

SARDAR PATEL UNIVERSITY



**FACULTY OF SCIENCE
COURSE OF STUDY**

RULES OF DEGREE OF THE MASTER OF SCIENCE (M.Sc.) BOTANY

R.PG.Sc.1: A candidate who has obtained the degree of Bachelor of Science of this University or of any other University recognized as equivalent thereto may, after successful completion of the course work etc. prescribed for the M.Sc. degree examination, be admitted to the examination for the degree of M.Sc. in the respective subject as per the regulation prescribed in that behalf.

A candidate possessing a bachelors degree in science with atleast 40% marks in theory papers in external examinations will be held eligible for admission to the Master degree course in Botany offered by him / her at the Bachelors degree examination. However, the number of eligible applications as in above is less than available seats a candidate possessing bachelors degree in science with three subjects (optional-equal weightage) with atleast 40% marks in theory papers in external examinations will be held eligible for admission to the Masters degree course in Botany.

The degree of Master of Science will be taken by papers, Practicals and project work only.

R.PG.Sc.2: The examination for the various theory papers and laboratory work will be conducted under semester system. For this purpose each academic year will be divided into two semesters.

R.PG.Sc. 3: Candidates will be examined in each theory paper for 100 marks and each practical (Lab I & Lab II) for 100 marks wherever prescribed at the end of each semester. Project work will be undertaken during IV semester and examined for 200 marks. There shall be a viva-voce examination of 50 marks at the end of the each semester to be held by the university.

(i) For deciding result of M.Sc. examination at each semester the ratio between the internal assessment and external assessment will be 30:70.

For the purpose of internal assessment, the Department concerned will conduct at least one test in each semester. The Department will also arrange Quiz, Seminar etc. for internal assessment in theory course work and the Practicals. The distribution of marks will be as under: -

1.	Structure for each theory paper:				
	a)	Quiz	..	..	5 marks
	b)	Seminar	..	..	5 marks
	c)	Test	..	..	20 marks

				Total	30 marks

2. Structure for each practical

a)	Regularity, records and results	...	10 marks
b)	Test	... ..	20 marks

	Total		30 marks

R.PG.Sc. 4: Candidate shall be required to attend at least 75% of total theory, lectures, practical and project work organized under each of the courses by them during the semesters.

R.PG.Sc.5: (i) The Head of the department in consultation with other teachers of the department will prepare in the beginning of the year a detailed scheme of seminars, home work, quizzes, etc, and the Programme for the test examinations and the same will be announced to the candidates.

(ii) The records of the test examinations as well as seminars, home work, quizzes etc. will be maintained by the department concerned.

(ii) Every candidate shall maintain a regular record of his / her practical work that shall be duly certified by his / her teacher(s) from time to time.

R.PG.Sc.6: Candidates will be required to obtain at least 33% marks in the internal evaluation separately in each head of passing. A candidate who fails to obtain 33% marks in not more than two heads of passing, may be allowed to appear at the University examination by the head of the department concerned on the recommendation of the committee appointed by him to assess the candidate's overall performance.

(Note: A Head of passing will mean a course in theory or practical or project work).

R.PG.Sc.7: A candidate desirous of appearing at each semester examination my forward his / her application in the prescribed form to the Registrar through the Head of the University Post-graduate Department concerned on or before the date prescribed for the purpose under the relevant ordinances.

R.PG.Sc.8: The final result for the award of the degree will be declared on the basis of the grand total of all the Theory papers, Practicals, Project work and viva-voce prescribed for all semester examinations prescribed for the examination.

R.PG.Sc.9: Only those students who fail in not more than two heads of passing at each semester examination be allowed to keep terms at the semester. No candidate will be allowed to reappear in course in which he/she has already passed.

R.PGSc.10: Standard of passing:

The standard of passing at the M.Sc. degree examination will be as under:

(a) To pass any semester for the M.Sc. degree, a candidate must obtain at least 40% marks at the University Examination and 40% marks in the aggregate of

University and Internal examination in each course of Theory, Practical and Project work and 40% marks in Viva-Voce Examination.

