

SYLLABUS FOR M. PHIL. BOTANY ENTRANCE EXAMINATION

Unit 1: Virology- Classification of viruses-ICTV and Baltimore System. Genome diversity in viruses. Mechanism of replication of DNA and RNA viruses. Viroids - Structure and multiplication; Prions - Structure and multiplication and Prion diseases, Phytoplasma. **Bacteriology-** Bergey's Manual of Determinative and Systematic Bacteriology; C R Woese Three domain classification of Bacteria. Archeobacteria and Eubacteria - Diversity and Evolution; Nutritional types of bacteria (Autotrophs, Heterotrophs and Symbionts); Growth of bacteria. Recombination in bacteria (Transformation, Transduction and Conjugation). Economic importance of bacteria. General characters of Actinomycetes and their economic importance. Structure and multiplication of Mycoplasma. **Mycology-** Classification of fungi. Thallus structure, spore producing organs. Nutrition in fungi- Saprotrophs, Biotrophs, Necrotrophs; Symbiotrophs. Methods of reproduction in fungi - Asexual, Sexual methods. Evolution of sex in fungi, Heterothallism and Parasexuality in fungi. **Plant Pathology-** Classification of plant diseases; Parasitism and Disease Development, Defense Mechanisms in Plants. Plant Disease Epidemics and Plant Disease forecasting. Methods of Plant disease management. Plant Diseases- Sandal Spike, Citrus canker, Bacterial Blight of Paddy, Late Blight of Potato, Downy Mildew of Bajra, , Tikka disease of ground nut, Grain smut of Sorghum. Phloem Necrosis of Coffee, Root Knot Disease of Mulberry.

Unit 2: Diversity and distribution of algae: Unicellular, colonial, filamentous, heterotrichous, parenchymatous, pseudoparenchymatous, siphonous forms in algal classes, General characteristics and phylogeny: **Pigmentation in algal groups:** Role of photosynthetic and accessory pigments, **Life cycles in algae:** Haplontic, diplontic, isomorphic, heteromorphic; Economic importance of algae. **Bryophytes:** Introduction, General characteristics, classification and phylogeny of Bryophytes; Distribution, habitat, External and Internal morphology and Reproduction; Comparative account of gametophytes and sporophytes of Bryophytes, Economic importance of Bryophytes. **Pteridophytes:** Introduction, Classification and phylogeny; Morphology, Anatomy Reproductive Biology and phylogeny: Psilophytes, Lycophytes, Sphenophytes, Filicophyta; Evolution of Sorus, Evolution of Sporangium; Gemetophyte

development- Homosporous and Heterosporous ferns; Heterospory and seed habit; Stellar evolution in Pteridophytes; Ecology of Pteridophytes; Economic importance. **Gymnosperms:** Introduction, Distribution, classification and phylogeny of Gymnosperms, Range in Morphology, Anatomy, Reproduction and interrelationships of- Cycadales, Ginkgoales, Coniferales, Gnetales, Economic importance of Gymnosperms.

Unit 3: Taxonomy of Angiosperms: Carolus Linnaeus and his contributions to Taxonomy; Concept of family, genus and species; Concept of primitive flower and evolutionary tendencies; Principles and Aims of ICBN. Experimental Taxonomy: Anatomy, Embryology, Palynology, Cytology, Phytochemistry, Molecular Biology, Numerical Taxonomy; Botanical Garden; Methods of preparation, maintenance and significance of Herbarium. Bentham and Hooker's, Engler and Prantl's, Hutchinson's system, Takhtajan's, Cronquist's system of classification. The Classification of Angiosperm Phylogenetic Group (APG)-III System. Salient features, morphological peculiarities, systematic position and affinities of the following families- **Dicotyledons-** Magnoliaceae, Nymphaeaceae, Papaveraceae, Urticaceae, Casuarinaceae, Nyctaginaceae, Malvaceae, Passifloraceae, Euphorbiaceae, Amaranthaceae, Droseraceae, Podostemaceae, Balanophoraceae, Loranthaceae, Meliaceae, Sapindaceae, Linaceae, Scrophulariaceae, Bignoniaceae, Acanthaceae, Rubiaceae and Asteraceae; **Monocotyledons-** Alismataceae, Araceae, Cyperaceae, Commelinaceae, Zingiberaceae, Liliaceae, Dioscoreaceae, and Orchidaceae. **Economic Botany:** Cereals and Millets, Legumes, Sugar yielding plants, Spices and condiments, Fibre yielding plants, Timber yielding plants, Dyes; Rubber yielding plant, Gums and Resins, Oil yielding plants; Medicinal plants; Ethnobotany and IPR.

