

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT.
SYLLABUS FOR M.Sc.-I & M.Sc. – II BOTANY.
IN FORCE FROM JUNE – 2003 – M.Sc. –I.
IN FORCE FROM JUNE – 2004 – M.Sc. –II.

Master of science examination in the Subject of Botany shall consist of two parts – M.Sc. –I and M.Sc. – II. For each examination there shall be four written papers and three practical. Each theory paper shall be of 75 marks and 3 hours duration and three practicals of 140 marks, each of 5 hours duration. 20 marks are for Botanical excursions, records, Submission and Viva-Voce examination. Students have to attend the botanical excursions tour as and when scheduled by the department and have to submit the tour report. (For the final examination)

M.Sc. Part – II (In force from June 2004)

Theory	External Evaluation	Internal Evaluation	Total
Paper-V	52	23	75
Paper-VI	52	23	75
Paper-VII	52	23	75
Paper-VIII	54	21	75
	210	90	300

M. Sc. Part-II. Botany
(In force from June-2004)

Paper-	V	:	Cytology, Genetics, Biotechnology, Genetic Engineering, Plant resources and their utilization.
Paper-	VI	:	Physiology, Ecology and Phytogeography
Paper-	VII	:	Forest Botany, Applied Botany and Botanical techniques.
Paper-	VIII	:	Elective (Special Paper)-Any one. Angiosperms- Systematics. Plant Physiology. Phycology Structural Botany.

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT.

M.Sc. Part – II BOTANY PEPER V

Cytology, Genetics, Biotechnology, Genetic engineering, Plant resources and their utilization.

Unit I: Cytology :

- (I) Ultra structure of cell organelles:
Nucleus, Ribosomes, Lysosomes, Sphaerosomes, Plasma membrane, Endoplasmic Reticulum, Chloroplast, Plant Vacuoles, Golgi bodies.
- (ii) Cytoplasmic inheritance.
- (iii) Cell-division: Mitosis, Meiosis
- (iv) Genetic recombination and genetic mapping: Molecular mechanism of recombination; role of RecA and RecBCD enzymes, sites-specific recombination; Chromosomes mapping, linking groups, genetic markers, construction of molecular maps, correlation of genetic and physical maps.

Unit II: (i) **Molecular cytogenetics:**

Nuclear DNA content, c-value paradox; cot curve and its significance, restriction mapping-concept and techniques; multigene families and their evolution, in situ hybridization-concept and techniques; multigene families and their evolution, in situ hybridization – concept and techniques; computer assisted chromosomes analysis, chromosomes microdissection and microcloning; flow cytometry and confocal microscopy in karyotype analysis.

(ii) **Alien gene transfer :**

Alien gene transfer through chromosome manipulation. Transfer of whole genome, examples from wheat, Arachis and Brassica; transfer of individual chromosomes and chromosome segments; methods for detecting alien Chromatin; production, characterization and utility of alien addition and substitution lines; genetic basis of inbreeding and heterosis; exploitation of hybrid vigor.

Unit III: **Bio technology :**

- (i) Basic concepts, principles and scope.
- (ii) Plant cell and tissue culture: General introduction, history, scope, concept of cellular differentiation, totipotency.
- (iii) Organogenesis and adventive embryogenesis Fundamental aspects of morphogenesis; Somatic embryogenesis and androgenesis, mechanisms, techniques and utility.
- (iv) Application of plant tissue culture: Clonal propagation, artificial seed, production of hybrids and somaclones, production of secondary metabolites, natural products ,cryopreservation and germplasm storage.
- (v) 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.

Unit IV: Genetic engineering of plants:

Aims, Align text strategies for development of transgenic (with suitable examples), Agrobacterium – the natural genetic engineer, T- DNA and transposon mediated gene tagging, chloroplast transformation and its utility, intellectual property right, possible ecological risks and ethical concerns.

Unit V: Plant resources and their utilization :

- (i) Vegetables and fruits: Their botanical names and morphology of the parts used as vegetables, edible parts of the fruit. The cultivation of fruits.
- (ii) Spices, flavouring materials, Phyto aromatic substance.
- (iii) Beverages and Beverage plants.
Non-alcoholic : Sources and processing of Tea, coffee, Cocoa
- (iv) Sugar producing plants : sugar cane, sugar beet and palm sugar.
- (v) Paper Raw materials, manufacture of paper, kinds of paper and paper products, paper industry in India.
- (vi) Natural Dyes: Turmeric, Henna, Indigo, Rubia, Saffron.
- (vii) Narcotic plants: Cultivation, harvesting, curing and use of Tobacco, Opium, Cannabis.
- (viii) Edible mushroom and their cultivation, Bio degradation, Biofertilizer.

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT.

M.Sc. Part – II BOTANY

PAPER – VI

PHYSIOLOGY, ECOLOGY AND PHYTOGEOGRAPHY

Unit – I : PHYSIOLOGY :

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, passive and active solute transport, membrane transport proteins.

Signal transduction: Overview, receptors and G-proteins, phospholipid signaling, role of cycle nucleotides, calcium-calmodulin cascade, diversity in protein kinases and phosphatases, specific signaling mechanisms, e.g. two-component sensor-regulator system in bacteria and plants, sucrose-sensing mechanism.

Photochemistry and photosynthesis : General concepts and historical background, evolution of photosynthetic apparatus, photosynthetic pigments and light harvesting complexes, photo oxidation of water, mechanisms of electron and proton transport, carbon assimilation – the Calvin cycle, photorespiration and its significance, the C₄ cycle the CAM pathway, biosynthesis of starch and sucrose, physiological and ecological considerations.

