



Structural diversity of Plant cell: Comparative account of cell in Animal and Plants (Bacteria, Mycoplasma, Algae, and Fungi ) Simple tissues: Living (collenchyma and parenchyma) and dead (sclerenchyma) cell types Complex Tissues: Xylem, Phloem elements, structure and function

Cell wall: Layers, function, formation of cell wall Intercellular communications: Plasmodesmata, pits - structure, types and functions - Cell Components I and Cell Division Membranes: Different types of bio-membranes; their constituents and organization. different models Endoplasmic Reticulum: Morphology, different types, structural and ultra structural features; origin and functions.

Structure and Functions of Nucleus: Ultra nuclear membrane; nuclear Chromosome Organization: Morphology; centromere and kinetochore. Mitosis & Meiosis: Different stages, chromosomal behavior. characteristics and significance. Golgi complex: Morphology, structural and ultra structural peculiarities, different origin and functions Lysosomes: Origin, different types: structural peculiarities, chemical constituents and function Plastids: Pigments, different types: classification and morphology; ultra structure of chloroplast and chemical constituents

Mitochondria: Distribution, morphology, structural and ultra structural peculiarities, chemical composition and functions.

Ribosome: Occurrence, types, differences between prokaryotes and eukaryotes. different constituents and functions. -Morphology and Taxonomy of Angiosperms - Morphology of Vegetative plant parts Root structure, types and function Stem structure, forms and function Leaf structure, types and function - Morphology of Reproductive plant parts - Inflorescence, basic types and function Flower — Structure of typical flower Floral parts — Types and functions. - Angiosperms Taxonomy - Classification as per Bentham and Hookers System Nomenclature and identification - International Code of Botanical Nomenclature (ICBN.) Scheme of description of plants and Unit IV Families:- Dicotyledons: -a) Polypetalae - Ranunculaceae, Malvaceae, Fabaceae -b) Gamopetalae Solanaceae, Lamiaceae, Rubiaceae, Monocotyledons – Liliaceae - Plant Structural Biology

Tissue system: Epidermal tissues general organization, cuticle trichomes and stomata types

Secretory tissues: gum and resin ducts, laticifers, hydathodes. floral and extrafloral nectaries vascular tissue Secondary xylem (basic structure of wood). Secondary phloem. Secondary growth: Normal and anomalous secondary growth in different Angiosperms. Periderm and lenticel - structure and development Organisation of the higher plant body: The shoot and root systems; variation in habit and longevity: environmental influences Meristems and development Shoot apical meristem, root apical meristem, lateral meristems and their functions. Nodal Anatomy: Leaf trace, leaf gap Root stem transition .

Basic Microbiology and Plant Physiology

Discovery of Microorganisms, Structure and classification of microbes, Systematic position of microorganisms in biological world; classification of microorganisms and characteristic features of different groups:

Methods in Microbiology: Basic principles of staining of Bacteria and Fungi, sterilization methods, culture media. pure methods, methods for population estimation, growth determination.- Ultra structure of Microorganisms: Prokaryotic microorganisms, fine structure of prokaryotic cell, Ultrastructure of fungal and algal cell., Viruses - properties and classification; bacteriophage T4 and TMV

Genetic recombination in Prokaryotes: Conjugation, transformation and transduction.

Industrial application of microorganisms: Alcohol, Food processing, milk products, and antibiotics

Plant Physiology - Water relations: Absorption of H<sub>2</sub>O - mechanisms, ascent of sap, various theories

Transpiration (Loss of H<sub>2</sub>O) - types, mechanism, stomata! Movements - Mineral nutrition: Criteria of essentiality of elements, essential elements (Major/minor), their role and - deficiency symptoms.