(b) Award of Classes:

- (i) The successful candidates will be placed in Second Class if they obtain at least 50% or more but less than 60% marks in the aggregate of all semesters examination taken together.
- (ii) The successful candidates will be placed in First Class if they obtain at least 60% or more but less than 70% of the marks in the aggregate of the all the semesters examination taken together.
- (iii) The successful candidates in First Class who obtain at least 70% or more marks in the aggregate of all the semesters examinations taken together will be declared to have passed the examination in First Class with Distinction.

R.PG.SC.11: (i) A candidate who fails in more than two courses (any two of the total heads of passing) in a particular semester will not be admitted for further study at a subsequent semester and will be required to repeat the courses in which he / she has failed by joining the department as a regular student the semester in which these courses are again offered.

(ii) A candidate failing in not more than two courses at any semester examination will be allowed to continue to the subsequent semester. Such candidate of the First Semester will be permitted to continue his/her study upto Third Semester but will not be permitted to go to the Fourth Semester until he / she has cleared all the courses of the First Semester, even though he / she may have passed in Second and / or Third Semester.

R.PG.Sc. 12: The following will be the scheme of the examination for the M.Sc. Botany.

M.Sc. BOTANY SYLLABUS

I SEMESTER

- BOT-401: CELL AND MOLECULAR BIOLOGY
- BOT-402: BIOINSTRUMENTATION
- BOT-403: DIVERSITY OF LOWER PLANTS (ALGAE, BRYOPHYTES AND PTERIDOPHYTES)
- BOT-404: TAXONOMY & DIVERSITY OF SEED PLANTS
- BOT-405: LAB – I PRACTICALS
- BOT-406: LAB – II PRACTICALS
- BOT-407: VIVA VOCE

II SEMESTER

- BOT-501: ENVIRONMENTAL BIOLOGY
- BOT-502: GENETICS, PLANT BREEDING & EVOLUTION
- BOT-503: PLANT PHYSIOLOGY
- BOT-504: MYCOLOGY & PLANT PATHOLOGY
- BOT-505: LAB – I PRACTICALS
- BOT-506: LAB – II PRACTICALS
- BOT-507: VIVA VOCE

III SEMESTER

- BOT-601: PLANT DEVELOPMENT & REPRODUCTION
- BOT-602: PLANT BIOTECHNOLOGY
- BOT-603: PLANT METABOLISM AND PHYTOCHEMISTRY
- BOT-604: PHYTORESOURCE UTILIZATION & CONSERVATION
- BOT-605: LAB – I PRACTICALS
- BOT-606: LAB – II PRACTICALS
- BOT-607: VIVA VOCE

IV SEMESTER

- BOT 701 PROJECT WORK & VIVA VOCE

I SEMESTER

BOT 401: CELL AND MOLECULAR BIOLOGY

An overview of cell organization; Structure of pro-and eukaryotic cell.

Experimental approaches for studying cells : Various types of light microscopy, Electron microscopy, fixation and staining, cytochemical methods and cell fractionation (flow cytometry)

Cell organization: Structure and functions of membranes, nucleus, Chloroplast, Mitochondria, Endoplasmic reticulum, Golgi complex, ribosomes, lysosomes, peroxisomes and glyoxysomes. The cytoskeleton and cell motility – Microtubules, microfilaments and intermediate filaments.

Cell cycle and cell division.

Nucleic acids as carries of genetic information; Physical properties and structure of DNA and RNA.

Replication of DNA : Enzyme and proteins involved in replication. DNA repair mechanisms.

Transcription of DNA, post transcriptional modifications of RNA and control of transcription. Genetic code and its properties.

Translation of RNA in pro and eukaryotes. Control of translation and protein targeting.

References Books:

Molecular biology of the cell, 1994 : By Bruce Alberts et al; Garland publishing New York.

Cell and molecular biology, 1999 : By Gerald Karp, John Wiley, London.

Cell and molecular biology, 1987 : By DeRobertis and DeRobertis, Lee and Febiger, Washington.