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

Plant growth regulators and electors : Physiological effects and mechanism of action of brassinosteroids, polyamines, jasmonic acid and salicylic acid, hormone receptors, signal transduction and gene expression.

Unit –II : ECOLOGY :

Climate, soil and vegetation patterns of the world : Life zones, major biomes and major vegetation and soil type of the world.

Vegetation organization : Concept 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), change in ecosystem properties during succession.

Ecosystem organization : Structure and functions, 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 climate factors), global biogeochemical cycle of C,N, P and S, mineral cycle (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.

Climate change : Greenhouse gases (CO₂, CH₄, N₂O, CFCs, sources, trends and role), ozone layer and ozone hole, consequences of climate change (CO₂ fertilization, global warming, sea level rise, UV radiation).

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

Unit –III : ECOLOGICAL MANAGEMENT :

Concept, sustainable development, sustainability indicators.

Weeds : Weeds and their controls.

Natural resources and their conservation

Unit – IV : PHYTOGEOGRAPHY :

Phytogeography : Principles of dynamic phytogeography. Major phytocnoria of the world.

Forests, Grasslands, Deserts.

Indian Deserts,

Mangrove of India,

Phytogeographical provinces of India,

Phytogeography of Gujarat.

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT.

M.Sc. Part – II BOTANY

PAPER – VII

FOREST BOTANY, APPLIED BOTANY AND BOTANICAL TECHNIQUES

UNIT – I : FOREST BOTANY :

1. Main forest type of Indian and their floristic composition.
2. Different forests of Gujarat and their vegetation.
3. Forest products
 - (a) Major forest products of India and their utilization.
 - (b) Following minor forest products of India and their utilization
Timaru leaf, Gums, Resins Mahuda and Wild taxa g medicinal importance .
4. Conservation of forests-Insitu and exsitu conservation
5. Social forestry and Agro forestry.

UNIT –II : APPLIED BOTANY :

1. Collection and processing of plant drugs, storage and preparation of drugs.
2. Herbal drugs – their sources, character and uses.
3. Pharmacognosy of Neem Rauwolfia, Adhatoda, Withania, Aloe, Ginger and Garlic.
4. Ethnobotany.
Protocol of Ethno Botanical investigation, its importance and Ethnobotany of Gujarat.

UNIT – III BOTANICAL TECHNIQUES

(A) Herbarium technique

1. Routine Herbarium technique uses and importance of Herbaria, Major herbaria of the world and India. Preparations of Museum Specimen.
2. Preparation of artificial key for plant identification. Use of taxonomic literature for identification of the plant.

(B) Anatomical – Microscopic methods

Free Hand sectioning, Maceration.
Microtome sections: Fixation Dehydration, Infiltration, embedding, Sectioning and Staining.

(C) Cytological Smearing technique

Micrometry, use of Camera Lucida

(D) Ecological methods

Uses of Ecological instruments.
Methods of floristic survey.
Quadrat and transect methods.
Soil analysis, Study of different properties of water and soils.

(E) Physiological methods

Chromatography, electrophoresis.
Calorimetric analysis, Enzymes activity.
Extraction and purification of organelles and compounds.

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT.

**M.Sc. Part – II BOTANY
PAPER – VIII (ELECTIVE)
ANGIOSPERMS – SYSTEMATICS**

UNIT – I

1. Botanical Gardens and their users
2. Botanical survey of India
3. Literature of taxonomy: Floras, Manual, Index, Monographs, Glossaries, Catalogues, Journals, Textbooks, Encyclopedia and Dictionary
4. Botanical Nomenclature – ICBN
A detailed knowledge of different principles and their significance.
Names of hybrids, names of cultivated plants, draft biocode.

UNIT – II :

Taxonomy in relation to Anatomy, Embryology, Cytology, Palynology and Phytochemistry.

UNIT – III :

1. Numerical taxonomy.
2. Chemotaxonomy.
3. Serotaxonomy
4. Application of DNA hybridization technique in taxonomy.

UNIT – IV :

1. Fossil angiosperms.
2. Origin and evolution of Angiosperms.
3. Endemism.
4. Special type of Angiosperms (a) Epiphytes (b) Parasites (c) Saprophytes (d) Insectivorous plants.

UNIT – V

Phylogeny and Floral Variations in Rosales, Myrtales, Gentianales and Helobiales.
Study of the following families with reference to their geographical distribution, systematic position, floral variations, uses and examples (scientific names)

Bixaceae, Flacourtiaceae, Resedaceae, Polygalaceae, Caryophyllaceae, Tamaricaceae, Elatineae, Zygophyllaceae, Simaroubaceae, Burseraceae, Ochnaceae, Averrhoaceae, Onagraceae, Alangiaceae, Ebenaceae, Myrsinaceae, Polemoniaceae, Pedaliaceae, Martyniaceae, Phytolaccaceae, Aristolochiaceae, Piperaceae, Lauraceae, Iridaceae, Alismaceae, Eriocaulaceae.

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT.

M.Sc. Part – II BOTANY

PAPER – VIII (ELECTIVE) PLANT PHYSIOLOGY

Unit – 1 :

1. Nitrogen Fixation:

Formation of legume root nodules, biochemistry of nitrogen fixation, gaseous exchange in nodules. The role of leghemoglobin. Ammonia assimilation pathways. Relationship with Photosynthesis factors affecting nitrogen fixation.

2. Translocation of nutrients and hormones.

3. Water relations :

Water movement water relation of cells and tissues. Determination of water status. Active water transport. The significance of transportation. Water movement through the soil, water movement across the root. Water movement through the vascular system, leaf and whole system factors affecting transportation.

