

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

T. Y. B.Sc.

Botany [Special]

Paper – VI

[Botany of Cryptogams and fossil Botany]

Effective from June - 2003

(I) Algae

- (i) Occurrence and distribution;
Thallus organization, ultrastructure of algal cell, reproduction and economic important.
- (ii) Life histories of the following:
[excluding development]
 - a) Cyanophyceae: Rivularia, Tolypothrix
 - b) Chlorophyceae: Chlamydomonas, Chlorella, Cladophora, Chara
 - c) Phaeophyceae : Sargassum
 - d) Rhodophyceae : Polysiphonia.

(II) Fungi and Plant diseases:

- (i) General characters, classification and economic importance of fungi.
- (ii) Life histories of the following fungi.
 - (a) Mastigomycotina : Phytophthora
 - (b) Ascomycotina : Pencillium
 - (c) Basidiomycotina : Agaricus
- (iii) Diseases of plants and their control:
Bast and brown spot of rice, white rust of crucifers, Tikka disease of ground nut, citrus die back, powdery mildews of cucarbits and grapes.

(III) Bryophytes:

Classification and comparative study of morphology, anatomy; reproduction; broad interrelations of Hepaticopsida, Anthocerotopsida, Bryopsida, ecological and economic importance of bryophytes:

- (a) Hepaticopsida : Peleia, Porella
- (b) Anthocerotopsida: Anthoceros
- (c) Bryopsida : Sphagnum [excluding development]

(IV) Pteridophytes including Fossil:

- (i) Classification, Leptosporangiate and Eurspo-rangiate type of development, comparative account of morphology, anatomy and reproduction [excluding development].
 - a) Psilophyta : Psilotum, Rhynia
 - b) Lepidophyta : Isoetes, Lepidodendron

- c) Calamophyta : Sphenophylum, Calamites
 - d) Pterophyta: Ophioglossum, Osmunda, Marsilea, Azolla.
- (ii) Fossil botany, Elements of Paleobotany, Geological ages, and changes in organic life through ages [table], Fossilization processes Petrification, Cast or incrustation, Impression, Compression, Rocks of organic origin.

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Botany [Special]

Paper – VII

Biodiversity and Systematic of Angiosperm and Gymnosperms [including fossils], plants and their utilization:

(I) Angiosperms:

- (i) Introduction: Aims and concepts of systematic, identification, elementary knowledge of nomenclature, classification. [B and H system of classification]
- (ii) Primitive and advanced features of angiosperms
- (iii) Distribution and general characters of morphology and floral morphology, examples [Scientific names] of important plants of the following families:

Ranunculaceae, Magnoliaceae, Menispermaceae, Papaveraceae, Portulacaceae, Tiliaceae, Rhamnaceae, Vitaceae, Rutaceae, Sapindaceae, Lythraceae, Umbelliferae, Sapotaceae, Boraginaceae, Lenitibulariaceae, Acanthaceae, Polygonaceae, Loranthaceae, Casuarinaceae, Hydrocharitaceae, Orchidaceae [only for theory], Musaceae, Cannaceae, Palmae, Gramineae.

(II) Gymnosperms:

- (i) Classification and Salient features; evolutionary significance of Gymnosperms; Comparative general study of morphology, anatomy and reproduction of the following:
- (ii) Ginkgoales - Ginkgo
Gnetales – Gnetum

(III) Fossils : General Account of:

- (i) Cycadophylales : Lyginopteris, Laginostoma
- (ii) Cycadeoidales : Cycadeoidea
- (iii) Corditales : Cordites

(IV) Plants and their utilization:

- (i) **Fats and Oils:** Types of vegetables fats, Drying oils, Non-drying oils, Major oil yielding oil plants. Extraction and uses of coconut oil, Ground nut oil, Sunflower oil, Sisemum oil, Castor oil.
- (ii) **Plant fibres :** Cotton, Jute, Coir.
- (iii) **Timber and firewood species:** A general account, uses and properties of the following:
Tectona grandis, Acacia nilotica, Terminalia crenulata, Acacia auriculiformis, Gmelina arts or Dalbergia, latifolia, Adina cordifolia, Mangifera indica, Azadirachta indica, Angeiosus latifolia, Mitragyna parvifolia.
- (iv) **Medicinal Plants:** Distribution, parts used, constituents and medicinal uses of the following:

