

ENTRANCE TEST SYLLABUS FOR INTEGRATED Ph.D. PROGRAMME IN BIORESOURCES 2018

Unit: A (PLANT RESOURCES)

- A. Origin of agriculture; World centres of origin and domestication of cultivated plants as proposed by de Candolle and Vavilov; Green revolution.
- B. Origin and cultivation of major cereals (rice, wheat, maize); cultivation and nutritional importance of buckwheat (*Fagopyrum* spp.), Origin and cultivation of saffron.
- C. **Extractives:** Important plant sources of gums, resins, dyes and tannins,
- D. **Medicinal plants of Kashmir Himalaya:** Ethnobotanical and medicinal importance of *Arnebia benthamii*, *Aconitum heterophyllum*, *Atropa acuminata*, *Podophyllum hexandrum*, *Saussurea costus*, *Rheum emodi*, *Digitalis purpurea*, *Valeriana jatamansii*, *Viola odorata*, *Picrorhiza kurroa*, *Dioscorea deltoidea* and *Hippophae rhamnoides*.
- E. **Genetically modified crops:** Transgenics for biotic and abiotic stress (insect, virus and herbicide resistance); modification of plant nutritional content (vitamins, aminoacids, lipids, Iron); transgenic plants for the production of biochemicals— edible vaccines and secondary metabolites, GMO's— ecological and ethical concerns.

Unit: B (ANIMAL RESOURCES)

- A. **Insect resources:** Importance and scope of insect based industries; Silkworm breeds, synthesis of silk, By-products of sericulture; Scope and importance of apiculture, Properties and uses of honey, Factors affecting honey yield; By-products of apiculture and apitherapy. Edible insect industry.
- B. **Aquaculture:** Fish monoculture, polyculture and composite culture; Integration of aquaculture with agriculture and animal husbandry; Natural and artificial breeding in fish; Genetic approach to fisheries (cross breeding, inbreeding and hybridization); Fish as a food commodity; Fish by-products.
- C. **Livestock domestication:** History of domestication; Important breeds of livestock (cow, sheep, goat) and poultry with special reference to economic characters; Important methods of selection and systems of breeding in farm animals and poultry birds.
- D. **Animal products and processing:** Principles and practices for production of high quality milk; Pasteurization and sterilization; Utilization of various animal and poultry by-products: Use of biotechnological tools in improving animal productivity

Unit: C (MICROBES AND MICROBIAL RESOURCES)

- A. **Microbial resources-** historical perspective; Types of microbial resources (algal, fungal, bacterial, viral); Morphology and ultrastructure of bacteria and viruses (bacteriophages); Microbial growth and growth curve.
- B. **Culturing of Microbes:** Isolation and screening of microorganisms; Nutritional requirements and factors affecting microbial growth (pH, temperature, water, oxygen, CO₂); Storage and transportation of microbes.
- C. **Fermentation Technology:** Types of fermentation (aerobic, anaerobic), fermenters and their types, substrates for fermentation; Role of enzymes in various fermentation processes.
- D. **Economic importance of microbes:** Major commercial microbial products (amino acids, enzymes, steroids, therapeutic agents and biopolymers); Single cell proteins;

Role of microbes in bioremediation; Microbes as bioindicators; Biodefense and bioterrorism;

- E. **Role of microbes in food production:** Role of microorganisms in food production and beverages (wine, beer, bread, cheese); Major commercial microbial products (amino acids, enzymes, steroids and biopolymers). Microbes as sources of antibiotics and therapeutic agents.

Unit: D (BIODIVERSITY CONSERVATION AND UTILIZATION)

