbial genetics**: Methods of genetic transfers - transformation, conjugation, transduction and sex-duction, mapping genes by interrupted mating, fine structure analysis of genes.

G. **Quantitative genetics:** Polygenic inheritance, heritability and its measurements, QTL mapping.

H. **Mutation:** Types, causes and detection, mutant types lethal, conditional, biochemical, loss of function, gain of function, germinal verses somatic mutants, insertional mutagenesis.

I. **Structural and numerical alterations of chromosomes**: Deletion, duplication, inversion, translocation, ploidy and their genetic implications.

J. **Recombination**: Homologous and non-homologous recombination including transposition.

7. DIVERSITY OF LIFE FORMS

A. **Principles & methods of taxonomy:** Concepts of species and hierarchical taxa, biological nomenclature, classical & quantititative methods of taxonomy of plants, animals and microorganisms.

B**. Levels of structural organization:** Unicellular, colonial and multicellular forms. Levels of organization of tissues, organs & systems. Comparative anatomy, adaptive radiation, adaptive modifications.

C**. Outline classification of plants, animals & microorganisms:** Important criteria used for classification in each taxon. Classification of plants. animals and microorganisms. Evolutionary relationships among taxa.

D**. Natural history of Indian subcontinent:** Major habitat types of the subcontinent, geographic origins and migrations of species. Comman Indian mammals, birds. Seasonality and phenology of the subcontinent.

E**. Organisms of health & agricultural importance**: Common parasites and pathogens of humans, domestic animals and crops.

F**. Organisms of conservation concern:** Rare, endangered species. Conservation strategies.

8. ECOLOGICAL PRINCIPLES

A.**The Environment**: Physical environment, biotic environment, biotic and abiotic interactions.

B.**Habitat and Niche**: Concept of habitat and niche, niche width and overlap, fundamental and realized niche; resource partitioning; character displacement.

C.**Population Ecology**: Characteristics of a population; population growth curves, population regulation; life history strategies (r and K selection); concept of metapopulation demes and dispersal, interdemic extinctions, age structured populations.

D.**Species Interactions:** Types of interactions, interspecific competition, herbivory. carnivory, pollination, symbiosis.

E.**Community Ecology**: Nature of communities; community structure and attributes, levels of species diversity and its measurement, edges and ecotones.

F. **Ecological Succession:** Types; mechanisms; changes involved in succession, concept of climax.

G. **Ecosystem Ecology:** Ecosystem structure; ecosystem function; energy flow and mineral cycling (C.N.P); primary production and decomposition, structure and function of some Indian ecosystems: terrestrial (forest, grassland) and aquatic (fresh water, marine, eustarine).

H. **Biogeography:** Major terrestrial biomes; theory of island biogeography; biogeographical zones of India.

I. **Applied Ecology:** Environmental pollution; global environmental change; biodiversity: status, monitoring and documentation; major drivers of biodiversity change, biodiversity management approaches.

J.**Conservation Biology**: Principles of conservation, major approaches to management, Indian case studies on conservation/management strategy (Project Tiger, Biosphere reserves).

9. MORPHOLOGY AND ANATOMY

A. **Structural organization of reproductive parts**

Inflorescence: Introduction and definition, Types of inflorescences (Racemose, Cymose and Special types -Verticillaster, Cyathium and Hypanthodium), Significance.

Flower: Introduction and definition, Parts of a typical flower, Symmetry, Floral whorls (Calyx, Corolla, Perianth, Androecium, Gynoecium)

Fruits: Introduction and definition, Types of fruits (Simple, Fleshy, Aggregate, Multiple fruits)

B. **Tissues, Organs and special tissues**: Diversity in plant forms – annuals, biennials and perennials; Tissues- meristematic and permanent (simple and complex); The Shoot system- shoot apical meristem and its histological organizations (monocot and dicot stem); Cambium-structure and functions, Secondary growth in dicot stem; characteristics of growth rings; sap wood and heart wood, periderm; Anomalous secondary growth (Dracaena, Boerhaavia and Achyranthes)

C. **Physiology, Morphology and anatomy**: Leaf-types of leaves (simple and compound), phyllotaxy; Epidermis-uniseriate and ultiseriate, epidermal appendages and their morphological types; Anatomy of typical Monocot and Dicot leaf and cell inclusions in leaves, leaf abscission; Stomatal apparatus and their morphological types; Root system- the root apical meristem, the histological organization (monocot and dicot root); Secondary growth in dicot root, Structural modifications in roots-storage (Beta), Respiratory (Rhizophora), Epiphytic (Vanda).