Glycyrrhiza glabra, Rauwolfia serpentina, Withania Somnifera, Cinnamomum zeylanicum, Terminalia arjuna, Adhathoda vasica, Aloe barbendensis, Ocimum sanctum, Emblica officianals, Terminalia bellerica, Trigonella foenugracum, Syzygium aromaticum. Abrus precatorius.

- (v) **Rubber:** Hevea rubber, properties of rubber, collection processing and uses of rubber, Panama rubber, Ceara rubber, Assam rubber Guayule rubber.

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Botany [Special]

Paper – VIII

Physiology, Ecology, Environmental Biology, and Biochemistry.

(I) Physiology:

(i) **Energy flow and enzymology:**

Laws of thermo-dynamics, concept of free energy, energy transfer and redox potential, classification and nomenclature of enzymes, enzymes as biocatalysts, physiochemical properties of enzymes, mechanism of action, cofactors and coenzymes, isoenzymes, kinetics of enzyme action, factors affecting activity.

(ii) **Respiration:**

Glycolysis, TCA cycle and its regulation electron transport in mitochondria, oxidative phosphorylation, Pentose Phosphate pathway, cyanide-resistant respiration, Anaerobic respiration, fermentation and RQ

(iii) **Growth:**

Definition, phases of growth, kinetics of growth, factors affecting the process of growth, features of growth, measurement of growth.

(iv) **Plant growth regulators:**

Introduction, mechanism of action, physiological effects, practical applications.

(v) **Senescence in plants:**

Introduction, classification, leaf senescence, mechanism of senescence, changes during senescence.

(vi) **Chromatography:**

Introduction, paper chromatography, ascending and descending paper chromatography, separation of chlorophyll pigments and amino acids.

(II) Ecology:

(i) **Population:**

Population characteristics, density, natality, mortality, vital index, survivorship, age distribution, and age pyramids, Biotic Potential, and environment resistance, population growth curves, population fluctuation and population dispersal.

(ii) **Plant Community:** Origin development and composition, characteristics, species diversity [Alpha, Beta and Gama], niche. Methods of studying vegetation: Quadrate, Frequency, Density, Abundance and Ecotone.

(iii) **Plant Succession:** Definition, causes of succession, processes in succession, significance of ecological successions, kinds of succession, Hydrosore and Xerosore.

- (iv) **Climax:** Concept, monocl意思, Polyclimax and information theory.
- (v) **Ecological instruments:**
Psychrometer, Thermograph, Hygrograph, Anaemometer, Prismatic compass, Soil thermometer.

(III) Environmental Biology:

- (i) **Vegetation types:** Vegetation types of Himalaya, Forests and deserts of Gujarat, Aquatic, Mangrove and Saline vegetation of Gujarat.
- (ii) Plant indicators and their role in environmental monitoring.
- (iii) Principles and methods in studying aquatic ecosystem with special reference to pH., temperature, total dissolved solids, dissolved oxygen, total alkalinity, carbonates, chlorides, sulphates.

[IV] Biochemistry:

- (i) Amino acid biosynthesis, protein biosynthesis, Protein degradation.
- (ii) Carbohydrates; classification, characteristics, biosynthesis and degradation of sucrose and starch.
- (iii) Lipid metabolism: Fatty acid biosynthesis and oxidation of fatty acids.

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Botany [Special]

Paper – IX

Cyto-genetics, Molecular Biology, Biotechnology, Anatomy and Embryology of Angiosperm.