Unit 4: Reproductive Biology of Angiosperms: Development of embryology in India; Microsporogenesis- Male gametophyte development; anther wall layers and functions; Tapetum-types, Concept of male germ unit; Pollen morphological features; Unusual features: pollen development in Cyperaceae, pollen embryosac; Scope of palynology. Megasporogenesis- Female gametophyte development; Ovular structure & types; Development of monosporic, bisporic, tetrasporic & special types of embryo sacs; Ultrastructure & nutrition of female gametophyte; Fertilization- double fertilization; single fertilization; heterofertilization & polyspermy; Pollen incompatibility reactions; Endosperm- Types; haustorial variations; ruminant & composite endosperm; Embryo- Structure; development of monocot, dicot & grass embryo; significance of

embryonal suspensor; Experimental Embryology. **Plant Morphogenesis:** Shoot apical meristems, root meristems Cell fate/ fate maps, gradients, stem cells in plants and their significance in development, polarity, symmetry, totipotency of cell types, pluripotency, plasticity, differentiation, redifferentiation, dedifferentiation and regeneration in *Acetabularia*, *Arabidopsis*, Photoreceptors & photo morphogenesis. Totipotency, factors affecting totipotency, Micropropagation and its applications, techniques and applications of Meristem culture, Embryo culture, Endosperm culture and Somatic embryogenesis including synthetic seeds production. Androgenesis and Microspore culture, Significance of Haploids, Diploidization and bulbosum technique. Isolation, culture methods and regeneration of protoplasts, somatic hybridization, fusogens, fusion techniques and its applications, Somaclonal variations. **Techniques of Suspension Culture.** Plant germplasm storage by cryopreservation and its advantages.

Unit 5: Primary vegetative body of the plant: Anatomical features of leaf, stem and root-dicot, monocot, fern and gymnosperm. Kranz anatomy. Ultrastructure and chemistry of the cell wall, Structure and differentiation of xylem and phloem tissues. Secondary growth- Vascular cambium, secondary xylem of gymnosperms and dicots and secondary phloem of gymnosperms and dicots. Periderm and Bark, Anomalous secondary growth in monocots and climbers. Floral anatomy: flower parts, floral meristem, vascular system. Structure, Composition of biomolecules, membrane structure and Functions. Plant propagation: **Seed Propagation** techniques Vegetative Propagation: **Cuttings, Buddings, Micro propagation** techniques. Applications in forestry and horticulture. Propagation methods of some selected plants – Citrus, grape, mango, mulberry, hibiscus, rose, croton, Eucalyptus. Cell and cellular components. **Plant Physiology:** Transport of solutes across the membranes Transmembrane proteins, Transport of ions, solutes and macro-molecules, Mechanism of translocations in phloem; Plant hormones: Discovery, Biosynthesis, Metabolism, transport and Physiological effects of plant hormones and their applications; Phytochrome: Photochemical and Biochemical properties of phytochrome. Role played in signal transduction pathway stomatal physiology; Photosynthesis in higher plants (i) Photophosphorylation (ii) Calvin cycle (iii) Photorespiration (iv) C₄ – Pathway (Cycle); (v) CAM in plants; Oxidative Phosphorylations; (i) Glycolysis (ii) TCA – Cycle (iii) ET – Chain. (ii) Biosynthesis of amino acids (iii) Assimilation of nitrate & ammonium; Lipid metabolism: Fats and Oils biosynthesis and oxidation of lipids; Physiology of Seed Germination and Flowering.