10. APPLIED BIOLOGY

A. Microbial fermentation and production of small and macro molecules.

B. Application of immunological principles, vaccines, diagnostics. Tissue and cell culture methods for plants and animals.

C. Transgenic animals and plants, molecular approaches to diagnosis and strain identification.

D. Genomics and its application to health and agriculture, including gene therapy.

E. Bioresource and uses of biodiversity.

F. Breeding in plants and animals, including marker-assisted selection

G. Bioremediation and phytoremediation

H. Biosensors

11.METHODS IN BIOLOGY

A. **Molecular Biology and Recombinant DNA methods:**

Isolation and purification of RNA, DNA (genomic and plasmid) and proteins, different separation methods.

Analysis of RNA, DNA and proteins by one and two dimensional gel electrophoresis, Isoelectric focusing gels.

Molecular cloning of DNA or RNA fragments in bacterial and eukaryotic systems. Expression of recombinant proteins using bacterial, animal and plant vectors.

Isolation of specific nucleic acid sequences

Generation of genomic and cDNA libraries in plasmid, phage, cosmid, BAC and YAC vectors.

In vitro mutagenesis and deletion techniques, gene knock out in bacterial and eukaryotic organisms.

Protein sequencing methods, detection of post translation modification of proteins.

DNA sequencing methods, strategies for genome sequencing.

Methods for analysis of gene expression at RNA and protein level, large scale expression, such as micro array based techniques Isolation, separation and analysis of carbohydrate and lipid molecules RFLP. RAPD and AFLP techniques

B. **Histochemical and Immunotechniques**

Antibody generation, Detection of molecules using ELISA, RIA, western blot, immunoprecipitation, fluocytometry and immunofluorescence microscopy. detection of molecules in living cells, in situ localization by techniques such as FISH and GISH.

C. **Biophysical Method:**

Molecular analysis using UV/visible, fluorescence, circular dichroism, NMR and ESR spectroscopy Molecular structure determination using X-ray diffraction and NMR, Molecular analysis using light scattering, different types of mass spectrometry surface plasma resonance methods.

D. **Statisitcal Methods:**

Measures of central tendency and dispersal; probability distributions (Binomial, Poisson and normal); Sampling distribution; Difference between parametric and non-parametric statistics; Confidence Interval: Errors: Levels of significance: Regression and Correlation; t-test; Analysis of variance; X^2 test;: Basic introduction to Muetrovariate statistics, etc.

E. **Radiolabeling techniques:**

Detection and measurement of different types of radioisotopes normally used in biology, incorporation of radioisotopes in biological tissues and cells, molecular imaging of radioactive material, safety guidelines.

F. **Microscopic techniques:**

Visulization of cells and subcellular components by light microscopy, resolving powers of different microscopes, microscopy of living cells, scanning and transmission microscopes, different fixation and staining techniques for EM, freeze-etch and freeze-fracture methods for EM, image processing methods in microscopy.

G. **Electrophysiological methods:**

Single neuron recording, patch-clamp recording, ECG, Brain activity recording, lesion and stimulation of brain, pharmacological testing, PET, MRI, IMRI, CAT.

H. **Methods in field biology:**

Methods of estimating population density of animals and plants, ranging patterns through direct, indirect and remote observations, sampling methods in the study of behavior, habitat characterization: ground and remote sensing methods.

11. TRADITIONAL KNOWLEDGE SYSTEM

A. **Introduction to traditional knowledge**: Definition, characteristics, scope and importance, kinds of traditional knowledge, TK in agriculture and healthcare.

B. **Protection of traditional knowledge**: The need for protecting traditional knowledge, Significance of TK Protection, value of TK in global economy, Role of Government to harness TK.

C. **Legal framework and TK:** The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006, Plant Varieties Protection and Farmer's Rights Act, 2001 (PPVFR Act); The Biological Diversity Act 2002 and Rules 2004, the protection of traditional knowledge bill, 2016.

D. **Traditional knowledge and intellectual property**: Systems of traditional knowledge protection, Legal concepts for the protection of traditional knowledge, Patents and traditional knowledge, Strategies to increase protection of traditional knowledge.

E. **Indian Traditional Medicine Systems**

Introduction to Medicinal Plants, Ayurveda, Siddha, Unani & Homeopathy Systems and

Traditional Formulations, Important Medicinal and Aromatic Plants mentioned in ancient texts.