Molecular cell biology, 2000 : By Lodish et al; W. H. Freeman & Company, Newyork.

BOT - 402: BIOINSTRUMENTATION

1. Principle and application of light, phase contrast, fluorescence, scanning and transmission electron microscopy, scanning tunneling microscopy, atomic force microscopy, confocal microscopy, cytophotometry and flow cytometry.
2. Preparation of microbial, animal and plant samples for microscopy. Types of microtomes and microtomy.
3. Principles, methodology and applications of gel – filtration, ion –exchange and affinity chromatography; thin layer and gas chromatography; high performance liquid chromatography, FPLC.
4. Centrifugation: Basic principle and application. Differential, density and ultracentrifugation.
5. Electrophoresis: Principle and applications of Native, SDS, Agarose and 2D gel electrophoresis.
6. Principle and method of biophysical analysis of biopolymer structure; X ray diffraction, fluorescence. UV, visible Spectroscopy, Atomic absorption and plasma emission spectroscopy. IR, NMR and ESR spectroscopy, MS and MALDI-TOF.
7. Principle and applications of tracer technique in biology: Radioactive Isotopes and half life of isotopes; Effect of radiation on biological system; autoradiography; Cerenkov radiation; radiation dosimetry; scintillation counting.
8. Biosensors: Principle and application.

References:

- Instrumental method of chemical analysis -Sharma BK
Instrumental methods of analysis- DA Skoog
An introduction to practical Biochemistry -Plummer
Instrumentation -Chatwal and Anand
Modern experimental Biology- Boyer
Sadasivam, S. and A. Manickam : Biochemical Methods. 2nd edition. New Age International (P) Ltd. New Delh.
Voet, D., J. G. Voet and C. W. Pratt : Fundamentals of Biochemistry. John Wiley & sons, Inc. New York.
Wilson and J. Walker. Principles and techniques of practical biochemistry
D. R. Browning. Spectroscopy :
H. H. Willard *et al.* Instrumental methods of analysis.
D. Freifelder Physical Biochemistry
S. C. Gupta. Fundamentals of Statistics. Himalaya Pub. House.
J. Medhi. Statistical Methods an introductory text. New Age International (P) Ltd. Publishers.
P. S. S. Sudar Rao & J. Richard. An introduction to biostatistics. Prentice Hall of India. N. Delhi.

BOT 403: DIVERSITY OF LOWER PLANTS (Algae, Bryophytes & Pteridophytes)

Archebacteria and eubacteria: General account; ultra structure, nutrition and reproduction biology and economic importance; cyanobacteria – salient features and biological importance.

Phycology : Algae in diversified habits (terrestrial, freshwater, marine); thallus organization; cell ultra structure; reproduction (vegetative, asexual, sexual); criteria for classification of algae: pigments, reserve food, flagella; classification, salient features of Protochlorophyta, Chlorophyta, Charophyta, Xanthophyta, Bacillariophyta, Phaeophyta and Rhodophyta; algal blooms.

Bryophyta : Morphology, structure, reproduction and life history; distribution; classification; general account of Marchantiales; Jungermaniales, Anthoceratales, Sphangales, Funariales and Polytrichales; economic and ecological importance.

Pteridophyta : Morphology, anatomy and reproduction; classification; evolution of stele; heterospory and origin of seed habit; general account of fossil pteridophyta; Introduction to Psilopsida, Lycopsidea, Sphenopsida and Pteropsida.

Reference Books :

- Kumar, H. D. Introductory Phycology. Affiliated East-West Press Ltd., New Delhi.
Parihar, N. S. Bryophyta. Central Book Depot, Allahabad.
Puri, P. Bryophytes. Atma Ram & Sons, Delhi.
Round, F. E. The Biology of Algae. Cambridge University Press, Cambridge.
Sporne, K. K. The Morphology of Pteridophytes. B. I. Publishing Pvt. Ltd., Bombay.
Stewart, W. N. and Rathwell, G. W. Paleobotany and the Evolution of Plants. Cambridge University Press.