Unit 6: Cell Biology: Biomolecules – Structure, Composition of biomolecules and their stabilizing Interactions (Carbohydrates, Lipids, Proteins and Nucleic acids). Unit membrane structure and Functions. Mechanism of protein sorting and intracellular transport including apoplast to symplast transport. Electrical properties of membranes. **Functions of intracellular Organelles:** Cell wall, Membranes, Nucleus, Mitochondria, Golgi bodies, Lysosomes, Spherosomes, Peroxisomes, Ribosomes, Endoplasmic Reticulum, Plastids, Chloroplast, Vacuoles and Cytoskeleton. Cell Cycle and mechanism of cell cycle regulations. A brief account of cell signaling, Receptors, Second messengers. General mechanism of Signal Transduction Pathway, Programmed cell death in life cycles of plants. **Chromosomal theory of inheritance, classical and modern Mendelian principles, Concept of the gene, Gene mapping methods-** linkage maps, tetrad analysis, Recombination in bacteria, mapping genes in bacteria by interrupted mating technique, fine structure mapping, transduction and transformation mapping, mapping genes in bacteriophages, **sex determination and dosage compensation-** Chromosomal and genetic basis of sex determination, mechanism of sex determination in melandrium, *C. elegans*, drosophila and humans, dosage compensation mechanisms in humans, Drosophila and *C. elegans*. **DNA replication-** patterns, Messelson and Stahl and Taylor's experiment, enzymes of replication, mechanism of DNA replication in prokaryotes and Eukaryotes, proof reading and error correction mechanisms. **Plants as genetic tools in Biology:** *Arabidopsis*, *Oryza*, *Zea*, and *Saccharomyces*. Genome organization. **Organization of chromosomes and genes in prokaryotes and eukaryotes-** operon, interrupted genes, gene families, unique and repetitive DNA. Plant genes and regulation, Nucleus and chromatin organization, DNA packaging, organization and types of DNA sequences, organization of plant nuclear genes, plastid genes and mitochondrial genes. Genes responding to hormones, phytochrome, responses to abiotic stresses. Genes involved in photosynthesis and nitrogen fixation and their regulation; Genetic and molecular analysis of flower development. Genes involved in Fertilization, seed development, Embryo development. Genetics of *Agrobacterium*. Proteomics, Genomics and Bioinformatics Bio-informatics- tools of bioinformatics, data bases and data base management, Bioinformatics in taxonomy, biodiversity, agriculture. Bioinformatics in drug design and drug discovery.

Unit 7: Molecular Biology, mechanism of mutation, repair and recombination:- Nature of genetic material: nucleic acids as genetic material, nucleic acid primary and secondary

structure and types, **Organization of chromosomes and genes in prokaryotes and eukaryotes-** operon, interrupted genes, gene families, unique and repetitive DNA, heterochromatin, euchromatin, transposons, mitochondrial and chloroplast genome organization, Transposable elements in prokaryotes and eukaryotes, genetic and evolutionary significance, **DNA replication-** patterns, Messelson and Stahl and Taylor's experiment, enzymes of replication, mechanism of DNA replication in prokaryotes and Eukaryotes, proof reading and error correction mechanisms; **Mutation-**DNA damage by spontaneous mutations, physical and chemical mutagens and their molecular mechanisms, **Repair mechanisms-** direct reversal of damage, base and excision repair, recombinational repair, SOS repair, translation repair synthesis, transcription coupled repair, **Recombination-** homologous recombination, models of recombination, mechanisms, protein machinery of homologous recombination, genetic consequence of homologous recombination, gene conversion, site specific recombination, mechanism and biological significance, non homologous recombination- transposition, molecular mechanisms of transposition- conservative, replicative and retrotransposition. **RNA synthesis, processing and translation:** transcription activators and repressors, promoters, RNA polymerases and transcription factors, mechanism of transcription in prokaryotes and eukaryotes, **RNA processing-** capping, polyadenylation, splicing, alternative splicing, RNA editing, exon shuffling and RNA transport, **Translation and processing-** ribosomes, tRNA aminoacylation, aminoacyl tRNA synthetase, genetic code, wobble hypothesis, deciphering of the code, translation mechanism, translation proof reading, translation inhibitors and post translation modifications. **Regulation of gene expression in Prokaryotes:** Operon concept, regulation at transcription initiation- lac and trp operon control, regulation of lytic and lysogenic cycles in lambda phage, regulation beyond transcription initiation-premature termination- trp operon, ribosomal proteins as translational repressors, ribo switches, **Regulation of gene expression in eukaryotes-**transcription activators and repressors, regulation after transcription initiation- alternative splicing, translational control in ferritin and transferrin mRNA, RNA interference, role of chromatin in regulation of gene expression and gene silencing.