- (I) **Cytology:**
- (i) Ultra structure of Nucleus, Chromosomes, DNA, Ribosomes, Plasma membrane, Golgicomplex, Lysosomes and their function.
 - (ii) Cell division: Mitosis.
- (II) **Genetics:**
- (i) Alternations in the genetic make up, change at the gene level. Genemutation: Introduction, definition, types of genesmutations, [Forward, Reverse, Frame Shift base substitution] spontaneous and induced, mutagenes, importance of mutation.
 - (ii) **Gene Synthesis:** Definition, DNA – replication in eukaryotic cell, enzymes of replication.
 - (iii) **Gene Action:** Operon model of Jacob and Monnad, Inducible and repressible system, gene action in eukaryotes.
- (III) **Anatomy:**
- (i) Root – stem transition.
 - (ii) Leaf abscission
 - (iii) Anamolous secondary Growth in the stems of Bouganvillaea, Mirabilis, Nyctanthus and Gnetum. Abnormal secondary growth in fleshy root in Radish and Beet.
- (IV) **Embryology:**
- (i) Microsporangium: Wall layers, Miscrosporogenesis.
 - (ii) Megasporangium: Structure and types of ovule, Megasporogenesis, types of embryo sacs, monosporic [Polygonum, eight nucleated type], bisporic [Allium eight nucleate type], tetrasporic [Fritillaria eight nucleate type]
 - (iii) **Embryo:** Embryogenesis in Dicotyled on [Nicotiana type], Monocotyledon [Poa type].
- (V) **Molecular Biology:**
- Gene organization in Prokaryotes, and Eukaryotes, Recombinant NA technology restriction, endonucleases, Prokoyotic and eukaryotic cloning vectors, various techniques of gene mapping and DNA finger printing.
- (VI) **Plant Biotechnology:**
- Cellular differentiation and totipotency; protoplast isolation and culture, somatic hybridization; clonal propagating; genetic engineering of plants, Vectors for gene delivery, Selectable markers and reporter genes; methods of gene delivery; Agrobacterium – the natural genetic engineer; Salient achievements in crop biotechnology [with suitable examples] and prospects.

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Botany [Special]

PRACTICALS

In paper VI and VII students are expected to study all the types as per syllabus [through fresh, preserved materials and permanent slides]. However, the specification is made for the paleobotanical slides, specimens.

PAPER VI and VII:

List of fossil slides [for practicals]:

- | | | |
|----|---------------|-----------------------------------------------------------------------------|
| 1. | Rhynia | T. S. Stem |
| 2. | Lepidodendron | T. S. of Lepidodendron stem
T. S. of Lepidostrobus
T. S. of stigmaria |
| 3. | Sphenophyllum | T. S. of Sphenophyllum stem
T. S. of Bowmanites |
| 4. | Calamites | T. S. of Calamites stem |
| 5. | Pteridosperms | T. S. of Lyginopteris stem
L.S. of Lagenostoma |
| 6. | Cordaites | T. S. of Cordaites leaf
T. S. of Cordaites root |

List of Fossil Stones:

Calamites stem
Annularia
Pterophyllum
Cordaites leaf

PAPER – VIII : [Setting of Experiments]

Plant Physiology:

- (1) To find out rate of photosynthesis by bubble counting method.
- (2) To find out effect of CO₂ concentration on rate of photosynthesis.
- (3) To find out effect of light intensity on the rate of photosynthesis.
- (4) Experiments on enzyme action:

- (a) Diastase or Amaylase.
- (b) Invertase.
- (5) To study the activity of enzyme urease and the factors effecting the activity [Temperature, concentration and time]
- (6) Estimation of total sugar and reducible sugar.
- (7) Separation of plant pigments by chemical and paper Chromatography methods.
- (8) Separation of amino acids by paper chromatography.
- (9) Use of colorimeter and pH meter.

Demonstration of Experiments.

(1) Growth:

- a. Pfeffer's auxanometer
- b. Arc Indicator
- c. Growth regions on root tip.