BOT-404: TAXONOMY & DIVERSITY OF SEED PLANTS

GYMNOSPERMS

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

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

ANGIOSPERMS

The species concept: taxonomic hierarchy, species, genus, family and other categories; principles used in assessing relationship, delimitation of taxa and attribution of rank.

Salient features of the international code of botanical nomenclature.

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

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

Systems of angiosperm classification: phenetic versus phylogenetic systems; cladistics in taxonomy; relative merits and demerits of major systems of classification

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

Salient features of different groups of angiosperms (subclasses and orders)

Reference Books :

Bhatnagar, S.P. and Moitra, A. 1996. Gymnosperms.

Gurcharan Singh. Plant systematics: Theory and Practice

Heywood (ed.) Modern Methods in Plant Taxonomy

Jeffery, C. An Introduction to Plant Taxonomy

Jones, S.B., Luchsinger, A.L. 1987. Plant Systematics

Judd, W.S; Campbell, C.S., Kellogg, E.A; Stevens, P.F. 1999. Plant Systematics: A phylogenetic approach

Lawrence, G.H.M. Vascular Plant Systematics

Nordenstam, B., El Gazaly, G. and Kassas, M. 2000. Plant systematics for 21st century.

Radford, A. 1986. Fundamentals of Plant Systematics

Solbrig, O.T. 1970. Principles and Methods of Plant Biosystematics

Sporne, K. Morphology of gymnosperms

Stace, C. A. 1980. Plant Taxonomy and Biosystematics

Stebins, G.L. Variation and Evolution in Plants.

Turrill, W.B. Vistas in Botany vol. IV (Recent Researches in Plant Taxonomy)

Woodland, D.W. Contemporary plant systematics.

BOT-405: Lab – I Practicals

BOT-406: Lab – II Practicals

BOT-407 VIVA VOCE

II SEMESTER

BOT – 501: ENVIRONMENTAL BIOLOGY

Environment and Ecology: Concept of Biosphere, its components, development and functioning, Ecological considerations; population growth; Limiting factors and their operation; Ecological balances and survival thresholds; Need for preservation of environmental quality.

Ecosystems and their functioning: Structural and functional attributes of Ecosystem; Biogeochemical cycles; Natural succession; Dynamic equilibrium and factors contributing to it; Major Ecosystems on Earth; Habitat and Niche; Diversity and stability in the ecosystem.

Impact of human activities on Environment: Over exploitation of natural resources including biological resources; indiscriminate agriculture; big dams; mining; urbanization and industrialization.

Environmental Pollution and Treatment: Atmospheric pollution; water pollution; land degradation; Pollution and Environmental Health.

Fossil fuels and the Environment: Conservation of Non Renewable Energy Resources and Alternative energy resources and Environment.

Environmental Impact Assessment and Management : Concept of Environmental inventory and impact assessment, key steps in EA process with reference to big dams/ chemical industries/ power plants/mining; methods for forecasting, assessing and preparing environmental impact statement, reviewing and evaluating EIA report; Environmental Audit: Programme planning, on-site audit, post-audit activities, Restoration of ecosystem.

Environmental Laws: Air quality and emission standards; Air pollution legislation and regulations; Functions of the central Board and the state Boards; Environmental law in independent India.

Environmental Education: Meaning, scope and principles of environmental education; Role of environmental education in bringing awareness among the public in problem solving and management; formal and informal environmental education; Role of various kinds of mass media in environmental education.

Biological diversity concepts and levels, role of biodiversity in ecosystem functions and stability, speciation and extinction, local categories of threat, terrestrial biodiversity hot-spots.