4. Ionic relations.

Basic aspect of membrane structure, driving forces on ions, effect of ionic concentration on the rate of transport, regulation of ion transport.

5. Phytochromes :

Introduction , discovery, phytochrome as a photoreceptor , Properties, Isolation, Purification and assay. Structure and properties, Phytochemistry dark reversion and destruction, mode of action.

6. photomorphogenesis :

Photochrome, cytochrome, phenomenology of photomorphogenesis, cellular and regulatory aspects of photomorphogenesis.

7. Senescence and Abscission

Natural selection and distribution metabolic regulation, monocarpic senescence.

Abscission:– Abscission zones, time, cell-biology, mechanics, biochemistry induction of abscission.

Unit II :

Plant Tissue Culture : Methods and Applications.

- (i) Background and prerequisites : Milestones, laboratory – facilities, types of cultures, nutritional mediacomposition , supplements including plant growth regulators, initiation and maintenance, of cultures.

- (ii) Growth Parameters, measurements, primary and secondary metabolites, morphogenesis – differentiation , totipotency , organogenesis.

Unit III :

- (i) Plant propagation : Axillary bud proliferation, adventitious shoots, meristem culture somatic embryogenesis - artificial seeds.
- (ii) Field transfer of in vitro Plants : Preparation , requirements, greenhouse, nethouse , pathogen certification , packaging – transport, transplantation to be the field.

Unit IV :

- (i) Organ cultures and their applications : Anther/ pollen culture , androgenesis, requirements.
- (ii) Exploitation of tissue culture techniques: for – selection of cell lines through somaclonal variation.
 - production of secondary metabolites, biotransformation, immobilization.
 - Conservation of germplasm through micropropagation .

Unit V :

- (i) Plant modifications : protoplast – isolation, culture, hybrids – their selection, cybrids.
- (ii) Plant transformation : Agro bacterium tumefactions, other vectors, direct methods, electroporation, micro projectile bombardment, Transgenics.

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT.

**M.Sc. Part – II BOTANY
PAPER : VIII
PHYCOLOGY (ELECTIVE)**

UNIT – I :

- (iii) Cyanophyta : Systematic position, taxonomy, salient features upto order level. Symbiotic association of blue green algae with fungi, bryophytes, pteridophytes and gymnosperms.
- (iv) Chlorophyta : Classification based on international congress of systematics, salient features upto order level, general account of reproduction phylogeny and life cycle patterns.

UNIT – II :

- (i) Rhodophyta: Classification, salient features upto order level, reproduction, sexual and asexual, types of sporangia, carpogonium, spermatangia, fertilization, variation and development of carpospores. Life cycle and phylogeny.
- (ii) Phaeophyta: Classification, salient features upto order level, reproduction- asexual and sexual reproduction, life cycle patterns and phylogeny.

UNIT – III :

- (i) Physiology, biochemistry and genesis of nitrogen fixation in heterocystous and non-heterocystous forms of blue green algae. Toxins produced by blue green algae.
- (ii) Cell biology – Detailed cell structure of the cyanophyta and chlorophyta, comparative account of structure of plastids and pigments in algae. Detailed ultrastructure of flagella in algae.

UNIT – IV :

- (i) Applied Phycology : Seaweed cultivation and their commercial industrial products. Blue green algae and seaweeds as biofertilizers. Role of algae as pollution indicators. and in pollution control. Spirulina – single cell protein.
- (ii) General account of habit and habitat of algae, Range of thallus structure in algae, collection, preservation of algae, preparation of herbaria and permanent slides.

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT.

M.Sc. Part – II BOTANY PAPPER : VIII STRUCTURAL BOTANY (ELECTIVE)

UNIT – I

- (i) Nodal anatomy and evolutionary significance.
- (ii) Meristems: primary and secondary; apical organizations in cryprogams, gymnosperms and angiosperms.
- (iii) Epidermis: Aerial parts, cuticle, hairs, cork, crystal cells, stomata, stomatal frequency and index, development of stomata, distribution of stomata, types of stomata.

UNIT-II

- (i) Vascular cambium: development of fusiform initials, development of ray initials, seasonal effects on cambium activity, Factors affecting cambium activity, Polarity of cambium, Vascular cambium in monocots, Periderm factors affecting formation and activity of phallogen, wound periderm, induction of secondary xylem.
- (ii) Floral apex and general anatomy of flower.
- (iii) Transfer cells-occurrence and ontogeny of transfer cells. Form and function of wall ingrowth, function of transfer cells. Factors controlling the differentiation of transfer cells, genetic and evolution ary aspects.

UNIT-III

- (i) Absorbing tissues-Definition, kinds of absorbing tissues and their importance in biological processes.
- (ii) Stelar and stelar evolution, detailed structure of steles and evolution.
- (iii) Anatomical structures of dehiscent and indehiscent fruits, structural change during the growth and fruit abscission.

UNIT – IV

- (i) Seed: Structural changes during the seed development, structure of seed coat of Ricinus, Brassica and Glycine, Cucurbita, Phaseolus, Thrinax, Nutrient storage tissues of seed.
- (ii) Anatomy in relation to taxonomy.