Growth movements: Phototropism, Gravitropism and their reaction mechanism

Ecology and Phytogeography

Ecology - Characteristics of Hydrophytes, Epiphytes and Xerophytes - Foodweb and foodchain - Ecological pyramids

Pollution types and control measures – Biomes - General principles of biogeography

Introduction about Types of Biomes - Characteristic features of Biomes

Plant Anatomy and Physiology - Primary and Secondary growth in Dicots, - Root stem Transition, Stomata and its Types, - Secretory tissues gum and resins, laticifers, hydathodes, floral and extra floral nectaries - Physiology

Water relation: Absorption of H<sub>2</sub>O - mechanisms, ascent of sap - Mineral nutrition, Micro and macronutrients

Photosynthesis- Process, significance, structure and composition of photosynthetic apparatus, factors - affecting photosynthesis

Plant Ecology, Instrumentation and Biostatistics - Plant Ecology - Concept and structure of ecosystem, Food chain, Food web. Ecological pyramids, Basic ideas about ecosystem functioning, energy flow, organic production, biogeochemical cycles and ecological instruments. Ecological classifications of plants, Adaptations in hydrophytes, neophytes, xerophytes, halophytes and epiphytes Air, water and land pollution, causes and control measures

Instrumentation and Biostatistics – Instrumentation- Principle and working of pH meter, spectrophotometer, conductivity meter, turbidity meter and – centrifuge- Biostatistics - introduction, sampling-irregularities, statistical methods and applicators, - Methods of presentation of data! Tables; graphs, diagrams and frequency distribution

Measures of central tendency - Mean, median, mode for raw and grouped data -

Origin of plant life on earth. Evolution of cultivated plants. Virus's centre of origin, primary and secondary centers of diversity; plant introduction A general account of major food crops, cereals, pulses: vegetables, nuts and fruits. Their source, botanical name, family, nutritional value and use - Food legumes - a brief account - Vegetable and essential oils: Mustard, Sesame, Groundnut, Coconut. Soybean and Coconut - a brief account. - Ethnobotany: introduction, historical background - The Folklore of Gujarat - Major tribal groups and their distribution in different parts of Gujarat. - Use of plants and plant products by the ethnic groups of Gujarat; p. 100

Plant fibers: Cotton, jute and coir- A brief account and its uses. - Timber and firewood species: Identification and uses of five major species in Gujarat Medicinal Plants: A brief account of ten important plant drugs and their chief constituents used in indigenous / allopathic systems of medicine. - Natural rubber, insecticides and dyes: A concise account.- Ornamental Plants: Major ornamental plants (Trees, Shrubs and herbs) in Gujarat

Tissue Culture Application: Plant tissue culture, principles, types and technique of micropropagation, commercial application. - Phytoremediation: Bacterial, fungal and algal remediation - Vegetation Monitoring: Remote sensing and its use in assessing vegetative cover -

Microbes and Conservation Biology – Microbes - Diversity of Microbes - Culture of microbes - Industrial uses of microbes Disease causing Microbes - Conservation-Biology - Natural resources and their conservation Conservation of Plant diversity - Protected areas of India - r\*

Horticulture and Economic Botany - Horticultural techniques and tissue culture Basics of Horticultural techniques

Basics of Plant tissue culture and its application - Use of fertilizer and biofertilizer Floriculture and Bonsai

Unit II Economic Botany- Food Resources: A general account of major food crops, including cereals, pulses and vegetables Drug Resources : A brief account of ten important plant drugs and their chief constituents used in indigenous / allopathic systems of medicine. - Commercial plant Resources: Fibers and Beverages

### Plant-Physiology

Photosynthesis: Process, significance, structure and composition of photosynthetic apparatus, PS I & II composition & functions, pathways of carbon fixation C<sub>3</sub>, C<sub>4</sub>, CAM, photorespiration, factors affecting photosynthesis. - Transport of organic substances: Transport of photosynthate; source-sink relationship; the mechanism of translocation in phloem - Respiration: Substrates, mechanism (Glycolysis, TCA Cycle, HMP shunt and oxidative phosphorylation) - Respiration: Substrates used by plants, mechanism (Glycolysis, TCA Cycle, HMP shunt and oxidative phosphorylation). - Nitrogen metabolism: Biological nitrogen fixation, reduction of N<sub>2</sub> into ammonia; nif genes; regulation of nitrate reductase and nitrogenase; nitrate and ammonium assimilation. - Growth and development: Growth distribution, phases, cell cycle, growth curve, measurement, its, senescence. - Phytohormones: Structure, distribution, bioassay, role in plant growth and practical applications of auxin, cytokinin, gibberellic acid, ethylene, abscisic acid; jasmonic acid, brassinosteroids and polyamines.

