PLANT SCIENCE SYLLABUS

PAPER I: GENETICS & CYTOGENETICS

UNIT I

A. Linkage and Crossing over : Concept of linkage and factors affecting true strength of Linkage.

B. Theories of crossing over at chromosomal & molecular level (Chiasmata, Precocity, Bellings, Whitehouse and Holiday model, Sobel's concept.

C. Measurement of linkage from F2 and back cross data, Genetic map of chromosomes, double crossing over, interference and coincidence.

UNIT II

A. Mutation : Types of mutation, mutation rate, Base substitution (transition and transversion) Frame shift mutation. Mechanism of gene mutation.

B. Induction of mutation : Target theory, Peroxide formation, UV rays and Thymine dimer, Incorporation of base analogue. Tautomerization and chemical alteration in nucleic acids.

C. Detection of mutation in plants and Drosophila.

UNIT III

A. Sex determination : Theories of sex determination in Drosophila, plant & man, Single gene harmonal control of sex and sex reversal and gynandromorph.

B. Human genetic disorder : Sex linked inheritance, (Colour blindness, haemophilia, Hypertichosis).
Physiological disorders : Phenylketoneurea, Alkaptonurea, Albinism and sickle cell anaemia and Syndromes : Down, Klinfelter and Turnor

C. Extrachromosomal Inheritance : Cytoplasmic inheritance in *Mirabilis*, Maize and Paramecium. Delayed inheritance, Dauer modification.

UNIT IV

A. Polyploidy : Classification, cytological and genetical method of identification of auto-polyploids and allopolyploids.

B. Classification, method of production, identification and meiotic behaviour of aneuploids (Monosomics, Nullisomics and trisomics).

C. Structural alteration in chromosome : Deletion, Duplication, Inversion & Translocation, hetrozygote.

UNIT V

A. Concept of Gene, Genetic load & Genetic councelling.

B. Nuclear DNA content, C-Value paradox, Cot value and its significance

C. *in situ* hybridization - concept & Techniques, flow cytometry in karyo type analysis.

PAPER II: BIOCHEMISTRY

UNIT I

Molecular Properties: Formation and biological significance of hydrogen bonds, Vander waal forces and hydrophobic interaction.

Acidity basicity pH buffers, buffering action in blood pH of the buffered solutions. Isomeric and optical activity in biological molecules.

Bioenergetics: Laws of thermodynamics concept of enthalpy and entropy and their significance in biological systems high energy molecules causes of energy richness of ATP, Redox potential.

UNIT II

Nucleic acid: Structure and conformation of Nucleic acids.

Amino acids: Structure and physico-chemical nature of amino acids.

Proteins: Peptide bond and polypeptides secondary tertiary and quaternary structure of proteins, Conformation of Proteins, Determination of amino acid sequence of proteins physical and chemical properties of proteins biological significance.

UNIT III

Carbohydrates: Structure and Physico- chemical properties of carbohydrates, Biological significance important, glycoproteins.

Lipids: Classification, structure and properties of important lipids biological significance glycolipids Fatty acid biosynthesis and storage lipids and their catabolism.

UNIT IV

Signal Transduction: Overview of receptors and G- proteins phospholipids signaling role of cyclic nucleotides calcium-calmodulin cascade diversity in protein kinase and phosphates specific signaling mechanism e.g. two component sensor –regulator system bacteria and plants sucrose- sensing mechanism.

UNIT V

Enzymes: Classification, Physico-chemical nature, Isolation, Purification and Immobilization Elementary idea of enzyme kinetics

Mechanism of action and regulation, Ribozymes, Zymogens,Isozyme.

Vitamins & Coenzymes: Structure and general biochemistry

PAPER III: CELL AND MOLECULAR BIOLOGOY OF PLANTS

UNIT I

A. Cell Wall: Structure biosynthesis and function
B. Plasma membrane: Structural models & functions, ATPases, ion carriers, channels & pumps.
C. Chloroplast: Structure, Genome & Biogenesis
D. Mitochondria: Structure, genome & biogenesis

UNIT II

A. Structure and function of endoplasmic reticulum, Golgi apparatus, lysosomes, peroxisomes.
B. Nucleus: Structure, Nuclear pore & nucleolus.
C. Chromosome structure, molecular organization of Centro mere and telomere, nucleosome organization & packaging of DNA
D. Sex B, Lamp brush & polytene chromosome.

UNIT III

A. Cytoskeleton: Organization and role of microtubules & microfilaments, motor movements implication in flagellar movements.
B. Control of cell cycle: role of cyclins & cyclin depensant kinases, retinoblastoma & E2F protein, cytokinesis and cell plate formation,
C. Cancer & oncogenes, mechanism of programmed cell death.