Unit 8: Breeding Methods: Plant introduction and Acclimatization, Domestication and agriculture, pure line, clonal, mass and progeny selections, recurrent selection, Pedigree, bulk and back cross methods, Heterosis, breeding synthetic and composite varieties. **Breeding Techniques :** Mutation breeding, Polyploidy, Hybridization, Tissue culture techniques in

crop improvement, protoplast fusion, electroporation, electro fusion, biolistics, somatic hybridization, Transgenic plants (GMO's), The role of Gene technology in plant breeding. **Breeding for Specific Purposes**: Breeding for disease resistance, insect resistance, drought and salinity, quality trait, multiple cropping systems, Idiotypic breeding, breeding for Adaptation. **Crop breeding and seed production**: Breeding field crops, seed production techniques, release of new varieties, intellectual property rights, computer application in plant breeding, Crop breeding Institutes/ centers. Genetic Resources and Germplasm conservation. **Scientific Plant breeding** Green revolution, The elite crop (Golden rice), **Modern Plant breeders**: M.S. Swaminathan, Norman E. Borlaug, N.I. Vavilov.

Unit 9: Ecology- Plants and the environment- plant adaptation, ecotypes; Life Cycles and Life History- Life span, Plant growth, Frequency of reproduction, Life history strategies; Habitat Ecology- Fresh Water and Marine water ecology (ecosystems), Wetlands and their Characteristics; Plant Communities and Ecosystems- Species diversity, Community structure, Ecosystem function; Interactions among Plants- Competition, Commensalism and Parasitism, Mutualisms, Herbivory. **Habitat ecology & Environment** - The distribution of biomes, Major Terrestrial Biomes; Forests-Tropical Forests, Temperate Forests, Taiga, Grasslands, Savanna, Temperate Grasslands/Prairies, Tundra, Desert, Chaparral, Management of terrestrial, aquatic and mangrove vegetation; The Changing Ecosystem- Characteristics of disturbances; Fire, Succession and Agriculture practices; Pollution, Protecting habitats and species; Environmental Education Programmes- WWF, UNEP, IUCN, MAB. **Biodiversity & Conservation Biology**- Science in the Service of Biodiversity. Biodiversity and its value. Biodiversity issues, Concerns, Management. Biodiversity Hot spots. Biodiversity- Creation and Destruction, Threats & current status of biodiversity. Invasive alien species as threat to biodiversity. Conservation Strategies, Past, Present, and Future- Attitudes about Conservation, Conservation Movements; Endangered Species Act. 2002 (GOI) National Biodiversity Conservation Strategy; Geologic and Biogeographic Forces, Selecting Reserves- Biogeography, Representation, Tools for Inventory and Evaluation; Protected area Network of India- History, size and scale & management. **Phytogeography**- Physical features of the world, India & Karnataka. Climatic zones, tectonics, continental movements; Types of plant distribution – discontinuous distribution - land bridge theory, continental drift, polar oscillation, shifting of poles, glaciation: continuous distribution- cosmopolitan, circumpolar, circumboreal, circumaustral, pantropical. Distribution of plants –

coastal regions, Rivers & Lakes of India & Karnataka; Distribution of plants – Islands; Distribution of crop plants Natural & artificial social environments; Floristic regions of the world, India; Floristic Ecological plant geography; Ecological crop geography; Plant dispersal, migrations & isolation - endemic plants of Western Ghats; Origin, Distribution and acclimatization of coffee, cardamom, sugarcane, cashew, ragi, maize, wheat, rice & cotton; Remote sensing, study of vegetation by GIS. **Management of Plant Biodiversity:** Organizations associated with biodiversity management-Methodology for execution-IUCN, UNEP, UNESCO, WWF, NBPGR; Biodiversity legislation and conservations, Biodiversity information management and communication. **Biodiversity and Biotechnology:** Role in assessment of biodiversity and bio-resources, Utilization of biodiversity, Conservation of biodiversity, Adverse impacts of biotechnology on biodiversity.