- A. **Biodiversity:** components, levels & values of biodiversity; present status of global biodiversity; Mega-biodiversity countries; Global biodiversity hotspots; Biodiversity monitoring— global biodiversity targets and indicators.
- B. **Loss of biodiversity:** species extinction (causes & methods of estimation); IUCN threatened categories (concept & criteria).
- C. **Conservation biology:** principles, practices & characteristics; *in-situ* and *ex situ* conservation strategies; global and national conservation efforts (initiatives & organizations); biogeographical zones of India.
- D. **Bioprospecting:** Concept and methods of bioprospecting; Biopiracy; Traditional Knowledge Digital Library (TKDL).
- E. **Bioenergy;** Biofuels (concept and classification); biodiesel production by transesterification; algae as a source of biodiesel; bioethanol; lignocellulosic biomass as feedstock for ethanol production; biohydrogen production by green algae and cyanobacteria; artificial photosynthesis; Bioenergy crops.
- F. **Sustainable agriculture:** biofertilizers, bacterial biofertilizers— morphology, life cycle, and methods of application of *Azotobacter*, *Rhizobium* and *Frankia*. Azolla-anabaena as biofertilizers, mycorrhizas (types and role); Biopesticides- types, Integrated Pest Management.

Unit: E (PLANT RESOURCE REGENERATION)

- A. **Gametogenesis, fertilization and early development:** production of gametes; embryosac development and double fertilization in plants; zygote formation; embryogenesis; seed formation and germination.
- B. **Pollination, Pollen pistil interactions:** pollination mechanisms and vectors, breeding systems, pollen stigma interactions, sporophytic and gametophytic self incompatibility.
- C. **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*.
- D. **In-vitro Regeneration:** Cellular totipotency; Micro propagation- cell and organ differentiation, Somatic embryos, synthetic seeds; Advantages of Micropropagation; Somaclonal variation; Production of haploids (anther and ovule culture); protoplast culture, cytoplasmic hybrids or cybrids; Plant growth regulators in tissue culture.

Unit: F (ANIMAL RESOURCE REGENERATION)

- A. **Principles of animal development:** Basic concepts of animal development- potency, commitment, specification, induction, competence, determination and differentiation; Morphogenetic gradients; Genomic equivalence and the cytoplasmic determinants; Genomic Imprinting.
- B. **Early embryonic development:** Gametogenesis (Spermatogenesis and Oogenesis); Types of eggs, fertilization and blocks to polyspermy. Mechanism of cleavage;

- Blastulation, Gastrulation and formation of germ layers. Fat maps of germinal layers.
- C. **Morphogenesis and organogenesis:** Axis and pattern formation in *Drosophila* and amphibia; Eye lens induction, limb development and regeneration in vertebrates; Environmental regulation of normal development.
 - D. **Hormones in Embryonic Development:** Physiological anatomy of the male and female sexual organs. Testosterone and other male sex hormones, ovarian cycle and functions of the ovarian hormones. Hormonal factors in pregnancy.
 - E. **Animal cell and tissue culture:** Culture media, culture procedures and techniques; Transfection, targeted transfection, transient and stable transfections; Large scale culture of cell lines for production of biomolecules (viral vaccines, interferons, recombinant proteins and hybrid antibodies).

Unit: G (IMMUNOLOGY AND BIOSIGNALLING)

- A. **Biosignaling:** General features of signal transduction pathways; diversity of basic signaling cascades (brief idea) with emphasis on protein kinases, phosphoinositides, G-protein complex and Calcium mediated signaling.
- B. **Antigen, antibody and cytokines:** Antigen and its types (Super antigens, Immunogens, haptens, allergens, tollerogens, allo-antigens, tumor antigens, auto antigens, TD and TI antigens) antibody structure, isoforms of antibodies, types of antibodies; digestion of antibodies and antibody fragments; cytokines and interferons.
- C. **Applied Immunology:** AIDS (disease characteristics, clinical manifestation and laboratory diagnosis of AIDS), allergic disorders (introduction, diagnosis and clinical manifestations), aeroallergens (identification, isolation and impact on human health); Role of immunotherapy in allergic disorders.
- D. **Immunodiagnosics and Serological techniques:** Blood grouping; Rh typing; immuno electrophoresis; enzyme linked immune-sorbent assay (ELISA); theory and principles of routine clinical immunology procedures; materials and methods necessary for basic serological tests (collection, preparation and preservation of specimen), HCG and pregnancy, pregnancy test, factors affecting pregnancy tests.