Plant Ecology - Environmental factors: Climatic, edaphic, and biotic factors-influencing the growth of plants,

Populations: Population characteristics; population dynamics, r and K-selection, factors affecting population growth, population interactions. - Plant communities: Concept, principles, properties, structure, development, methods & purpose of studying plant communities - Plant Productivity: Concept, importance, methods for measuring plant productivity, variations across ecosystems.

Ecological Niches. Concept types, examples. - Species diversity: Dominance, spatial & temporal variations. endemism, ecotone and concept of - edge effect species extinction & biodiversity, plant geography, major biomes of the world &

Role of anthropogenic factors. Man & environment, Natural energy resources, biological indicators, other environmental changes. - Conservation : Concept, problems of depletion of natural vegetation, loss of species, and genetic diversity, endangered & extinct plant, Methods of conservation, national parks, sanctuaries and reserves.

Horticulture and Plant Breeding - General introduction: Definition and scope, utility aspects. Bonsai. - Plant propagation: Plant propagation through seeds, seed advantages, seed dormancy, seed germination — types and factors controlling, maintenance of purity, harvesting, processing, storage, factors affecting germination, „asexual methods“; advanced techniques of propagation by cutting (root, stem, leaf) types . rooting • conditions recultured. establishment —factors affecting, layering types including natural modes of plant modification for propagation. - Plant improvement Types (grafting, budding), process, advantages. techniques, factors affecting, introduction of varieties. - Landscaping: Planning, site preparation for Lawn, Pond, rockeries. - Plant breeding: Introduction to plant breeding, objectives, some important achievements of plant breeding. - Hybridization: Objectives, types and procedure of hybridization. Apomixis: concept, development, potential for crop improvement. Breeding for disease resistance: disease resistance, vertical and disease resistance methods of breeding for disease resistance. Selection methods Mass, Pure line, Pedigree and clonal selection. Release of varieties for certification

Biochemistry and Reproductive Biology - horizontal resistance, sources of release, multiplication and seed

Plant metabolism: Basics, biosynthetic pathways; primary and secondary metabolites. Introduction to . alkaloids, terpenoids and phenolics - Lipid metabolism: Saturated and unsaturated fatty acids; fatty acid biosynthesis; oxidation of fatty acids; storage and metabolism of fatty acids. - Carbohydrate metabolism: Classification, structure of some representative examples of monosaccharides stereoisomers, enantiomers and epimers, polysaccharides.; biosynthesis and degradation of sucrose, starch and cellulose. - Amino acids and protein metabolism: Structure, characteristics and classification of amino acids, protein and non-protein amino acids; amino

acid biosynthesis; GSIGOGAT cycle; transamination; peptide bond and polypeptide chain; protein targeting; protein degradation. - Vegetative and sexual reproduction, functions of flower. -Structure of Anther: Anther wall, tapetum, sporogenous tissue Microsporogenesis; formation of pollen grains; pollen germination; pollen tube growth - Structure of Pistil: Types of ovules, nucellus, megasporogenesis; Types of embryo sac, Double fertilization, Polyembryony; Types and causes - Seed and fruit Monocotyledons and Dicotyledons seeds, Endosperm, their types and functions, Seed dormancy

Diversity of Non-Alveolar plants - Algae: Occurrence and outline classification (Smith, 1955). - Typical life histories of algae: Chlorella, Oedogonium, Chara, Vaucheria, Dictyota, Polysiphonia Role of algae in human welfare. - Bryophytes: Occurrence and outline classification (Srinivasan, 1955) -Morphology, anatomy and reproduction in: Mosses, Liverworts, Hornworts, Notothylas, Sphagnum and Polytrichum - Economic importance of bryophytes —