REFERENCE BOOKS

ALGAE :

- | | |
|--------------|--|
| Bold H.C | Introduction to Algae, structure and reproduction.
1978 Prentice Hall of India Pvt.Ltd. New Delhi |
| Boney A.D. | 1966 The Biology of Marine Algae, Hutchinson, London |
| Carter N.C. | Fresh water Algae from India |
| Chapman V.J. | 1980 Seaweeds and their uses, 2 nd edi. Methuen, London |

- Chapman V.J. 1962 The Algae, Macmillan Co., London
- Desikachary T.V. 1969 Cyanophyta I.C.A.P, New Delhi
- Fritsch F.R. 1945 The structure and reproduction of the Algae Vo.I & Vo.II
Camb.Uni.Press, London
- Jackson D.F. Algae and man
- Khan M. Algae today
- Kumar H.D. & H.N.Singh 1976 Text book of Algae East West Press
New Delhi
- Kumar H.D. Algae cell biology
- Kumar H.D & Singh H.N. A Text Book of Algae
- Morris I 1968 An introduction to Algae, Second edi.
Hutchison & Co., London
- Pal B.R. 1968 Charophyta I.C.A.R., New Delhi
- Randhava M.B. 1959 Zygnemataceae I.C.A.R., New Delhi
- Robert Edward Lee 1980 Phycology – Camb.Unit.Press
Cambridge, London, New-York
- Round F.E The Biology of the Algae
- Sharma Y.R. Algae Taxonomy in India
- Sharma O.P 1986 Text Book of Algae – Tata McCraw Hill
Publishing Co., New Delhi
- Silva P.C. Names of Classes, families of living Algae
- Smith G.M. 1955 Cryptogamic Botany Vol.I
McCraw Hill Books Co., New York
- Smith G.M. 1956 Fresh Water Algae of the United States
2nd edi. McCraw Hill Books Co., New York
- Vashista B.R. 2001 Algae – S.Chand & Co.Ltd., New Delhi.
- Samit Ray Cyanobacteria, New Age International, Delhi, India.

FUNGI

- Alexopoulos C.J. Introduction to Mycology 3rd edi.
- Mims C.N. 1975 John Ailey & Sons
- Bessey F.A. 1950 Morphology and Taxonomy of Fungi
Constable, London
- Bilgrami P.S. Physiology of Micro organism
- Gaumann E.A. 1928 Comparative Morphology of Fungi
McGraw Hill Book Co., New York
- Hawker L.E. 1967 An Introduction to Fungi
Hutchison & Co.Ltd. London
- Ingold C.T. 1965 Spore Libeation, Uni.Press, Oxford
- Kamat M.N. 1959 Handbook of Mycology
Prakash Pub. House, Poona.
- Sharma P.D. 1987 The Fungi - Rastogi & Co., Meerut
- Wolf F.A. & 1947 The Fungi Vol.I & II
Wolf P.T. John Wiley & Sons, New York
- Vashista 2001 Fungi – S.Chand & Co. Ltd, New Delhi

VIRUSES : Plant Viruses and Virus diseases Waltham Mass-Chronica Botanica

- Bawden F.C. 1958 Introduction to Virus
- Boo L. Symptoms of virus diseases in plants
- Dube H.C. Text Book of Fungi, Bacteria and Viruses
- Kado C.I. Principles and Techniques in plant viruses
- Luvia S.E. General virology
- Mandaha C.L. Introduction to plant viruses
- Neordham Introduction of plant viruses

Ray Chaudhari Viruses and mycoplasma diseases in plants in India and their control
 Singh B.P. Current trends in plant virology

BACTERIA:

Buchanan R.E. General systematic Bacteriology
 Clifton C.E. 1958 Introduction to the Bacteria
 McGraw Hill Book Co., New York
 Oginsky E.L. Introduction to Bacterial Physiology
 Salle A.I. Fundamental Principles of Bacteriology
 Thimann K.V. 1955 The Life of Bacteria – McMillan Co., New York
 Wedberg S.E. Microbes and You.

LICHENS:

Arya H. Microbiology and Lichens
 Sahina Y. Chemistry of Lichens
 Gilbert O.I. 1973 The Lichens – Academic Press, London
 Gulberson C.P. Chemical and Biological guide to Lichen products
 Milhva A. Lichens
 Singh A. Lichens of India

PLANT PATHOLOGY

Bilgrami K.S. & 1993 A Text Book of Modern Plant Pathology
 Dube H.C. Vikas Publishing House Pvt.Ltd.
 Horsfall J.G & 1960 Plant Pathology,
 Diomond A.E. Academic Press, London
 Singh P.S. 1969 Plant Diseases – Oxford and IBH
 Publishing Co., Culcutta

BRYOPHYTES :

Bower F.O. 1936 Primitive Land Plants
 The McMillan Co., New York
 Bower F.O. 1908 The Origin of Land Flora
 The McMillan Co., New York
 Cambell D.H. 1940 The Ecolotion of land plants
 (Embryophyta) Stanford Uni.Press, California
 Keshvan S.D 1929 Liverworts of the estern Himalayas Part I and the Punjab
 plain Part I University of the Punjab – Lahore
 1932 Part II – Uni.of Punjab - Lahore
 Parihar N.S. 1967 An Introduction to Embryophyta Voi.I
 Central Book Depot, Allahabad.
 Smith G.M. 1955 Cryptogamic Botany Vol.II
 McGraw Hill – New York
 Vashistha B.R. 2001 Bryophyta – S.Chand & Co.Ltd., New Delhi

PETRIDONHYTES

Bierhost D.V. 1971 Mophology of vascular plants – McMillan Co.NewYork
 Cambell D.H. 1905 The Structure and development of Mosses and Ferns,
 McMillan Co., New York