Unit 10: Proteins: Classification, Structure- primary, secondary, tertiary and quaternary structure; properties of proteins; **Enzymes:** Nomenclature, nature and properties of enzymes, active sites, co-enzymes, kinetics of enzyme action, Catalysis, specificity and inhibition, Allosteric enzymes, Ribozyme and Abzyme. **Biomolecules-** A brief account of carbohydrates, proteins, lipids and nucleic acids; **Principles and applications of Chromatography-** Basic principle, Partition Coefficient, Survey of chromatographic procedures, techniques of chromatography, types of chromatography and their applications; **Spectroscopy-** Basic principle, Electromagnetic spectrum, the Laws of Absorption, Absorption Spectrum, Instrumentation for UV, Vis. and Infrared spectroscopy, NMR, and applications; **Electrophoresis-** Basic principle, Migration of an ion in electric field, Factors affecting electrophoretic mobility, types of electrophoresis- micro electrophoresis, moving boundary electrophoresis and Zone electrophoresis and their applications; **Centrifugation-** Basic principle- Relative Centrifugal Force, Instrumentation- Desktop, High speed and Ultra centrifuge, Preparative Centrifugation-(i) Differential centrifugation (ii) Density Gradient Centrifugation -(a) rate zonal (b) iso-pycnic, Analytical Centrifugation and applications. **Biofertilizers:** Preparation and applications of biofertilizers such as Rhizobium, Azotobacter, Blue Green Algae and VAM. Single Cell proteins (SCP): Health benefits and advantages of single cell proteins- *Spirulina*. Biofuels: Ethanol and Biofuel production from plants. Mushroom cultivation and its advantages. Bioremediation: Phytoremediation; Biodegradation, Xenobiotics. Biotechnology of medicinal and aromatic plants for human welfare.

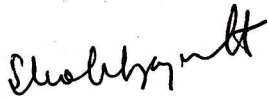
Unit 11. Seed Technology Seed Science and Technology and its goal at national and international level. Seed Biology, Seed structure and functions. Seed programmes and organizations. Principles of seed production in self and cross pollinated and vegetatively propagated crops; Hybrid seed production; Maintenance of inbred lines and breeders seeds; Synthetic and composite seeds; Improved seed and their identification. Germplasm Banks, Seed Processing: Harvesting- seed drying, seed cleaning and grading; Equipment needed; Seed Storage- types of storage structure; seed factors affecting storage life; effect of storage on relative humidity; temperature and moisture; Seed deterioration of commerce, Seed treatment. Seed quality Testing: Devices and tools used in seed testing. ISTA and its role in seed testing. Seed Sampling: Physical purity and heterogeneity test. Seed moisture content: importance and determination and methods, Viability and Vigour Testing, Genetic purity testing : objective and criteria for genetic purity testing, Seed health Testing: field and seed standards ; designated diseases, objectionable weeds - significance of seed borne diseases, Seed health testing and detection methods for seed borne fungi, bacteria, viruses and nematodes. Testing of GM seeds and trait purity. Preparation and dispatch of seed testing reports; storage of guard samples; application and use of seed standards and tolerances. Seed Certification: Principles and Philosophy of Seed Certification, purpose and Procedures, National Seed Programme: National Seed Corporation- agencies responsible for achieving self reliance in seed production and supply of quality of seeds (State Seeds Corporation; National Seed Development Council- Central Seed Committee; Seed market surveys, seed industry in relation to global market . concept of WTO, GATT, IPR, Plant Variety Protection and its significance; UPOV and its role.

Unit 12: Plant Recombinant DNA Technology. Tools in Genetic Engineering: Restriction endonucleases- types and action, All DNA modifying enzymes. Cloning vectors: Plasmids isolation and purification- Ti Plasmid, pBR322, pUC -series. Phage vectors-M13 phage vectors, Cosmids-Types, Phasmids or Phagemids, Shuttle vectors-types. YAC and BAC vectors, Lambda phage vectors, Lamda phage DNA as a vectors. Cloning vectors and expression vectors. Vectors for Plant cells, Vectors for animal cells, Baculovirus vectors- adenoviruses Retroviruses, Transposons as vectors. Synthetic construction of vectors. **Binary vectors for plant transformation:** Introduction, Desirable features of any plasmid vector, Development of plant transformation vector, Basic features of vectors for plant transformation, Optimization, Clean

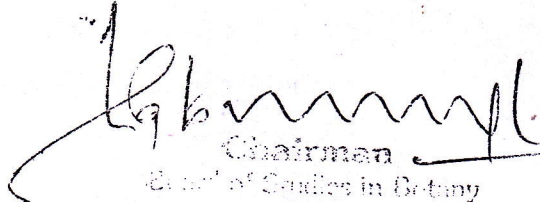
gene technology. **Techniques for plant Transformation:** Integration of plant tissue culture in to plant transformation protocols. **The genetic manipulation of herbicide resistance:** The use of herbicide in modern agriculture, Strategies for engineering herbicide resistance, The environmental impact of herbicide-resistant crops. **The genetic manipulation of pest resistance:** GM strategies for insect resistance The *Bacillus thuringiensis* approach to insect resistance, The Copy Nature Strategy, Insect resistant crops and food safety. **The genetic resistance to plant disease resistance:** Plant pathogen interaction, Natural disease resistance pathways-Overlap between pests and diseases, Biotechnological resistance to disease resistance. Transgenic approaches to viral disease resistance. **Engineering stress tolerance, the improvement of crop yield and quality:** The genetic manipulation of fruit ripening, engineering plant protein composition for improved nutrition, The genetic manipulation of crop yield by enhancement of photosynthesis. **Molecular Farming/Pharming:** Metabolic engineering of plants. Carbohydrates and lipids, Molecular farming of proteins, Economic consideration of molecular farming. **Future prospects for GM crops:** The current state of transgenic crops, Concerns about GM crops, the regulations of GM crops and products.

Unit 13: Biological control of Pests, Pathogens and weeds: Bio-control agents and Biopesticides; Biological control of crop pests; Biological control of Pathogens and weeds. Mycoherbicides. **Gene Therapy:** Gene therapy methods and applications. **Fermentation Technology:** Industrial production of economically important products-acids, enzymes, amino acids, beverages, biopolymers, antibiotics. **Biofertilizers:** Preparation and applications of biofertilizers such as Rhizobium, Azotobacter, Azospirillum, Blue Green Algae, VAM and Azolla. **Single cell proteins (SCP):** Health benefits and advantages of single cell proteins- Spirulina, Chlorella, Scenedesmus; Yeast as SCP. **Biofuels:** Biofuels production; Ethanol, Biogas, Hydrogen and their applications. **Mushroom cultivation:** Important edible mushrooms. Nutritive and medicinal value of edible mushrooms; Cultivation and Advantages. **Biological waste treatment and reuse of wastes:** Waste treatment, Steps, Reuse of wastes; Conversion of wastes in biogas; Ethanol and compost. **Bioremediation:** Cleaning environment; Insitu bioremediation. **Biodegradation:** Xenobiotics; Biodegrading agents; Treatment of Toxic pollutants, Advantages of Biodegradation. **Biomining:** Bioleaching, microbes involved in bioleaching; Advantages of Biomining.

Unit 14: Theories of Evolution of life, Earth and Universe, condition of the early earth, Emergence of the first living cell, origin of Prokaryotic and Eukaryotic cells, life in the Paleozoic, Mesozoic and coenozoic era. Development of Evolutionary thoughts , Ecological context, Before Darwin, Darwinsim, Darwins evolutionary theory. Fossil evidence of Ancient life, fossilization, Evidences from comparative, morphology, Patterns of Development, Comparative Physiology and Biochemistry, Biogeography, Paleontology, Taxonomy, Anatomy and Embryology, plant and animal breeding, Evidence from changing earth and sea. Extinctions. Evolutionary ecology. Speciation and origin of higher categories: Natural Selection- Selective forces, Types of Natural Selection, Selection models. Sexual Selection, Selection and nonadaptive characters. Isolating Mechanism and Species formation: Mendelian Genetics, Isolation and Subspeciation; Premating and Postmating Mechanisms; Chromosomal Rearrangement as Isolating mechanisms. Polyploidy: Autotetraploidy in plant evolution, Allotetraploidy in experiment and in nature, Polyploidy in the Animal kingdom. Evolutionary mathematics: Hardy-Weinberg law, Selection Pressure and Rate of Evolution, Mutation Pressure and Genetic Equilibrium, Genetic Drift. Molecular basis of evolution, Neo-Darwinism and modern synthesis.


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