Unit: H (MOLECULES AND THEIR INTERACTION)

- A. Composition, structure and function of biomolecules (carbohydrates, lipids, proteins and nucleic acids); Properties of water.
- B. Principles of biophysical chemistry (pH, buffer, reaction kinetics, thermodynamics colligative properties).
- C. Principles of catalysis, enzymes and enzyme kinetics, enzyme regulation, mechanism of enzyme catalysis, isozymes.
- D. Conformation of proteins (primary, secondary, tertiary and quaternary structure; domains; motif and folds).
- E. Conformation of nucleic acids (A-, B-, Z-,DNA), t-RNA, micro-RNA).
- F. Biosynthesis and roles of terpenes, phenols and alkaloids; Plant pigments, classification; structure, biosynthesis and properties; Stress physiology: responses of plants to biotic (pathogen and insects) and abiotic (water, temperature and salt) stress, mechanisms of resistance to biotic stress and tolerance to abiotic stress.

Unit: I (CELLULAR ORGANIZATION)

- A. **Membrane structure and function:** structure of model membrane, lipid bilayer and membrane protein; membrane transport (diffusion, osmosis, ion channels, active transport, ion pumps), 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, interrupted genes, gene families, structure of chromatin and chromosomes, unique and repetitive DNA, heterochromatin, euchromatin, transposons.
- D. **Cell division and cell cycle:** mitosis and meiosis, their regulation, steps in cell cycle, and control of cell cycle.

Unit: J (NUCLEIC ACID SYNTHESIS AND GENE EXPRESSION)

- A. **DNA replication, repair and recombination:** unit of replication, enzymes involved, replication origin and replication fork, fidelity of replication, extra chromosomal replicons, DNA damage and repair mechanisms.
- B. **RNA synthesis and processing:** transcription factors and machinery, formation of initiation complex, transcription activators and repressors, RNA polymerases, capping, elongation and termination, RNA processing, splicing, polyadenylation, structure and function of different types of RNA.
- C. **Protein synthesis and processing:** ribosome, formation of initiation complex, initiation factors, elongation and elongation factors, termination, genetic code, aminoacylation of tRNA, aminoacyl tRNA synthetase, translational inhibitors, post-translational modification of proteins.
- D. **Control of gene expression at transcription and translation level:** regulation of prokaryotic and eukaryotic gene expression, role of chromatin in regulating gene expression and gene silencing.

Unit: K (INHERITANCE BIOLOGY)

- A. **Mendelian principles:** dominance, segregation, independent assortment, deviation from Mendelian inheritance.
- B. **Concept of gene:** allele, multiple alleles, pseudoallele, complementation tests.
- C. **Extensions of Mendelian principles:** codominance, incomplete dominance, gene interactions, pleiotropy, phenocopy, linkage and crossing over, sex linkage, sex limited and sex influenced characters.
- D. **Microbial genetics:** methods of genetic transfers – transformation, conjugation, transduction and sex-duction.
- E. **Mutation:** types, causes and detection, mutant types – lethal, conditional, biochemical, loss of function, gain of function, germinal verses somatic mutants, insertional mutagenesis.
- F. **Structural and numerical alterations of chromosomes:** deletion, duplication, inversion, translocation, ploidy and their genetic implications.
- G. **Recombination:** homologous and non-homologous recombination, including transposition, site-specific recombination.
- H. **Population genetics:** populations, gene pool, gene frequency; Hardy-Weinberg law; concepts and rate of change in gene frequency through natural selection, migration and random genetic drift

Unit: L (METHODS IN BIOLOGY)

- A. **Molecular biology and recombinant DNA technology:** molecular cloning of DNA or RNA fragments in bacterial and eukaryotic systems; generation of genomic and

cDNA libraries in plasmid, phage, cosmid, BAC and YAC vectors; DNA sequencing methods, strategies for genome sequencing; RFLP, RAPD and AFLP techniques;

B. **Gene transfer methods:** Physical & chemical methods of gene transfer, *Agrobacterium* mediated gene transfer; large scale gene expression analysis, such as micro array based techniques.

C. **Proteomic analysis and Histochemical techniques:** Electrophoresis, techniques of southern and western blotting, flow cytometry and immunofluorescence microscopy, *in situ* localization by techniques such as FISH and GISH,

D. **Microscopic techniques:** concept of 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.