- Eames A.J. 1986 Morphology of Vascular Plants, Lower grounds
McGraw Hill – New York
- Foster A.S & Gifford F.M. 1959 Comparative Morphology of vascular Plants
Freeman, San Francisco
- Rashid A. 1982 An Introduction to pteridophytes
Vikas Pub.House P.Ltd., New Delhi
- Sporne K.R. 1962 The Morphology of Pteridophytes
Hutchinson Uni.Library, London
- Vashista 2001 Pteridophyta – S.Chand & Co.Ltd., New Delhi

PALAEO BOTANY

- Andrews H.N. 1961 Studies in Palaeobotany, John Willey & Sons, New York
- Arnold C.A. 1947 An introduction to Palaeobotany – McGraw Hill, New York
- Bold H.C. 1957 Morphology of Plants, New York
- Delevoryas T. 1962 Morphology and Evolution of Fossil Plants Hold, Peinhart
and Winstons, New York.
- Shukla A.C. & Misra S.P. 1982 Essential of Palaeobotany
Vikas Publishing P.Ltd.
- Valton J. 1940 An Introduction to the Study of Fossil Plants A.C. Block-
London
- Seward A.C. 1931 Plant life through the Ages
Cambridge Uni.Press, London.
- Stewart W.M. 1983 Palaeobotany and the Evolution of Plants
Cambridge Uni.Press, London.

GYMNOSPERMS

- Bhatnagar S.P & Moitra 1996 Gymnosperms – New Age International Ltd.,
New Delhi
- Bierhorst D.W. 1971 Morphology of Vascular Plants
McMillan Co. New York.
- Chamberlin C.J. 1934 Gymnosperms Structure and Evolution
Chicago Uni.Press, Chicago
- Coulter J.M. & Chamberlin C.J. 1917 Morphology of Gymnosperms
Chicago Uni.Press, Chicago
- Dallimore W & Jackson A.B. 1948 Hand Book of Coniferae – including Ginkgoaceae
(Revised edi.), Edward Arnold Ltd., London
- Foster A.S. & Gifford E.M. 1959 Comparative Morphology of Vascular Plants
W.H.Freeman Co. San Francisco (2nd Edition)
- Scott D.H. 1929 Studies in Fossil Botany Vol.2
Spermatophyta – A&C Block Co.London
- Seward A.C. 1919 Fossils Plants for students of Botany and Geology
Cambridge Uni.Press
- Sporne K.R. 1974 The Morphology of Gymnosperms
Hutchinson Uni.Press, London
- Vasistha P.C. 1993 Gymnosperms – S.Chand & Co.Ltd., New Delhi

- Bhatnagar S.P., A. Moitra 1996 Gymnosperms, New Age International, Delhi, India.
- Powar C.B. 2003 Cell biology, Himalaya publishing House , Delhi, India.
- Arora & Sandhu 2003 Genetics, Himalaya publishing House , Delhi, India.
- Sundara Rajan S. 2003 College Botany Vol.I to IV, Himalaya publishing House , Delhi, India.
- Gifford E.M. & Foster 1988 Morphology and Evolution of Vascular Plants
W.H.Freeman & Co. New York

ANATOMY

- Carlquist S. 1961 Comparative Plants Anatomy
Hol Rinchart & Wilston, New York
- Clowers F.A.L. 1961 Apical Meristems
Blackwell Co., Oxford
- Corner E.J.H. 1976 The Seeds of Dicotylesons
University Press, Cambridge
- Cutter E.G. 1971-78 Plant Anatomy Experiment and Interpretation
Edward Arnold Press Ltd., London
- Eames A.J & Mac Daniels L.N. 1947 An Introduction to Plant Anatomy
McGraw Hill Book Co.Inc., New York.
- Esau K. 1965 Plant Anatomy – John Wiley & Sons Inc. New York.
- Esau K. 1977 Anatomy of seed plants
John Wiley & Sons Inc. New York.
- Fahn A. 1967 Plant Anatomy – Pergamno Press, Oxford
- Fahn A. 1979 Secretory Tissues in plants – Academic Press, London
- Haberlandt G. 1914 Physiological Plant Anatomy
McMillan & Co., London
- Hall M.A. 1976 Plant Structure, Function and Adaptation
The McMillan Press, London
- Metcalf C.R. & Chalk L. 1950 Anatomy of Dicotyledons
London Monocotyledons clarendon Press, Oxford 2 Vol.
- Pande B.O. 1994 Plant Anatomy - S.Chand & Co.New Delhi
- Shah C.K. 1973 University Granth Nirman Board, Ahmedabad
- Singh V. 1987 Anatomy of Seed Plants
Rastogi Publication
Meerut.
- Pande P.C. & Jain D.K. 1966 Manual for plant Anatomy
C.V.Mosley Co. Saint Louis
- Tomlinson T.B. 1961 Anatomy of Monocotyledones –II Palmae
Clarendon Press Oxford
- Wardlaw C.V 1968 Morphogenesis in plants
Methuen & Co., London
- Wardlaw C.W. 1965 Organisation & Evolution in plants
Longmans, London

EMBRYOLOGY

- Bhojwani S.S. & Bhatnagar S.P. 1981 The Embryology of Angiosperms
Vikas Publishing House, New Delhi
- Coulter J.M & Chamberlin 1903 Morphology of Angiosperms
Systematic Embryology of the Angiosperms
- Davis G.L. 1966 John Wiley & Sons, New York

- Erdtman G. 1969 Hand Book of Palynology Morphology Taxonomy
Hafner Pub.Co., New York
- Maheshwari P. 1959 An Introduction to the Embryology of Angiosperms
McGraw Hill Books Co.Inc., New York.
- Raghavan V. 1976 Experimental Embryogenesis in Vascular Plants
Academic Press, London
- Street H.E.(edi) 1973 Plant Tissue and Cell cultures
Black Well Scientific Pub. Oxford
- Raghavan V. 1997 Molecular Embryology of flowering plants
Cambridge Uni.Press, Cambridge,
- Chopra V.L. 2001 Plant breeding : Theory and practice
Oxford IBH Pvt.Ltd., New Delhi