Plant Kingdom: Occurrence and outline classification (Smith, 1955). - Morphology, anatomy and reproduction in: Pteridophytes, Lycophytes, Isoetes, Equisetum, Marsilea and Adiantum - Economic importance of pteridophytes

Gymnosperms: Occurrence and outline classification (Smith, 1955). - Detailed life cycles: Cycadales (Zamia), Coniferales (Pinus, Cedrus, etc.) and Ginkgo biloba Economic importance

Plant resource utilization - Traditional uses of plants: Ethnobotany, areas of ethnobotanical studies, Brief account of locally available plants and their various uses by the tribal people of Gujarat. - Aesthetic uses of plants: Landscaping, identification of avenue, sacred (Plants in Mythology, Taboos and Totems in Relation to Plant. Folklores and Folktales. Plant in Similes and Metaphors, Wild Life Protection in Tribals, Plant domestication by the Tribals) and ornamental plants - Biofactories: Industrial uses of different plant groups - Phytoremediation: Definition, Phytoextraction, Phytostabilization and Phytotransformation Phytoremediation of contaminated soil and air, Applications, Advantages and Limitations, -Hyperaccumulating plants - Phytochemicals: Role of fungi in remediation of heavy metals, Fungi commonly used for bioremediation and their application on oil spills, Extraction of heavy metals from absorbent mass, Problems associated with remediation through fungi

Green Belt: Definition and purpose, Benefits of green belt policy, Criteria for selection of plants in green belt, Criticism and disadvantages

Evolution and Angiosperm Systematics - Basic concept of evolution: Account of origin of life, changes in atmosphere, theory of spontaneous creation. Chemical evolution; experimental evidences for chemical evolution: Miller's, Fox and Urey's experiments. Evidences for evolution, - Theories of evolution: Lamarck, Darwin, Mutation and Neo-Lamarckism, Neo-Darwinism and its present development - Synthetic theory of evolution; Step: - involved, chromosomal variation and Natural selection of organisms, Reproductive isolation, origin of species: Species, racial differences in species, reproductive isolation, hybridization and speciation mechanisms.

Major trends: Origin of life, evolution and evolutionary constancy. - Systematics: Introduction, Aims and components of systematics; introduction to identification, nomenclature and classification. - Systematics in Practice: importance of herbarium specimens and their preparation; role of herbaria and botanical gardens; - documentation (floras, monographs, journals, indices and dictionaries); keys for identification of plants — single access and multi access; review - Taxonomic hierarchy: Taxonomic categories; species concept - Botanical nomenclature: Principles and rules; ranks and names; type method; principle of priority and its limitations; names of hybrids and cultivars. - Phylogeny of angiosperms: A general account of the origin and evolution of angiosperms (special reference to Bennettitalean, Gnetalean, Caytonialean and herbaceous origin theories); primitive living angiosperms- basal angiosperms; co-evolution of angiosperms and animals. - Systems of Classification: Bentham and Hooker's Classification; Engler and Prantl's system, Hutchinson's system, - Modern and Molecular Taxonomy: Supporting evidences for taxonomy; taxonomy in relation to anatomy, embryology, palynology, ecology, cytology, chemotaxonomy. Cladistics and its approaches and their utility (for taxonomy review only).- Diagnostic characters and economically important members of the Salicaceae families: Annonaceae, Gaopariadateae,

Cleornaceae, Stemulaareae, Tiliaceae, hctiiaesai Viticeae, Anecardiaceae, Mimosaceae, Myriaceae, Cucurbitaceae, ikpiaceae, Rublatae, Sapolucae, Ascleplaclacea, Verbenaceae, Arnaranthacea, Euphorbiacea, Cannaceae, Likaceae and Poaceae.