Reference Books :

- Trivedi, P. R. and Singh, U. K. Global environmental Education
Botkin, D. B. and Keller, E. A. Environmental Science: Earth as a living Planet
Kaufman, D. G. and Fraz, C. M. Biosphere 2000: Protecting our Global Environment
Chary, EP Fundamentals of Ecology
The State of India's Environment: The second citizen's Report Centre for Science and Environment
B. C. Rana. Biomonitoring
Botkin, E. B. *et al.* Changing the Global Environment: Perspectives on Human Involvement
Saxena, A. B. Environmental Education
Khoshoo, T. N. Environmental priorities in India and sustainable development
Mansfield: Effect of Air pollution on plants
Masson, C. J. Biology of pollution

BOT –502: GENETICS, PLANT BREEDING AND EVOLUTION

Genetics

Principles of Mendelian inheritance; Chromosome structure and function; Interaction of genes; Gene structure and regulation of gene expression; Linkage and genetic mapping; Extrachromosomal inheritance; Mutation; DNA damage and repair, Chromosomal aberrations; Ploidy; Transposons; Sex determination and Sex-linked inheritance and genetic disorders; Somatic cell genetics.

Plant Breeding:

History, methods and objectives of plant breeding; Present status and future prospects; Origin, domestication and introduction of crop plants; Modes of reproduction – asexual and sexual reproduction, determination of mode of reproduction in a species, modes of pollination, mechanism of pollination control, self incompatibility, male sterility; Breeding in self pollinate crops; Hybridization: History, objectives and procedures in hybridization, consequences of hybridization; Polyploidy in plant breeding; application of polyploidy in crop improvement and its limitations.

Evolution :

Introduction, Fundamental Evolutionary process. The elemental forces of Evolution. The sources of variation. The role of Natural Selection, Evidence of organic Evolution & theories of organic evolution.

Result of evolution adaptive; Evolutionary divergence : Plant diversity as a result of evolution, Isolating mechanisms.

Reference Books :

- Strickberger M. W. Genetics. Third Edition. Macmillan Publishing co. New York.
Robert Weaber & Philip W. Hedrick. Basic Genetics, Second Edition. W. M. C. Brown Publishers Dubuque lowq.
Anna C. Pal & Helen M. Roberts. Genetics – its concepts & implications, Prentic – Hall Inc. Engle cliffs, New Jersey. USA
Edmund W. Sinnott, L. C. Dunn & T. Dobzhansky, Principles of Genetics. McGraw Hill Book company Inc. New York, USA.
A. M. Sr & R. W. Owen. General Genetics, W. H. Freeman & Company, Sanfrancisco.
P. K. Gupta, Genetics. Rastogi Publications. Shivaji Road Meerut, India.
Stebbins G. L. Variation & Evolution in plant.
G. Ledyard Stebbins. Process of organic Evolution.
Jay M. Savage. Evolution
Edward O. Dodson. Evolution : Process & Product.
Paul Amos Moody. Introduction to Evolution.

BOT – 503: PLANT PHYSIOLOGY

Introduction - The scope of Plant Physiology

Plant and water relations - Water potential, Absorption of water by land plants, Transpiration

Mineral Nutrition and Translocation in plants

General functions of Essential elements, Nutrient roles and deficiency symptoms; Toxicity of micronutrients; Criteria of essentiality, chemical analysis, detection of mineral elements, Mineral salt absorption and transport.

Ascent of sap, Mechanism of ascent of sap, phloem transport

Photosynthesis - Light and pigments; Light dependent reactions of Photosynthesis; Carbon metabolism – The Photosynthetic Carbon Reduction (PCR) cycle; Activation and regulation of the PCR cycle, The C₄ syndrome, Crustacean Acid Metabolism (CAM), Regulation of C₄ photosynthesis and CAM; Translocation and distribution of photoassimilates, Photorespiration, Factors affecting the rate of photosynthesis .

Respiration - Organization of mitochondrial electron transport system in plants, cyanide resistant pathway and alternative oxidase, its role in regulation of mitochondrial electron transport. Transport of metabolites across mitochondrial membrane. Regulation of pentose phosphate pathway and its significance. Gluconeogenesis. Anaerobic respiration.

Photomorphogenesis and Physiology of flowering & Vernalization

Responding to light: Photomorphogenesis: Phytochrome, Phytochrome in dark grown seedling, Physiological effects of Phytochrome, Phytochrome in green plants, Phytochrome under natural conditions, mechanism of Phytochrome action.