- (2) Experiment to Demonstrate Anearonic respiration.
- (3) Experiment to Demonstrate CO₂ is evolved during respiration.
- (4) Experiment to Demonstrate Kohne's tube fermentation experiments.
- (5) Experiment to demonstrate heat is evolved during respiration.
- (6) Experiments to demonstrate O₂ is used during respiration.
- (7) Ganong's respirometer.

To compare and measure [Respiratory Quotient by means of a pair of respiroscope].

ECOLOGY:

Aquatic Ecosystem:

- (1) Parameters: (PH) Temp, Total dissolved solids, Light penetration, Dissolved oxygen, Total Alkalinity, Carbonates, bicarbonates, Hardness, Calcium, magnesium, Chloride.
- (2) To study the biotic components of a pond ecosystem.
- (3) Study of ecological instruments as per theory.
- (4) Study of vegetation by quadrature methods.

PAPER – IX

For Practical following slides, experiments are to be studied.

Embryology :Megaspore mother cell, Diad. Embryosec 2 nucleate, 4 nucleate, 8 nucleate, T.S. anther, Pollentetrad, Pollen tube, Pollinia, Ebryo mounting Cucurbita.

Plant Anatomy:

- (1) Different types of steles, Maceration of any woody tissue, Measurement of microscopic structure and sketching with camera lucida.
- (2) Leaf fall slide (to be demonstrated)
- (3) Anamolous Secondary growth fleshyroot: Beat, Radish, Carrot.
- (4) Abnormal Secondary growth stem: Gnetum, Bougainvillea, Mirabillis, Nyctanthus.
- (5) Nodal Anatomy.
 - (a) Unilacunar
 - (b) Trilacunar
- (6) Hand section permanent slide preparation.
- (7) Use of microtome, Fixation, Dehydration, Infiltration, Embedding, Sectioning, staining, amonting [to be demonstrated].

Cytology:

- (1) Preparation of mitotic chromosomas from onion root tips.

The Practical examination shall include detailed Botanical description of plants, identification of natural orders and cryptogamic plants as well as preparations of material for microscopic examination. Candidates are expected to visit local and zonal botanical areas for collection of plants; their collections and micro slides shall be presented at the time of examination along with practical records. The candidate is expected to prepare microscopic preparation, measurement of microscopic structure and drawing camera lucida. The candidate is expected to set up physiological experiments.

Every candidate shall record their observations directly in the laboratory. Every journal signed periodically by the teacher in charge and certified by the head of the department at the end of the year.

Candidate shall produce their certified journal, collection of plants, and prepared micro slides at the practical examination. It shall be taken in to account by the examiners in assigning marks.

LIST OF BOOKS FOR THIRD YEAR B. Sc.
Paper – VI [Biology of cryptogams and fossil botany]
Algae

1. Smith G. M. Cryptogame Botany Vol. I
M. C. Graw Hill Book Co. Ltd.,
New Delhi, London (2nd Edition)
2. Vashi shtha B. R. Botany for Degree students
Algae
S. Chand & Co. Ltd.,
New Delhi (7th edition)
3. O. P.Sharma Algae
Tata McGraw Mill Co.,
Delhi – 110006.
4. S. N. Pandey A text book of Botany Vol. I [Algae, Fungi,
P. S. Trivedi Bacteria, Viruses, Lichens, Mycoplasma and
elementary plant Pathology.
Vikas Publishing House Pvt. Ltd., New Delhi.
5. Gangulee & Kar College Botany Vol – II
[Algae, Fungi, Bryophytes, Pteridophyta,
Gymnosperms & Paleo-Botany.
6. Vashishtha B. R. Botany for Degree Students Fungi.
S. Chand & Co. Ltd.
7. Leel Vaidh, C. Vasavada University Grandh Nirman Board, Ahmedabad.