CYTO-GENETICS

- Ahluwalia K.B. 1991 Genetic Willey Eastern Ltd., New Delhi
- 1965 Genetics Oxford & IBH Publications
- Ranker J.R. 1966 Comp.Cal Bom.Mad.
Cytological Techniques (5th edi.)
Methuen, London
- Burns G.W 1969,-1972 The Science of Genetics
- Brachet J & 1959 The cell – Vol.1-5
Academic Press, New York.
- Mirsky A.E. 1971 Genetics – Oxford & IBH Pub.Co.Calcutta
- Cove D.J 1969 Cell and Molecular Biology
Academic Press, New York
- Derobertis E.D.P. 1984 Principles of Genetics
Wiley Eastern Pvt.Ltd., New Delhi
- Gardner E.J.& 1974 Foundation of Genetics
- Sunstad 1997 Cell-Biology – Himalayas Book Co.Bombay
McGraw Hill Book Co. New York
- Poi A.C. 1993 Genetics
S.Chand & Co. New Delhi
- Powar C.B. 1972 Cytoplasmic Genes and Organcells
Academic Press New York
- Verma P.S. & 1968 Principles of Genetics (2nd edi.)
McGraw Hill Book Co.
New York.
- Agarwal V.K. 1965 Chromosome Technique
Butterworkd, London
- Sagar Buth 1976 The Chromosomes – Oxford IBH New Delhi
- Sinnot E.I. 1957 Cytology and Cytogenetics – Prentice
Hill New York
- Dunn L.C & 1970 Molecular Biology of the gene 2nd edi.
L.A.Bunjamin
- Dobzhansky T. 1964 The Cytoplasm in heredity
- Sharma A.K. & 1964 The Cytoplasm in heredity
- Sharma A. 1964 The Cytoplasm in heredity
- Swanson C.P. 1964 The Cytoplasm in heredity
- Watson J.D. 1964 The Cytoplasm in heredity
- Wilkie D. 1964 The Cytoplasm in heredity

Methuen Book Co. London

Stent G.S. 1986 Molecular Genetics CBS Publication
 Vijendra Das L.D. 1998 Plant Breeding New Age International , Delhi, India.
 Rastogi Sc.Sharma 1995 Concept of Molecular Biology , New Age Inter. Delhi.India.
 V.N.Tondon Anuradha
 Arora Mohan P. 2001 Molecular Biology, H.P. House , India.

ECONOMIC BOTANY

Bor N.L. 1953 Manual of Indian Forester Oxford University Press, London
 Chopra.R.N. 1949 Indigenous Drugs of India Manager of Publications, Delhi.
 Chopra R.N. 1949 Glossary of Indian Medicinal Plants CSIR , New Delhi.
 Dastur J.F. 1951 Useful Plants of India Pakistan D.R. Taraporwala Sons & Co. Ltd. Bombay
 Eckey E. 1954 Vegetable Fats & Oils Reinhold Publishino Corroration New York.
 Finnemore, H. 1926 The Essential Oils Ernest Benn Ltd. London.
 Hill A.F. 1952 The Economic Botany McGraw Hill Book Co. New York
 Kirtikar K.P.& Basu B.D. 1933 Indian Medicinal Plants 3 Vol.
 Maheshwari P.& Singh U. 1965 Directory of Economic Plants in India ICAR , New Delhi.
 Pandey B.P. 1925 Economic Botany S Chand & Co.
 Roy, S.C. 1951 Monograph on Sugar Industry. Indian Central Sugar Cane Indu. New Delhi.
 Ranjit Singh 1963 Fruits , National Book Trust , India.
 Singh V.B.& Kirit Singh. 1996 Spices, New Age International Pub. New Delhi, London Bangkok .
 Sabnis S.D. 1990 Phytochemical Approach to Economic Botany, Kalyani Pub. New Delhi – Ludhiana.
 M. Deniel
 Vishwajit Chawdhari 1957 Vegetables , National Book Trust New Delhi.
 The wealth of India 1948-76 A Dictionary of India Raw Materials and Industrial Product CAIF New Delhi.
 Bendre Kumar Economic Botany Rastogi Publication Measur
 Kocchar S.L. 1998 Economic Botany In Tropics MacMillan India Ltd., New Delhi.
 Sambamurthy 1989 A Text Book of Economic Botany Wiley Eastern Ltd. New Delhi.
 A.V.S.& Subramangan
 Sharma O.P. 1996 Hills Economic Botany Tata McGraw Hill Co. Ltd. New Delhi.
 Chatwal G.R. 2003 Biopharmaceutics & Pharmacokinetics, H.P. House India.
 Parabia Minoo & Smita Pathak 2002 Apani Van Aushadhi (Gujarati) Vijay Offset, Surat, India.
 Anjaria J., Parabia Minoo, Ethnovet Heritage , Pathik International , Ahmedabad, India.
 Dwivedi
 Shah Bharat, Mahskar 2007 Apana Swasthyaman Vanaspati Jatan, Vadodara, India.
 Parabia Minoo

Kothari I.L. , M.H. 1998 Medicinal Plants India's Herbal Heritage , WHO KTC
Parabia,
G.C. Jadeja, T.V. Ramarao.(Edi.)
Corporation, Ahmedabad, India.