Genetic engineering of plant vectors for gene delivery. selectable markers and reporter genes, effects of genetic diversity, development of transgenics: *Agrobacterium* - the natural genetic engineer; plant movements in crop biotechnology (with suitable examples) and prospects, recombinant DNA technology. Restriction enzymes, prokaryotic and eukaryotic cloning vectors, genomic and cDNA libraries; Southern and Northern Blotting, various techniques of gene mapping and DNA fingerprinting (RFLP, RAPD, AFLP); chromosome walking, polymerase chain reaction; DNA sequencing. - Plant Tissue culture: History, Cellular differentiation and totipotency, organogenesis and embryogenesis; protoplast isolation and culture; somatic hybridization; clonal propagation; - Industrial Botany: Antibiotics, Production of acid and enzymes, Introduction to preparations of a few herbal drugs. Medicinal plants, natural dyes and biofertilisers - Mushroom cultivation: Commercially cultivated edible mushrooms - biology and cultivation aspects., Medicinal mushrooms.

Genetics and Molecular Biology - Genetic Inheritance: Mendelism; laws of segregation and independent assortment; gene interactions; linkage analysis; allelic and non-allelic interactions. - DNA the genetic material: DNA structure; replication: DNA-protein interactions; the nucleosome model; genetic code; satellite and repetitive DNA - Genetic variations: Mutations, spontaneous and induced; transposable genetic elements; DNA damage and repair.

Cytogenetics:- Chromosome variations- nature and consequences of altered chromosomal structure, Deletions, Duplications, inversions, translocations, Ploidy- Variations in chromosome number, haploids, diploids and Polyploids, auto and allopolyploids, aneuploids and their importance, linkage or genetic mapping, In situ hybridization, Flow cytometry in karyotype analysis. - Population Genetics: Population and gene pool, Genetic variation and evolution; Genotypic and gene frequencies: Measuring genetic variation, Polymorphism and heterozygosity; Genetic variations in natural populations, Evolutionary change and the Hardy-Weinberg law; applications of the Hardy-Weinberg law. Migration; random genetic drift and bottlenecks. - Gene expression: Structure of genes - transcription of genes into mRNA, translation of mRNA into protein, primary structure of proteins, regulation of gene expression: regulation of gene expression in Prokaryotes (operon concept) and eukaryotes; -

Applied Botany and Analytical Techniques and Biostatistics - Forestry : Silviculture — General silviculture practices, special approaches; Silviculture of important trees *Acacia nilotica*, *Albizia lebbek*, *Butea monosperma*, *Daibergia sisoo*, *Erblica officinalis*, redwood trees - Agroforestry — scope and necessity; agro-forestry systems under different agro-ecological zones; role of multipurpose trees and NTFPs - principles, objectives, methodology, scope, benefits and role of NGOs. - Microscopy: Principles of light and electron microscopy; phase contrast and fluorescence microscopy; TEM, SEM and STEM - Spectroscopy: Principle and applications of X-ray, UV, Visible and IR spectroscopy

Chromatography: Principles and types of various chromatographic techniques. - Electrophoresis: Principle of electrophoresis; instrumentation and different kinds of electrophoretic techniques. -Centrifugation: Principle of centrifugation - types of centrifuges.- Biostatistics Introduction: Sampling methods in biological experiments, Data generation and – compilation - Measures of variation: Types, mean deviation, standard deviation and standard error.

Probability distribution- Types of Probability, Relevance in biological sampling - Testing the Data: Chi-square test, Test Analysis of Variance - Regression and Correlation: Components, utility aspect, applications in biological research, statistical analysis. graphic and simulation studies

Plant pathology - Pathology Historical developments, general account of diseases caused by plant pathogens

Pathogen attack and defense mechanisms, Plant-pathogen interactions, Phytochemistry, physiological, SAR and molecular aspects - Plant disease management; Chemical control, biological control, IPM systems, biopesticides - Major Plant Diseases: -

Differentiation between bacterial, viral and fungal diseases - the following diseases - their symptoms, causal organisms - disease control, - Aerial diseases - Citrus Canker, Angular leaf spot - Viral diseases - Leaf curl of papaya, Yellow vein mosaic - Fungal diseases - White rust of crucifers, red rot of sugarcane, rikka disease of groundnut, Stripe rust of wheat, and wilt of pigeon pea, Mosaic diseases.