BRYOPHYTA

- (1) Gangulee & Kar. College Botany Vol. II
New Central Book Agency,
Chintamani, Das Lane, Calcutta – 9
(6th Edi. Repri.)
- (2) Parihar N. S. An Introduction to Embryo – phyta Bryophyta,
Central Book Depot, Allahabad, Printed at
Indian Uni. Press, Allahabad.
- (3) Panday, Trivedi & Misra. A text book of Botany Vol – II [Bryo Phyto,
Ptaridophyta, Gymnosperms and Paleo –
Botany).
Vikas Publishing House Pvt. Ltd., New Delhi.
- (4) Smith G. M. Cryptogemic Botany Vol-II Mcgraw Hill Book
Co. Ltd., New York, London (2nd Edi.)

- (5) Vashishtha B. R. Botany for Degree Students
Bryophytes,
S.Chand & Co. Ltd.,
New Delhi. (5th Edi.)
- (6) Dwichingi Vanaspathies, University Grandalay Board, Ahmedabad.
Makand and Dave.

PTERIDOPHITES

- (1) Parihar N. S. The Biology & Morphology of Pteridophytes
Central Book Depot, Allahabad.
Published by Indian Uni. Press,
Allahabad (2nd Edition)
- (2) A. Rashid An Introduction to Pteridophyta
Vikas Publication House
New Delhi (1st Edition) Reprinted
- (3) Smith G. M. Cryptogamic Botany Vol – II
McGraw Hill-Kogakusha Co. Ltd.,
Japan (2nd Asian Edition)
- (4) Vashishtha P. C. Pteridophyta – Vascular Cryptogams.
S. Chand & Co. Pvt. Ltd., New Delhi
(4th Edition)
- (5) Vashishtha B. R. Botany for Degree students
Pteridophytes.
S. Chand & Co., New Delhi
(6th Edition)
- (6) Gangulee & Kar College Botany Vol. II
New Central Book Agency,
Chintamani Das Lane,
Calcutta – 9.
- (7) Panday, Trivedi & Misra A text book of Botany Vol – II.
[Bryophytae, Pteridophyte, Gymnosperm And
Paelo-Botany)
Vikas Publishing House Pvt. Ltd., New Delhi.

PAPER – VII

(Biodiversity and Systematics of Angiosperms and gymnosperms [including fossils], plants and their utilization).

- (1) Pandey B. P. Text book of Gymnosperms
S. Chand & Co., New Delhi
(1st Edition)
- (2) Vashishtha B. R. Botany for degree students
Gymnosperms
S. Chand & Co., New Delhi.
(1st Edition)
- (3) Sharma O.P. Gymnosperms, A treatise Pragati Prakashan,
Meerut.
- (4) Gangulee & Kar College Botany Vol – II
New Central Book Agency
Chintamani Das Lane,
Calcutta – 9.
- (5) S. N. Pandey, P.S. Trivedi, A text book of Botany Vol – II
S. P. Misra. Vikas Publishing House Pvt. Ltd.,
New Delhi.
- (6) Arnold C. A. An introduction to Paleo Botany, Mc Graw Hill
Book Co., New York, London, Toronto.
(1st Edition)

ANGIOSPERMS

- (1) C. H. M. Lawrence Taxonomy of Vascular Plants
Mcmillan Press, New York
(1st Edition)
- (2) Mitra J. N. An Introduction to Systematic Botany and
Ecology. The world Press Pvt. Ltd., Calcutta (1st
Edition)
- (3) Mukerjee College Botany, Vol. III New Central Book
Agency, 8/1 Calcutta – 700 009
- (4) Naik V. N. Taxonomy of Angiosperms Tata McGraw Hill
New Delhi (1st Edition)
- (5) Sutaria R. N. A text book of systematic Botany.
Khadiyata Book Depot Bala Hanuman,
Ahmedabad (3rd Edition)

- (6) Shukla P & Misra Introduction to Angiosperm Taxonomy
Vikas Publishing House Pvt. Ltd.,
New Delhi. (1st Edition)
- (7) V. Sing & D. K. Jain Taxonomy of Angiosperms,
Rastogi Publications, Meerut
(1st Edition)
- (8) V. D. Tiagi & S. Kshtrapal Texonomy of Angiosperms
(1st Edition)
- (9) Chapushp Vanaspati,
Vignan and Chasmibhut
Vignan – N. N. Udvardia University Granda Nirman Board, Ahmedabad.
- (10) Sapushpi Vanaspatina
kulo. Dr. J. Y. Joshi Dr. J. V. Joshi
University Grandh Nirman Board, Gujarat
Rajya, Ahmedabad.
- (11) Avrut Beejdhari
Vanaspatinu vargikaran Dr. J. V. Joshi,
University Grandh Nirman Board, Gujarat
Rajya, Ahmedabad.

ECONOMIC BOTANY

- (1) Albert F. Hill Medical Plants
National Book Trust India
Delhi (4th Edition)
- (2) Pandey B. P. Economic Botany
S. Chand & Co. Ltd.
Ramnagar, New Delhi
(3rd Edition)
- (3) V. Varma A text book of Economic Botany
Em Key Publication
New Delhi (4th Edition Reprinted)
- (4) P. K. Gujta Elements of biotechnology, Rastagi and
Company, Meerut.
- (5) Aarthik Vanaspati Vignan
– 1, M. K. Kapadia University Grandh Nirman Board, Gujarat
Rajya, Ahmedabad.
- (6) Aarthik Vanaspati Vigyan – 2, M. K. Kapadia Dr. V. S. Chudasama, University Grandh
Nirman Board, Gujarat Rajya, Ahmedabad.
- (7) Bendra, Kumar Economic Botany, Rastogi Publication, Meerut.

PAPER – VIII

[Physiology, Ecology, Environmental Biology and biochemistry]

- (1) Devlin R. M. Plant Physiology
Affiliated East-West Press Pvt. Ltd.
(3rd Edition)
- (2) Jain V. K. Plant Physiology
S. Chand & Co. Ltd., New Delhi.
(3rd Edition)
- (3) V. Varma Plant Physiology,
Em Kay Publication, Delhi
(3rd Edition)
- (4) S. N. Pandey &
B. K. Sinha Plant Physiology
Vikas Publishig House, New Delhi.
- (5) S. Kumar Gupta Plant Physiology
S. N. chand & Co., Jalandhar (P.S.)
- (6) H. S. Srivastava Plant Physiology
Rastogi & Co., Meerut.
- (7) S. Sundara Rajan Plant Physiology
Anand Publications Pvt. Ltd.,
New Delhi.

ECOLOGY

- (1) Bhatia & Sharma A treatise on plant ecology
Pradeep Publication
Jalandhar (Reprint)
- (2) Kumar H. D. Modern Concepts of Ecology
Vikas Publishing House, New Delhi.
(6th edition)
- (3) V. B. Mehra & S. Khanna Plant Ecology
S. Chand & Co. Ltd., New Delhi.
(2nd Edition)
- (4) Odum E. P. Basic Ecology
Saunders College Publishing
Japan (1st Edition)
- (5) P. S. Verma, v. K. Agarwal Principles of econogy
S. Chand &Co. Ltd.,
Ramnagar, New Delhi – 110055.
- (6) P. D. Sharma Elements of ecology
Rastogi Publication, Meerut
(5th Edition reprint)

- (7) V. Verma Emkay Publications, P-19,
East Krishna Nagar,
Delhi – 110 051
(5th Edition Reprinted)
- (8) R. C. Ambasht A text book of Plant Ecology.
Students, Friends & Co., Varanasi.
- (9) J. E. Weaver & F. E. Plant Ecology
Clement.
- (10) K. C. Mishra Manual of Plant Ecology
- (11) Vanaspathi Paristhiti Vidya Uni. Grandha Nirman Board, Ahmedabad
Prof. N. I. Dani and
M.D.Adhvaryu
- (12) Vanaspathi Paristhiti Vidya Uni. Grandha Nirman Board, Ahmedabad
Dr. Surendra M. Pandya

PAPER – IX

(Cyto-genetics, Molecular biology, Biotechnology, Anatomy and Angiosperm Embryology)