Physiology

- Bidwell R.G.S. 1979 Plant Physiology 2nd edi. MacMillan Publishing New York
- Bonner J.F. & Verner 1965 Plant Biochemistry Academic Press New York .
- Bourne G.H. 1964 Cytology and Cell physiology (3rd Edi.) Academic Press New York.
- Brachet J.& A.E. 1959- 61 The Cell Vol. 5 Academic Press
- Mistry
- Beevers H. 1961 Respiratory metabolism in Plants Harper and Row Pub. New York
- Crocker H. 1948 Growth of Plants Reinhold Publishing Comm. New York.
- Conn, E.& 1966 Outlines of Biochemistry John iley & Sons New – York.
- P.K.Stump
- Devlin R,M.& 1971 Photosynthesis Van Nostrand Reinhold "N"
- Paeker A.V.
- Dixon M.& F.C. Pebb 1964 Enzymes Academic Press, New – York.
- Goodvin T.V. 1967 Biochemistry of Chloroplast
- Purohit S.S. 2002 Photosynthesis : Physiological, Biochemical & Molecular Aspects,
Agrobios,India.
- Powar & Chatwal 2003 Biochemistry, H.P. House , India.
- Joshi J.V. Bhytochemishtry - Vanspati Rashayan – Uni.Granth Nirman Road
Ahmedabad
- Fogg,G.E. 1968 Photosynthesis Press Ltd. London.
- Leopold A.C. 1984 Plant growth & Development Mcraw, Hill Camn. N.Y.
- Leviti J. 1969 Introduction to Plant Physiology.
- Malcolm R. Milkins 1984 Advanced Plant Physiology – ELRS Es e, X-UK, Toppan
Co.Ltd.Tokyo.
- Malik C.P.& 1982 Text Book of Plants Physiology Kalyani Publishers New Delhi.
- A.K. Ghrivastava
- Pandey S.N. & 1982 Plant Physiology (6th Edi.) Vikas Pub. New Delhi.
- B.K. Sinha
- Phillips J.D.I. 1971 The Biochemistry and Physiology of Plant Hormones
McGraw Hill Comp. New – York
- Pridhan J.R. 1967 Terpenoid in Plants Academic P.N.Y.
- Steward F.C. 1964 Plants work Addison – Asley Pub.Com. Reading Mass.
- Tedeschi, H. Vatson 1974 Cell Physiology Academic Press , London.
- Wilkins M.R. 1968 Physiology of Plant Growth & Development .McMillan Hill Comp.
N.Y.
- Galston A.W. 1989 Life processes in Plants Scientific American Library , Springer –
Verlag New York. U.S.A.
- Hopkins , W.G. 1995 Introduction to Plant Physiology John Wiles & Sons , Inc. New York
U.S.A.

Ecology

- Ambhash P.S. 1974 A Text Book of Plan Ecology (3rd Edi.) Student Friends & Co.
Varanssi.
- Billings V.D. 1964 Plants & Ecosystem MacMillan & Co. London.
- Clarke G.L. 1954 Elements of Ecology John Willey & Sons New York.
- Daubenmire R.T. 1959 Plants and environment John Willey & Sons New York.

- Dash, M.C. 1993 Fundamental of Ecology .Tata McGraw Hill Publishing Com. Ltd. New Delhi.
- Etherington J.R. 1975 Environment and Plant Ecology John Willey & Sons .New York.
- Kumar H.D. 1981 Modern Concept of Ecology Vikash Pub.House New Delhi.
- Krebs C.J. 1985 Ecology 3rd Edi. Harper & Raw , New York.
- Mishra 1988 Manual of Plants Ecology 2nd Edi. Oxford & Ind. Publis Ind. Co. New Delhi.
- Mishra R. 1968 Ecology Work Book Oxford & Ind. Publis Ind. Co. New Delhi.
- Odum E.P. 1971 Fundamental of Ecology.
- Puri G.S. 1960 Indian Forest Ecology. Oxford Book Co. New Delhi.
- Sharma P.D. 1993 Ecology and Environments Rastogi Pub. Meerut .
- Raunkaiar C. 1934 The Life Forms of Plants and Statistical Plant Geography Clarendon Press Oxrord.
- Picklefs R.E. 1979 Ecology (2nd Edi.) Chiron Press New York
- Warming U. 1909 Ecology of Plants Uni. Press Oxford
- Weaver J.E. 1938 Plant Ecology McGraw Hill Book .New York.
- Vhittaker P.N. 1970 Communities and Ecosystem MacMillan Co. New York
- Smith R.L. 1996 Ecology and Field Bioligy. Harper Collins New York
- Kormondy E.J. 1996 Concept of Ecology . Prentice Hall of India Pvt. Ltd. New Delhi.
- Odum E.P. 1983 Basic Ecology Saunders , Philadelphia.
- Nair Burvey& Kadam 1993 Principles of Environmental Biology, H.P. House India.
- Sastri M.N. 1993 Introduction to Environmental
- Prabhakaran G. 2004 Introduction to Soil & Agricultural Microbiology, Himalaya Publishing House , Delhi, India.
- Arora Mohan P. 2004 Ecology, H.P. House , India.