UNIT IV

A. Structure of nucleotides & DNA, A, B, & Z form of DNA & properties, coding and noncoding sequences, satellite DNA.
B. DNA damage & repair, replication and transcription of DNA
C. Structure of mRNA, rRNA & t RNA, replication of RNA.
D. Splicing, transport of RNAs, RNA editing.

UNIT V

A. Ribosome: Structure biogenesis
B.Protein synthesis: Mechanism of translation (initiation, elongation and termination)
C. Post translational modification, protein targeting to organelles
D. Regulation of protein synthesis at transcription and translation level in prokaryotes & eukaryotes.

PAPER IV: MYCOLOGY AND PLANT PATHOLOGY

A. Mycology

UNIT I

Classification of fungi: Criteria for classification, Comparative study of different systems of classifications and salient features of different classes, Nutrition in fungi, Heterothallism, Dikaryotization, Parasexuality, physiological specialization.

UNIT II

Range and comparative account of vegetative and reproductive structures with evolutionary significance in Myxomycotina, Mastigomycotina, Amastigomycotina. Hormones in sexuality

UNIT III

Range and comparative account of vegetative and reproductive structures with evolutionary significance in Ascomycotina, Basidiomycotina and salient features of Deuteromycotina. Sexuality in Ascomycotina.

B. Plant Pathology

UNIT IV

Nature and classification of plant diseases, symptoms, Host-parasite relationship, Disease resistance in plants, Control of plant diseases.

UNIT V

Fungicides, Phytoalexins, Antibiosis, Antagonism, Chemotherapy, Hypersensivity, Plant quarantine, Toxins and Toxoids.
Monographic study of following diseases:
Phycomycetes: Black wart of potato, Club-root disease of cabbage, Late blight of potato.

Ascomycotina: Peach leaf curl, Stem gall of Corriander Powdery mildew of wheat, Ergot of rye.
Basidiomycotina: Loose smut of Wheat, Covered smut of Wheat, Smut of Oat, Smut of Bajra, Rust disease of Wheat, Rust of gram, Rust of linseed.
Deuteromycotina: Early blight of Potato, Wilts disease of Arhar, Tikka disease of groundnut, Red rot of Sugarcane.

PAPER V: PLANT DIVERSITY
(Algae, Bryophytes & Pteridophytes)

UNTI I
Distinguishing Characters of Different Classes of Algae: A general knowledge of algal pigments foods reserves specific cell organelles.
Economic importance: algal blooms algal biofertilizers algal foods feed and uses in industry.

UNIT II
Range of Vegetative structure and reproduction of algae (Cyanophyceae Chlorophyceae Xanthophyceae Bacillariophyceae and Rhodophyceae).

UNIT III
Important characters of bryophytes outline of classification and evolutionary tendencies and comparative study of different groups- Hepaticeae Anthocerotae and Music and economics importance of bryophytes.

UNIT IV
Types of rocks fossils conditions for fossilization and methods of their study.
Classification and characteristic features of pteridophytes.
Heterospory and origin of seed habit.
Apo gamy apospory evolution of stellar system in pteridophytes.

UNIT V
Comparative study of structure of saprophyte gametophyte and embryo in relation to Psilopsida Lycopsida Sphenopsida and Pteropsida.

PAPER VI: PLANT DIVERSITY II. GYMNOSPERMS &ANGIOSPERMS

UNIT I

Gymnosperms: A comparative study of vegetative and reproductive organs in the groups - Cycadopsida (Pteridospermales, Cycadeoidales, Pentoxylales & Cycadales), Origin and evolution of Gymnosperms.

UNIT II

A comparative study of vegetative and reproductive organs in groups-Coniferopsida (Cordaitales, Ginkgoales, Coniferales) Gnetoipsida (Gnetales, Ephedrales, Welwitschiales).

UNIT III

Principle of nomenclature, modern trends in plant taxonomy with particular reference to evidence from anatomy, embryology palynology and cytogenetics, numerical taxonomy.
Origin and evolution of Angiosperm.
Economic importance of Angiosperms.

UNIT IV

Anther: Microsporogenesis and male gametophyte.
Ovule: Magasporogenesis and the female gametophyte, fertilization.
Endosperm and embryo development, apomixes, parthenocarpy, polyembryony.

UNIT V

Morphological nature of carpel, stamen morphology and evolution, inferior ovary, placentation.
Root shoots transition zone, nodal anatomy, meristems origin & organization and function of cambium.