- (1) S. S. Bhojwani & Embryology of Angiosperms. Vikas Publishing
S. P. Bhatnagar House, New Delhi
(2nd Edition)
- (2) P. Maheshwari An Introduction to Embryology of Angiosperms,
McGraw Hill Book Co., London
(1st Edition)
- (3) Esau K. Anatomy of seed plants.
Wiley-eastern Pvt. Ltd., New Delhi
(3rd Reprint)
- (4) Eames & Macdaniels Plant Anatomy, Mc Graw Hill Book Co. Inc.
New York & London
(2nd Edition)
- (5) Fahn Plant Anatomy, Pergamon Press Ltd.,
Oxford England
(2nd Edition)
- (6) Dr. G. Haberlandt. Physiological Plant Anatomy
Today & Tomorrows Book Agency,
New Delhi (Reprint Edition)

- (7) Gandulee, Das Datta College Botany, Vol – I
New Central Book agency,
Chintamani Das Lane,
Calcutta – 9.
(6th Edition)
- (8) V. R. Dayansagar Cytogenetics, Tata Mc Graw Hill Pub.,
New Delhi.
- (9) C. B. Power Essential of cytology, Himalaya Publishing
House, Bombay
(2nd Edition)
- (10) U. Sinha & Sunita Sinha Cytogenetics, Plant Breeding & Evolution.
Vikas Pub. House, New Delhi
(5th Edition)
- (11) P. S. verma & V. K.
Agarwal Cell Biology, Genetics, Molecular Biology &
Evolution.
- (12) S. S. Khanna Genetics & evolution.
Central Book Depot,
Allahabad
(4th Edition)
- (13) E.Dp.DeRobertis cMf
Derobertis. Cell and Molecular biology Holt Saunders.
International Japan, Tokyo
(7th Edition)
- (14) Veerbala Rastogi Introductory Cytology.
Kedarnath Ramnath, 132, College road,
Meerut – 250001 (U.P.)
(9th Edition)
- (15) P. K. Gupta Cytology Genetics and Evolution
4th edition R. Print.
- (16) P. K. Gupta Geneticws (2nd Edition)
Rastogi Publications
Shivaji Road, Meerut – 250002
- (17) Veerbala Rstogi A text book of Genetics
Kedernath Ramnath, Meerut
(6th Edition)
- (18) M. P. Arora and G. S.
Sandhu Genetics
- (19) S. R. Agrawal Embryology of Angiosperms
Sahitya Bhandar, Agra

- (20) Anatomy: Singh, Pandey & Jain. Anatomy of seed plants. Rastogi Publication, Meerut.
- (21) B. P. Pandey Plant Anatomy, S. Chand & Co., New Delhi.
- (22) P. C. Vashishta Plant Anatomy S. Nagin & Co., Jalandur (P. S.)
- (23) Vanaspati Peshi Vidya, Chadurkar Uni. Grandha Nirman Board, Ahmedabad.
- (24) B. P. Pandey Plant Anatomy [Including Embryology and morphogenesis of Angiosperms] S. Chand & Co. Ltd., New Delhi.
- (25) B. P. Pandey Embryology of Angiosperms S. Chand & Co. Ltd.
- (26) H. S. Bhamrah, C. M. Chaturvedi A text book of Genetics. Anmol Publication Pvt. Ltd., New Delhi.
- (27) G. R. Chhatwal Text Book of Biotechnology, Anmol Publication Pvt. Ltd., New Delhi.
- (28) Keshav Trehan Biotechnology, Willey Easter Ltd., New Delhi.
- (29) K. S. Bilgrami, A. K. Pandey Introduction to Biotechnology. C. B. S. Publisher & Distributor, New Delhi.
- (30) S. N. Jogdand Advances in Biotechnology Himalaya Publications.
- (31) J. H. Weil General Biochemistry
- (32) Powar & Chatwal Bio Chemistry [Himalaya Publishing House]
- (33) Eric E. Com & others Outline of Biochemistry John Wiely & Sons
- (34) S. K. Verma Text Book of Plant Physiology and Bio-Chemistry. S. Chand & Company.