Biotechnology:

- G.R. Chhatwal 1998 Textbook of Biotechnology Anmol publication Pvt. Ltd. New Delhi.
- K.S. Bilgrami Introduction to Biotechnology
- A.K. Pandey C.B.S. Publisher & Distributor.
- Keshave Trehan 1991 Biotechnology Wiley Easter Ltd. New Delhi.
- S.N. Jogdand Advances in Biotechnology Himalaya Publishing house .
- Gupta P.K. A Textbook of Biotechnology Rastogi Co. Meerut.
- Bohjwani S.S. & 1996 Plant Tissue culture : Theory & Practice. Elsevier Science Publishers, New York , U.S.A.
- Razdan , M.K.
- Callow J.A. Etal. 1997 Biotechnology & Plant Genetic Resources Conservation & Use. CAB International , Oxon NK.
- Raghavan V. 1996 Embryogenesis in Angiosperms. A Development & Expermental Study. Cambridge Uni. Press , New York . USA.
- Shantharam , S & Biotechnology , Biosafety & Biodiversity .
- Montgomery J.F. 1999 Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.

Biotechnology

- Kumar N.C. 1999 Biotechnology in Plant Science, H.P. House, India.
- Powar C.B. 2002 Cell Biology , H.P. House, India
- Jogdand S.N. 1996 Environmental – Biotechnology, H.P. House, India
- Joshi S.R. Biopesticides – A Biological Approach, New Age International Delhi India.

- S.N. Jogdand 2003 Advances in Biotechnology, Himalaya Publishing House, Delhi India.
Arora & Sandhu 2002 Genetcs, Himalaya Publishing House, Delhi, India.

Angiosperms :-

- Bailey L.H. 1949 Manual of Cultivated Plants The Maxmillan Comp. New York.
Benson L.B. 1957 Plant Classification D.C. Health Comp. Beston.
Benson L.B. 1962 Plant Taxonomy – Ronald Press New – York.
Core E.L. 1955 Plant Taxonomy – Prentice – Hall Engle – wood Cliff New – Jersey.
Cronquist 1968 Evolution and Classification of Flowering Plants , Nelson, New York
Davis , P.H. and 1963 Principles of Angiosperms , Taxonomy . Oliver & Road. Edinburgh.
V.M.Heywood
Gunderson A. 1950 Families of Flowering Plants E.L.R.S. Series , London.
Heywood V.H. 1970 Plant Taxonomy E.L.R.S. Series , London
Hutchinson J. 1959 The Families of Flowering Plants Vol. I – Dicotyledons Vol.II Mono
Cotyledons Oxford Uni. Press . London.
Jain S.K.& P.P.Raw 1977 Hand Book of Field – Herbarium Methods To- day & Tomorrow Pub.
Jeffrey C. 1968 An Introduction to Plant Taxonomy Oxford, London.
Jones S.P.& 1987 Plant Gystematics (2nd Edi.)
A.E. Luchsinger McGraw Hill New York .
Joshi J.V. 1998 Taxonomy of Angiosperms (Gujarati – version) University
Granth Nirman Board , Ahmedabad.
Lawrence G.H.M. 1951 Taxonomy of Vascular Plants Macmillan comp. New York.
Mukerjee, S.K. 1984 College Botany Vol. III New central Book Agency Calcutta.
Naik , V.N. 1984 Taxonomy of Angiosperms Tata McGraw Hill Publishing comp.Ltd.
New Delhi.
Radford A.E. 1986 Fundamentals of Plant Systematics Harper and Row New York
Rendle , A.R. 1930, 1961 The Classification of Flowering Plant Vol.I& II , Cambridge Uni.
Press , London.
Shah, C.K. 1972 Plant Classification . Guj.Uni. (Gujarati) Ahmedabad.
Shah, C.L. 1973 Plant Classification . Guj.Uni. (Gujarati) Ahmedabad.

Phyto – Geography & Forest Botany , Pollution.

- Bharucha 1983 A Text book of Plant Geography of Oxford Uni.Press. Bombay.
Champoin H.G. 1968 A Revised Survey of the Forest types of Indian Govt. of India Press,
& S.K. Seth Nasik .
Coupland , R.T.(edi.) 1979 Grassland Ecosystems of the World isp Cambridge Uni. Press,
Cambridge.
Daubynmire ,P. 1979 Plant Geography – Academic Press, London.
Good, R. 1953 The Geography of Flowering Plants (2nd edi.) Longmans Green &
Co.London.
Hynes , H.R.N. 1966 The Biology of Polluted Vaters Liverpool Uni. Press .Liverpool.
Kiwal J.M. 1978 Agricultural Ecology of Savanna Clarendon Press Oxford.
Kassam A&H
Macan ,T.T. 1974 Fresh Ecology 2nd edi. Longmann, London.
Parker ,H.W. 1977 Air Pollution Prentice – Hall Cliffs
Polunin N. 1960 Introduction to Plant Geography. Longmans . Co. Ltd. London.
Puri, G.S. 1960 Indian Forest Ecology Vol. I & II Oxford Book Comp. New Delhi.
Spedding D.J. 1974 Air Pollution Oxford Uni. London.

- Schimper F.W. 1903 Plant Geography upon a Physiological Clarendon Press , Oxford.
 Willis J.C. 1922 A Study in Geographical distribution and Eng. Origin of Species.
 Cambridge Uni. Press .
 Whyte , R.O. 1957 The Grassland and Fodder Resources of India.

Angiosperms Continue

- B.R.Bhattacharya, 1998 Flowering Plants Taxonomy & Phylogeny Narosa Publishing House
 B.M. Johri New Bombay
 Saxena and Saxena 2001 Plant Taxonomy Pragati Prakashan , Meerut.
 Guru Charansing 2000 Plant Systematics Theory & Practice – Oxford & IBH. Pub.New Delhi.
 M.P. Singh , Nagar Text book of Forest Taxonomy Anmol Publications Pvt. Ltd.
 & R.P.Roy. New Delhi.
 Kumar N.C. 1996 An Introduction to Taxonomy of Angiosperms.