Temperature and Plant Development: Temperature in the Plant environment, Influence of temperature on growth and plant distribution, and development.

Photoperiodism and Rhythmic Phenomena : Photoperiodism; the Biological Clock, Genetic approaches to photoperiodism, and rhythms; Photoperiodism in nature.

Plant growth regulators and elicitors: Physiological effects and mechanism of action of auxins, gibberellins, Cytokinins, ethylene, abscisic acid, brassinosteroids, Polyamines, Salicylic acid hormone receptors, signal transduction and gene expression.

Physiology of fruit ripening, senescence and abscission.

Seed Germination and Dormancy

Physiology of plants under stress: Water stress, Temperature stress, Salt stress, Insects and diseases

Plant movements

References:

Hopkins, W. G., Introduction to Plant Physiology. 3rd Edition. John Wiley & Sons, New York.
Salisbury, F. B. and Ross, C. W., Plant Physiology, 4th Edition. Wadsworth Publishing Company, California.

Marschner, H., Water relations of plants. Academic Press, New York.

Briggs, W. R. (ed.) Plant hormones. Kluwer Academic Publishers, Dordrecht.

Kendrick, R. E. and Kroenber, G. H. M., Photomorphogenesis in plants, 2nd Edition, Kluwer Academic Publishers, Dordrecht.

Thomas, B. & Vince-Prue, D. Photoperiodism in plants, 2nd Edition. Academic Press, San Diego.

Thimann, K. V. Senescence in plants, CRC Press, Florida.

Bewley, J. D. and Black, M. Seeds: Physiology of development and germination. Plenum, New York.

Levitt, J. Responses of plants to environmental stresses. Academic Press, New York.

Dey, P. M. & Harborne, J. B. (Eds.) 1997. Plant Biochemistry, Academic Press, London

Heldt, H. 2005. Plant Biochemistry (3rd Edn.) Indian Reprint, Elsevier, New Delhi.

Dennis, D. T., D. H. Turpin, D. D. Lefebvre and D. B. Layzell : Plant Metabolism. Addison Wesley Longman Ltd. England.

Doby, G.: Plant Biochemistry. Inter Science Publishers, New York

Lehninger, A. L., D. L. Nelson and M. M. Cox 2000: Principles of Biochemistry. CBS Publishers and Distributors, New Delhi.

Witham et. al. Experiments in Plant Physiology. Van Nostrand Reinhold Company, New York.

Meidner, H. Class experiments in Physiology. George Allen & Unwin Publishers Ltd., London

Kalra, Y. P. (ed.). Hand book of reference methods for plant analysis. CRC Press, USA.

BOT – 504 : MYCOLOGY & PLANT PATHOLOGY

Introduction to fungi: History and classification of fungi. Life cycle, morphology, structure and reproduction in Myxomycotina, Mastigomycotina, Zygomycotina, Ascomycotina, Basidiomycotina and Deuteromycotina

Lichens: growth forms and reproductive structures.

Techniques for mushroom cultivation: Schedule and systems of cultivation; composting; peak heating; spawn preparation and mushroom strains; spawning and mycelial growth; supplementation; cultivation techniques from casing to ruffling and recovery growth to harvesting; pests and diseases, its protection.

Introduction to plant pathogens: Viruses, bacteria, fungi, nematodes and insect pests.

Introduction to plant pathology. Detailed study on symptoms, etiology, epidemiology and control of the following fungal diseases of plants. Late blight; powdery mildew; smuts, rusts; blast, red rot and tikka diseases.

Symptoms, etiology, epidemiology and control of bacterial and viral diseases with reference to leaf blight, leaf spot, canker, brown rot, mosaic diseases in plants.

Host-pathogen interactions: Pathogen attack strategies; plant defense mechanisms; HR and SAR in plant defense. Molecular mechanisms in plant defense.

References:

Alexopoulos, C. J., Mims, C. W. and Blackwel, M., Introductory Mycology, John Wiley & Sons Inc.

Mandahar, C. L. Introduction to Plant Viruses. Chand & Co. Ltd., Delhi.

Mehrotra, R. S. and Aneja, R. S. An Introduction to Mycology. New Age Intermediate Press.

Rangaswamy, G. and Mahadevan, A. 1999. Diseases of Crop Plants in India. Prentice Hall of India Pvt. Ltd., New Delhi.

Singh R S. Plant diseases. 6th edition. Oxford and IBH, New Delhi

Singh R.S. Principles of plant pathology. 3rd edition. Oxford and IBH, New Delhi

BOT-505: LAB – I PRACTICALS

BOT-506: LAB – II PRACTICALS

BOT-507 VIVA VOCE

III SEMESTER

BOT – 601: PLANT DEVELOPMENT AND REPRODUCTION

Introduction to growth and development of higher plants:

The major groups of plants; The structure of higher plants – The cell, meristems; simple tissue; complex tissues and tissue systems – Protective systems, Absorbing systems, Supporting systems, Photosynthetic systems, Storage systems, Transporting systems; Secretory and Excretory systems, Aerating systems; Movement systems of positional perception, Intra-organismal communication systems.

Concepts of plant growth and development from an organismal perspective.

Seed to seedling : Seed germination, seedling growth.

Seedling to adult plant – Primary vegetative body of the Plant : Growth and Differentiation of the shoot, leaf and root; Secondary body of the plant: The vascular cambium, secondary xylem, secondary phloem, periderm.

Reproduction : Floral evocation and development of the floral meristem, formation of floral organs, Microsporogenesis and formation of the male gametophyte, Megasporogenesis and formation of the embryo sac, Pollen-pistill interaction and fertilization.

Seed and Fruit formation : Endosperm development and embryogenesis, Fruit growth and ripening, Dormancy of seeds and buds.

Alternative Development strategies : Embryonic development of somatic cells and pollen grains, Abnormal Growth.

Reference Books :

Carlquist, S. Comparative Wood Anatomy, Springer – Verlag, Berlin.

Cutter, D. F., Applied Plant Anatomy, Logman, London.

Cutter, E. G. Plant Anatomy : Experiment and Interpretation : Part 2 – Organs. Edward Arnold, London.

Cutter, E. G., Plant Anatomy: Part – 1 Cell and Tissues, 2nd Edition, Edward Arnold, London.

Eames, A. J. and Mac Daniels, L. H. An Introduction to Plant Anatomy, 2nd Edition, McGraw – Hill, New York.

Fahn, A., Plant Anatomy, 4th Edition, Butterworth, Heinemann Ltd.

Fosket, D. E., Plant Growth & Development: A Molecular Approach. Academic press, San Diego.

Kozolowski, T.T. Growth & Development of Trees. Vols. I & II. Academic Press, New York.

Lyndon, R. F., Plant Development: The cellular basis. Unwin Hyman, London.

Maheswari, P. An Introduction to the Embryology of Angiosperms. McGraw-Hill Book Co., New York.

Mauseth, J. D. Plant Anatomy, The Benjamin/Cummings Publishing Co. California.

Metcalfé, C. R. and Chalk. L. Anatomy of the Dicotyledons. 2nd Edition Vol – III, Clarendon Press, Oxford.

Metcalfé, C. R. and Chalk. L. Anatomy of the Dicotyledons, Vols.I and II, Clarendon Press, Oxford.

Murphy, T.M. & Thompson, W. F. Molecular Plant Development, Prentice Hall, New Jersey.

Peter, W., Jeske, H., Jurgens, G., Kloppstech, K. and Link, G. Molecular Plant Development: from gene to plant. Oxford University Press, Oxford, NY.

Raghavan, V. An Introduction to the Embryology of Angiosperms. McGraw Hill Co. NY.

Raghavan, V. Developmental Biology of Flowering Plants. Springer – Verlag, NY.

Romberger, J. A., Hejnowicz, Z. and Hill, J. F. Plant Structure : Function and Development : A Treatise on Anatomy and Vegetative Development, with special reference to woody plants, Springer – Verlag, NY

Zimmerman, M.H. and Brown, C.L. Trees – Structure and Function, Springer-Verlag, Berlin.

BOT – 602: PLANT BIOTECHNOLOGY

Concepts and scope of Biotechnology:

Cell & tissue culture in plants; callus cultures; *in-vitro* morphogenesis-organogenesis and embryogenesis; Artificial Seeds Micropropagation; Haploidy; Embryo cultures; Protoplast isolation, culture and protoplast fusion and somatic hybridization, Cybrids, Somaclonal Variation; *in-vitro* mutation methods; Virus elimination, pathogen indexing; Cryopreservation; Production of secondary metabolites and biotransformation;

Principles and methods of genetic engineering, and its applications in Agriculture.

Recombinant DNA technology; major events; methodologies and rationale of cloning a gene; Concept of restriction and modification; restriction endonucleases; modifying enzymes, Ligases, Host-Vector system; Plasmids, Phage vectors, M₁₃, cosmids and expression vectors; Different strategies of cloning; genomic libraries, C-DNA libraries, gene tagging, Sequencing and sequence analysis, expression of the cloned gene, isolation and purification of the expressed product; PCR technology; Methods for transformation and transgenic plant production. PEG-mediated, microinjection, particle bombardment, electroporation, *Agrobacterium tumefaciens* and *A. rhizogenes*; Gene transfer methods in plants; transgenic plants production, principles and methods of genetic engineering and applications in Agriculture.

Algal and fungal Biotechnology – degree and production of single cell protein for food, feed and fuels; mushroom cultivation; Algae in Agriculture; algal biofertilizers Seaweed for industrial production.

Biotechnology and intellectual property rights (IPR); Plant genetic resources GATT & TRIPS; Patent for higher plant genes and DNA sequence; International convention; Plant breeders rights and farmers rights.

Reference Books :

Plant biotechnology – J Hammond, *et. al.*, Springer Verlag.

Plant cell and tissue culture for production of food ingredients – T J Fu, G Singh, *et. al.*

Biotechnology in crop improvement – H S Chawla.

Practical application of plant molecular biology – R J Henry, Chapman & Hall.

Elements of biotechnology – P K Gupta.

An introduction to plant tissue culture – M K Razdan.

Plant propagation by tissue culture : The technology (Vols. 1 & 2) – Edwin George.

Handbook of plant cell culture (Vols. 1 to 4) – Evans *et. al.*, Macmillan.

Plant tissue and cell culture – H E Street, Blackwell Scientific.

Cell culture and somatic cell genetics of plants (Vols. 1 to 3) – A K Vasil, A. Press.

Plant cell culture technology – M M Yeoman.

Plant tissue culture and its biotechnological applications – W Bary, *et. al.*, Springer Verlag.

Principles of plant biotechnology : An introduction to genetic engineering in plants – S H Mantell, *et. al.*

Advances in biochemical engineering / Biotechnology – Anderson, *et. al.*

Applied and fundamental aspects of plant cell tissue and organ culture edited by Reinert & Bajaj Y P S, Springer Verlag.

Plant cell and tissue culture – S Narayanswamy, Tata Mc Graw Hill Co.

BOT-603: PLANT METABOLISM & PHYTOCHEMISTRY

Plant Metabolism:

Introduction: Metabolism and growth and development of plants.

Carbohydrates - Structural interconversions and functions. Biosynthesis and metabolism of polysaccharides., Cell wall architecture and its componenets

Lipids- Biosynthesis and metabolism of lipids with reference to membrane, structural and storage lipids. Storage and mobilization of lipids.

Proteins –Biosynthesis, translocation, storage and degradation

Enzymes – Major groups; distribution of plant enzymes; functional compartmentation; soluble and membrane bound enzymes; purification; localization of enzymes

Secondary metabolites: Major pathways, structure and biosynthesis of plant pigments, alkaloids, glycosides and lignin.

Phenolic metabolism – Shikimate /arogenate pathway, Phenylamine / hydroxycinnamate pathway, Flavonoids, Lignins, Tannins and quinones

Nitrogen metabolism – Non-Biological and Biological Nitrogen fixation, