DR. B. R. AMBEDKAR UNIVERSITY

SYLLABUS

BOTANY

M. Sc. Previous & Final

2017

BOTANY
M. Sc. Previous

The candidates will be required to take Five papers for previous examination and five for the final examination.

There shall be a Practical Examination in both the Previous and Final Classes.

Paper I—Cell and Molecular Biology of Plants :

The dynamic cell—Structural organization of the plant cell; specialized plant cell types; chemical foundation; biochemical energetics.

Cell wall—Structure and functions; biogenesis; growth.

Plasma membrane—Structure, models and functions; sites for ATPases, ion carriers, channels and pumps; receptors.

Plasmodesmata—Structure; role in movement of molecules and macromolecules; comparison with gap junctions.

Chloroplast—Structure; genome organization; gene expression; RNA editing; nucleo-chloroplastic interactions.

Mitochondria—Structure; genome organization; biogenesis.

Plant vacuole—Tonoplast membrane; ATP ases; transporters; as storage organelle.

Nucleus—Structure, nuclear pores; nucleosome organization; DNA Structure; A, B and Z forms; replication, damage and repair; transcription; plant promoters and trnascription factors; splicing; m RNA transport; nucleolous; rRNA biosynthesis.

Ribosomes—Structure; site of protein synthesis; mechanism of translation, initiation, elongation and termination; structure and role of tRNA.

Protein sorting—Targeting of proteins to organelles.

Cell shape and motility—The Cytoskeleton; organization and role of microtubules and microfilaments; motor movements; implications in flagellar and other movements.

Cell cycle and adoptosis—Control mechanisms; role of cyclin and cyclin-dependent kinases; retinoblastoma and E2F proteins; cytokinesis and cell plate formation; mechanisms of programmed cell death.

Other cellular organelles—Structure and functions of microbodies, golgi apparatus, lysosomes, endoplasmic reticulum.

Techniques in cell biology—Immunotechniques; in situ hybridization to locate transcripts in cell types; FISH; GISH confocal microscopy.

Paper II—Cytology, Genetics and Cytogenetics

CYTOLOGY

Chromatin organization—Chromosome structure and packaging of DNA. Molecular organization of centromere and telomere; nucleous and ribosomal RNA genes; euchromatin and heterochromatin; karyotype analysis; banding patterns; karyotype evolution; specialized types of chromosomes; polytene, lampbrush, B-Chromosomes and sex chromosomes; molecular basis of chromosome pairing.

Structural and Numerical alterations in chromosomes—Origin, meiosis and breeding behaviour of duplication, deficiency, inversion and translocation heterozygotes; origin, occurrence, production and meiosis of haploids, aneuploids and euploids; origin and production of autopolyploids; chromosome and chromatid segregation; allopolyploids, types, genome constitution and analysis; evolution of major crop plant; induction and characterization of trisomics and monosomics.

GENETICS

Genetics of prokaryotes and eukaryotic organelles—Mapping the bacteriophage genome; phage phenotypes; genetic recombination in phage; genetic transformation, conjugation and transduction in bacteria; genetics of mitochondria and chloroplasts; cytoplasmic male sterility.

Gene structure and expression—Genetic fine structure; cis-trans test; fine structure analysis of eukaryotes; introns and their significance; RNA splicing; regulation of gene expression in prokaryotes and eukaryotes.

Genetic recombination and genetic mapping—Recombination; independent assortment and crossing over; molecular mechanism of recombination; role of Rec A and Rec BCD enzymes; site specific recombination; chromosome mapping, linkage groups, genetic markers, construction of molecular maps correlation of genetic and physical maps; somatic cell genetic-an alternative approach to gene mapping.

Mutations—Spontaneous and induced mutations; physical and chemical mutagens; molecular basis of gene mutation;

transposable elements in prokaryotes and eukaryotes; mutations induced by transposnos; site-directed mutagenesis; DNA damage and repair mechanisms; inherited human diseases and defects in DNA repair; initiation of cancer at cellular level; proto-oncogenes and oncogenes.

CYTOGENETICS

Cytogenetics of aneuploids and structural heterozygotes—Effect of aneuploidy on phenotype in plants; transmission of monosomics and trisomics and their use in chromosome mapping of diploid and polyploid species; breeding behaviour and genetics of structural heterozygotes; complex translocation heterozygotes; translocation tester sets; Robertsonian translocations; B-A Translocations.

Molecular cytogenetics—Nuclear DNA content; C-value paradox; *cot* curve and its significance; restriction mapping-concept and techniques; multigene familes and their evolution; *in situ* hybridization-concept and techniques; physical mapping of genes on chromosomes; computer assisted chromsome analysis; chromosome microdissection and microcloning; flow cytometry and confocal microscopy in karyotype analysis.

Alien gene transfer through chromosome manipulations—Transfer of whole genome, examples from wheat, *Archis* and Brassica; transfer of individual chromosomes and chromosome segments; methods for detecting alien chromatin; production, charcterization and utility of alien addition and substitution lines; genetic basis of inbreeding and heterosis; exploitation of hybrid vigour.

Paper III—Biology and Diversity of Lower Plants : Cryptogems

MICROBIOLOGY

(a) Archaebacteria and eubacteira : General account; ultrastructure, nutrition and reproduction; biology and economic importance; cyanobacteria—salient features and biological importance.

(b) Viruses : Characteristics and ultrastructure of virions; isolation and purification of viruses; chemical nature, replication, transmission of viruses; economic importance.

(c) Phytoplasma : General characteristics and role in causing plant diseases.

Phycology—Algae in diversified habitats (terrestrial, fresh water, marine) : thallus organization; cell ultrastructure; reproduction (vegetative, asexual, sexual) criteria for classification of algae; pigments, reserve food, flagella; classification, salient features of Protochlorophyta, Chlorophyta, Charophyta, Xanthophyata, Bacillariophyta, Phaeophyta and Rhodophyta; algal blooms, algal biofertilizers; algae as food, feed and uses in industry.

Mycology—General characters of fungi; substrate relationship in fungi; cell ultrastructure; unicellular and multicellular organization; cell wall composition; nutrition (saprobic, biotrophic symbiotic); reproduction (vegetative, asexual, sexual); heterothallism; heterokaryosis; parasexuality; recent trends in classification.

Phylogeny of fungi; general account of mastigomycotima, Zygomycotina, Ascomycotina, Basidiomycotina, Deteromycotina; fungi in industry, medicine and as food; fungal diseases in plant and human; Mycorrhizae; fungi as biocontrol agents.

Bryophyta—Morphology, structure reproduction and life history : distribution; classification; general account of Marchantiales, Junger-maniales, Anthoceratales, Sphagnales, Funariales and Polytrichales; economic and ecological importance.

Pteridophyta—Morphology, anatomy and reproduction; classification; evolution of stele; heterospory and origin of seed habit; general account of fossil pteriodophyta; introduction to Psilopsida, Lycopsida, Sphenopsida and Pteropsida.

Paper IV—Taxonomy and Diversity of Seed Plants

GYMNOSPERSM

Introduction : Gymnosperms, the vessel-less and fruitless seed plants varying in the structure of their sperms, pollen grains, pollen germination and the complexity of their female gametophyte; evolution of gymnosperms.

Classification of Gymnosperms and their Distribution in India. Brief account of the families of Pteriodospermales (Lyginopteridaceae, Medullosaceae, Caytoniacease and Glossopteridaceae).

General Account of Cycadeoidales and Cordaitales

Structure and reproduction in Cycadales, Ginkgoales, Coniferales, Ephedrales, Welwitschiales and Gnetales.

TAXONOMY OF ANGIOSPERMS

Origin of Intrapopulation variation—Population and the environment; ecads and ecotypes; evolution and differentiation of species—various models.

The species concept—Taxonomic hierarchy, species, genius, family and other categories; principles used in assessing relationship, delimitation of taxa and attribution of rank.

Salient features of the International Code of Botanical nomenclature.

Taxonomic evidence—Morphology, anatomy, palynology, embryology, cytology; phytochemistry; genome analysis and nucleic acid hybridization.

Taxonomic tools—Herbarium; floras; histological, cytological, phytochemical, serological, biochemical and molecular techniques; computers and GIS.

Systems of angiosperm classification—Phenetic versus phylogenetic systems; cladistics in taxonomy; relative merits and demerits of major systems of classification; relevance of taxonomy to conservation, sustainable utilization of bio-resources and ecosystem research.

Concepts of phytogeography—Endemism, hotspots and hottest hotspots; plant explorations; invasions and introductions; local plant diversity and its socio-economic importance.

Paper V—Plant Physiology and Metabolism

Energy flow—Principles of thermodynamics, free energy and chemical potential, redox reactions, structure and functions of ATP.

Fundamentals of enzymology—General aspects, allosteric mechanism, regulatory and active sites, isozymes, kinetics of enzymatic catalysis, Michaelis-Menten equation and its significance.

Membrane transport and translocation of water and solutes—Plant-water relations, mechanism of water transport through xylem, root-microbe interactions in facilitating nutrient uptake, comparison of xylem and phloem transport, phloem loading and unloading, passive and active solute transport, membrane transport proteins.

Photochemistry and Photosynthesis—General concepts and historical background, evolution of photosynthetic apparatus, photosynthetic pigments and light harvesting complexes, photooxidation of water, mechanisms of electron and proton transport, carbon assimilation-the Calvin cycle, photorespiration and its significance, the C_4 cycle, the CAM pathway, biosynthesis of starch and sucrose, physiological and ecological considerations.

Respiration and lipid metabolism—Overview of plant respiration, glycolysis, the TCA cycle, electron transport and ATP synthesis, pentose phosphate pathway, glyoxylate cycle, alternative oxidase system, structure and function of lipids, fatty acid biosynthesis, synthesis of membrane lipids, structural lipids and storage lipids, and their catabolism.

Nitrogen fixation, nitrogen and sulphur metabolism—Over view, biological nitrogen fixation, nodule formation and nod factors, mechanism of nitrate uptake and reduction, ammonium assimilation, sulfate, uptake, transport and assimilation.

Sensory photobiology—History of discovery of phytochromes and cryptochromes, and their photochemical and biochemical properties, photophysiology of light-induced responses, cellular localization, molecular mechanism of action of photomorphogenic receptors, signaling and gene expression.

Plant growth regulators andelicitors—Physiological effect and mechanism of action of auxins, gibberellins, cytokinins, ethylene, abscisic acid, brassinosteroids, polyamines, jasmonic acid and salycylic acid hormone receptor, signal transduction and gene expression.

The flowering process—Photoperiodism and its significance, endogenous clock and its regulation, floral induction and development-genetic and molecular analysis, role of vernalization.

Stress physiology—Plant responses to biotic and abiotic stress, mechanisms of biotic and abiotic stress tolerance, HR and SAR, water deficit and drought resistance, Salinity stress, metal toxicity freezing and heat stress, oxidative stress.

Paper VI—Plant Development and Reproduction

Introduction—Unique features of plant development: differences between animal and plant development.

Seed germination and seedling growth—Metabolism of nucleic acids, proteins and mobilization of food reserves; tropisms; hormonal control of seedling growth; gene expression; use of mutants in understanding seedling development.

Shoot development—Organization of the shoot apical meristem (SAM); cytological and molecular analysis of SAM; control of cell division and cell to cell communication; control of tissue differentiation, especially xylem and phloem secretory ducts and laticifers; wood development in relation to environmental factors.

Leaf growth and differentiation—Determination; phyllotaxy; control of leaf from; differentiation of epidermis (with special reference to stomata and trichomes) and mesophyll.

Root development—Organization of root apical meristem (RAM); cell fates and lineages; vascular tissue differentiation; lateral roots; root hairs, root-microbe interactions.

Reproduction—Vegetative options and sexual reproduction; flower development; genetics of floral organ differentiation; homeotic mutants in *Arbidopsis* and *Antirrhinum*; sex determination.

Male gametophyte—Structure of anthers; microsporogenesis, role of tapetum; pollen development and gene expression; male sterility sperm dimorphism and hybrid seed production; pollen germination, pollen tube growth and guidance; pollen storage; pollen allergy; pollen embryos.

Famel gametophyte—Ovule development; megasporogenesis; organization of the embryo sac, structure of the embryo sac cells.

Pollination, Pollen-pistil interaction and fertilization—Floral Characteristics, pollination mechanisms and vectors; breeding systems; commercial considerations; structure of the pistill; pollen-stigma interactions, sporophytic and gametophytic self-incompatibility (Cytological, biochemical and molecular aspects); double fertilization; in vitro fertilization.

Seed development and fruit growth—Endosperm development during early, maturation and desiccation stages; embryogenesis, ultrastructure and nuclear cytology; cell leneages during late embryo development; storage proteins of endosperm

and embryo; polyembryony; apomixis; embryo culture; dynamics of fruit growth; biochemistry and molecular biology of fruit maturation.

Latent life-dormancy—Importance and types of dormancy; seed dormancy; overcoming seed dormancy; bud dormancy.

Senescence and programmed cell death (PCD)—Basic concepts, types of cell death, PCD in the life cycle of plants, metabolic changes associated with senescence and its regulation; influence of hormones and environmental factors on senescence.

Paper VII—Plant Ecology

Climate, soil and vegetation patterns of the world—Life zones; major biomes and major vegetation and soil types of the world.

Vegetation organization—Concepts of community and continuum; analysis of communities (analytical and synthetic characters); community coefficients; interspecific associations, ordination; concept of ecological niche.

Vegetation development—Temporal changes (cyclic and non-cyclic); mechanism of ecological succession (relay floristics and initial floristic composition; facilitation, tolerance and inhibition models); changes in ecosystem properties during succession.

Ecosystem organization—Structure and function; primary production (methods of measurement, global pattern, controlling factors); energy dynamics (trophic organization, energy flow pathways, ecological efficiencies); litter fall and decomposition (mechanism, substrate quality and climatic factors); global biogeochemical cycles of C, N, P and S; mineral cycles (pathways, processes, budgets) in terrestrial and aquatic ecosystems.

Biological diversity—Concept and levels; role of biodiversity in ecosystem functions and stability; speciation and extinction; IUCN categories of threat; distribution and global patterns; terrestrial biodiversity hot spots; inventory.

Air, water and soil pollution—Kinds; sources; quality parameters; effects on plants and ecosystems.

Climate change—Greenhouse gases (CO_2, CH_4, N_2O, CFCs : sources, trends and role); ozone layer and ozone hole; consequences of climate change (CO_2 fertilization, global warming, sea level rise, UV radiation).

Ecosystem stability—Concept (resistance and resilence); ecological perturbations (natural and anthropogenic) and their impact on plants and ecosystems; ecology of plant invasion; environmental impact assessment; ecosystem restoration.

Ecological management—Concepts; sustainable development; sustainability indicators.

Paper VIII—Plant Resource Utilization and Conservation

Plant Biodiversity—Concept, status in India, utilization and concerns.

Sustainable development—Basic concepts.

Origin of agriculture.

World centres of primary diversity of domesticated plants—The Indo-Burmese centre; plant introductions and secondary centres.

Origin, evolution, botany, cultivation and uses of; (i) Food, forage and fodder crops, (ii) fibre crops, (iii) medicinal and aromatic plants, and (iv) vegetable oil-yielding crops.

Important fire-wood and timber-yielding plants and non-wood forest products (NWFPs) such as bamboos, rattans, raw materials for paper-making, gums, tannins, dyes, resins and fruits.

Green revolution—Benefits and adverse consequences.

Innovations for meeting world food demands—Plants used as avenue trees forshade, pollution control and aesthetics. Principles of conservation; extinctions; environmental status of plants based on International Union for Conservation of Nature.

Strategies for conservation-*in situ* conservation—International efforts and Indian initiatives; protected areas in India-sanctuaries, national parks, biosphere reserves, wetlands, mangroves and coral reefs for conservation of wild biodiversity.

Strategies for conservation-*ex situ* conservation—Principles and practices; botanical gardens, field gene banks, seed banks, *in vitro* repositories, cryobanks; general accont of the activities of Botanical survey of India (BSI), National Bureau of Plant Genetic Resources (NBPGR), Indian Council of Agricultural Research (ICAR), Council of Scientific & Industrial Research (CSIR), and the Department of Biotechnology (DBT) for conservation, non-formal conservation efforts.

Paper IX—Biotechnology and Genetic Engineering of Plant and Microbes

Biotechnology—Basic concepts, principles and scope.

Plant Cell and Tissue Culture—General introduction, history scope, concept of cellular differentiation, totipotency.

Organogenesis and adventive embryogenesis—Fundamental aspects of morphogenesis : Somatic embryogenesis and androgenesis, mechanisms, techniques and utility.

Somatic hybridization—Protoplast isolation, fusion and culture, hybrid selection and regeneration, possibilities, achievements and limitations of protoplast research.

Applications of plant tissue culture—Clonal propagation, artificial seed, production of hybrids and somaclones, production of secondary metabolites/natural products, cryopreservation and germplasm storage.

Recombinant DNA Technology—Gene cloning principles and techniques, construction of genomic/cDNA libraries, choice of vectors, DNA synthesis and sequencing, polymerase chain reaction, DNA fingerprinting.

Genetic engineering of plants—Aims, strategies for development of transgenics (with suitable examples), Agrobacterium-the natural genetic engineer, T-DNA and transposon mediated gene tagging, chloroplast transformation and its utility, intellectual property rights, possible ecological risks and ethical concerns.

Microbial genetic manipulation—Bacterial transformation, selection of recombinants and transformants, genetic improvement of industrial microbes and nitrogen fixers, fermentation technology.

Genomics and proteomics—Genetic and physical mapping of genes, molecular markers for introgression of useful traits, artificial chromosomes, high throughput sequencing, genome projects, bioinformatics, functional genomics, microarrays, protein profilling and its significance.

Paper X—NOTE : Elective courses/Indesplainary/Project may be choosen by the colleges as per available facilities (Only one)

1. Advanced Phycology, 2. Limnology, 3. Microbial Ecology 4. Industrial Microbiology, 5. Microbial Genetics, 6. Integrated Pest Management : Concepts and Applications, 7. Seed Pathology, 8. Lichenology, 9. Biology of Bryophytes, 10. Reproductive Biology, 11. Weed Biology, 12. Population Biology, 13. Forest Biology, 14. Biosystematics, 15. Molecular Biology and Biotechnology, 16. Palaeobotany, 17. Plants and Society, 18. Advanced Plant Physiology and Biochemistry, 19. Crop Genetics and Plant Breeding, 20. Plant Tissue Culture, 21. Stress Biology, 22. Plant Genomics and Proteomics, 23. Phytochemistry, 24. Arboriculture, 25. Plant Propagation : Concepts and Applications, 26. Ethnobotany, 27. Applied Mycology, 28. Molecular Plant Pathology, 29. Plant Protection.

Interdisciplinary Elective Courses :

1. Information Technology
2. Computer Applications and Databases
3. Biostatistics
4. Bioinformatics
5. Phytochemistry and Pharmacognosy

Alternative : Project/Field Work

1. Plant Biodiversity Assessment
2. Conservation of Endanagered Species
3. Inventorization of Unexplored Areas and Hotspots
4. Pollution Monitoring
5. Survey of Less-Known Economic Plants in India
6. Chromosome Analysis and Indexing of Indian Flora
7. Xenobiotics