PAPER VII: ENVIRONMENTAL BIOLOGY (PLANT ECOLOGY):

UNIT I

Population dynamics : Population characteristics, population growth forms, density dependent & density independent controls, Population structure (distribution, aggregation, isolation territoriality) energy partitioning, r-&k-selection, concept of carrying capacity.

UNIT II

Vegetation organization & development: Concepts of community & continuum, analysis of communities (analytical & synthetic characters), community coefficients, competition, ecological niche Mechanism of ecological succession (relay floristic & initial floristic composition facilitation, tolerance & inhibition models), concept of climax.

UNIT III

Ecosystem organization & Function: Structure primary production (methods of measurement controlling factors), energy dynamics (tropic organization, energy flow pathways, energy quality ecological efficiencies), Cybernetic nature of Ecosystem & gaia hypothesis.

UNIT IV

Pollution & climate change:

Kinds sources & effects of pollution heavy metals (Pb, Cd, Hg), green house gases f(CO_2 ,CH_4, N_2O, CFCs), green house effect & global warming ozone layer & ozone hole Acid rain Environmental Impact Assessment.

UNIT V

Biological Diversity & Ecosystem stability:

Concept & level of biodiversity ,natural selection, speciation ,co-evolution, threatened & endangered plant species, concept of resistance & resilience role of diversity in ecosystem stability general account of remote sensing & its application , sustainable development.

PAPER VIII: PLANT BREEDING AND BIOSTATISTICS

UNIT I

A. Source of variability and its genetic basis
B. Heritability and genetic Advance.
C. Hybrid seed Production and its application

UNIT II

A. Mutation breeding: Direct and indirect uses, achievement and prospects.
B. Role of polyploidy and haploidy in plant breeding.
C. Monosomic analysis (origin source, recognition, maintenance, cytological behaviour, breeding behaviour and uses) and genome analysis.

UNIT III

A. Male sterility and incompatibility, their mechanism, genetic maintenance and application.
B. Heterosis and inbreeding selection, its genetic basis and uses in crop improvement progammes.
C. Varietal release and maintenance procedure : Improved seeds, seed production, practice, naming, multiplication, maintenance and release of new variety and seed testing.

UNIT IV

A. Breeding for specific characters : Adoptive breeding and quality breeding.
B. Protection breeding : Sources of disease, genetics of disease and methods of producing disease, pest resistance.
C. Intellectual Property Rights (IPR) : Patents, Copy rights & Trademarks.

UNIT V

A. Estimation of mean, variance, standard error.
B. Test of significance x^2 and t-test, ANOVA
C. Correlation and simple regression

PAPER IX- PLANT PHYSIOLOGY

Unit I

Translocation of water and soluteses: 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.

Stress Physiology: Plant responses to biotic and abiotic stress, physiological and metabolic responses of plants to high CO_2 HR and SAR, Water deficit and drought resistance salinity stress, Metal toxicity, Freezing and heat stress and oxidative stress.

Unit II

Nitrogen fixation Nitrogen and Metabolism: Biological nitrogen fixation nodule formation and nod factors, mechanism of nitrate uptake and reduction, Ammonium assimilation, Foliar nitrogen nutrition. Interaction of nitrogen assimilation with carbon metabolism.

Sensory Photobiology: Phytochromes and crypto chromes and their photochemical and biochemical properties Photo physiology of light- induced responses, Cellular localization Molecular mechanism of action of photomorphogenic receptors, signaling and gene expression.

Unit III

Photochemistry and photosynthesis: The photosynthetic apparatus, Photoreceptor, Light Reaction of photosynthesis, Photo oxidation of water mechanism of electron and proton transport, Carbon assimilation, Calvin cycle, Photorespiration and its significance, C_4 cycle, CAM pathway.

Respiration – Glycolysis TCA cycle, electron transport and ATP synthesis, Pentose phosphate pathway glyoxylate cycle, Cyanide Resistant Respiration.

Unit IV

Plant growth substances and signal molecules:

Chemical structure, physiological effects and mechanism of action of auxin, gibberellins, cytokinins erhyline abscesic acid.

Growth regularly nature of Polyamines, Jasmonic acid Salicylic acid and Brassinosteroids, systemin.

Unit V

Growth and Developmental Aspects:

Metabolic changes during seed germination, factors affecting seed germination dormancy breaking of dormancy, measurement of vegetative growth, factors affecting vegetative growth, biochemistry of flowering, initiation and development of flower, induction of flowering vernalization physiology and biochemistry of leat abscission and senescence.

PAPER X: MICROBIOLOGY AND IMMUNOLOGY

Unit I

Introductory Microbiology: Types of Microbes: A-cellular, Prokaryotic and Eukaryotic, their detail characters: Identification of Microbes, Media, pure Culture, Aseptic techniques.

Unit II

Growth: Growth factors and nutrition, Population growth curve, Counting methods total cell count, Viable cell count, Biomass determination, and Biological assay.

Unit III

Microbial Biotechnology:

A. **Food Microbiology:** Microbes and food, Single cell protein, Food spillage, Food poisoning, Food infection.
B. **Agriculture & Aquatic Microbiology:** Biodegradable materials and their degradation like; cellulose, hemicellulose lignocelluloses; Non biodegradable herbicides and pesticides, Water contaminants, Water purification, Sewage disposal and Waste water treatment.
C. **Industrial Microbiology:** Fermentation, Microbial enzymes in industry, Enhancement of enzyme productivity, Protoplast fusion.

Unit IV

Immune system: Introduction of immune system, Specific & Non-specific defence, Blood groups, Type of leukocytes, Phagocytes, Inflammation, Interferon, Antigens, Molecular basis of antigen recognition, Lymphoid organs, T-Lymphocytes B-Lymphocytes, Histocompatibility ,MHC Human leukocytes antigen (HLA) system, Molecular structure of HLA class I and class II protein.

Unit V

Antibody & its reactions: Immunoglobulin, and their properties; Diversity and Specificity of antibody, Hybridoma –Monoclonal antibody and its applications, Antigen antibody interactions: Agglutination, Precipitation, Complement- fixation, Opsonization, Neutralization.
Hypersensitivity (Allergy): Anaphylaxis, Cytotoxicity, immuno-complex disorders, Delayed cell mediated hypersensitivity, immunodeficiency, Cancer and immunology.

PAPER XI: PLANT BIOTECHNOLOGY 1. GENE TECHNOLOGY

Unit I

Biotechnology: Basic concepts and dsscoppe

Synthesis of gene: c-DNA, chemical synthesis of gene, amplification of gene through polymerase chain reaction

Gene sequencing: Maxam and Glibert's method, Sanger's method

Gene isolation, RNA, DAN hybridization, DNA (genomic & cDNA) library, restriction endonucleases, production of recombinant DNA

Unit II

Gene Transfer

Vector Mediated: bacteriophages, plant and animal viruses, plasmids cosmist

Direct Transfer: Microinjection, gum particle method.

Physic chemical methods: imbibition, chemically induced acquisition of DNA, through liposomes, sanitation, electroporation

Unit III

Maps of plant genomes: Random amplified polymorphic DNA, (RAPDs), use of RAPDs in crop improvement, restriction fragment length polymorphism (RFLPs), micro satellites,

DNA, RNA probes

Transformation of chloroplast genome

Unit IV

Transgenic:

Expression and measures of transgenes, Marker genes

Antisense RNA expression, heat shock gene transgenesis, stress resistant transgenesis.

Herbicide resistant transgenesis: Modification of the target metabolite, degradation of the herbicide and herbicide resistance through gene amplification

Insect resistant transgenesis: Bt – toxin gene trangenesis, protease inhibitor transgenesis

Virus resistant transgenesis:

Unit V

Molecular farming, acceptability and ethical aspects of transgenic vegetables & flowers, Micro arrays, DNA profiling & significance, protein profiling and its significances, Bioinformatics.

Paper XII: Plant Biotechnology 2. Micro Propagation and Analytical Techniques

Unit I

Plant cell and tissue culture: General introduction, history, scope concept of cellular differentiation, totipotency.

Organogenesis and adventious embryogenesis: Fundamental aspects of morphogenesis: somatic embryogenesis and androgenesis, mechanism, techniques and utility.

Unit II

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

Applications of plant tissues culture: Clonal propagation, artificial seed, production of hybrids and soma clones, production of secondary metabolites/ natural products, cry preservation and germplasm storage.

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Unit III

Centrifugation: Theory and application, ultracentrifugation

Electrophoresis: Free boundary and zone electrophoresis, paper and gel electrophoresis

Two dimensional electrophoresis, immunoelectrophoresis, isoelectrofocussing, disc electrophoresis.

Chromatography: Paper, Thin layer, Ion exchange Gas, High performance liquid, Molecular sieve filtration and affinity chromatography.

Unit IV

Principles,Working and Application of the following instruments/ techniques.

Autoradiography

Polari meter

Electtronmicroscopes (TEM, SEM)

X-ray crystallography

Unit V

Principles and Biological application of:

Simple Spectroscopy

Mass spectroscopy

ORD/CD spectroscopy

NMR and ESR spectroscopy

Atomic absorption spectroscopy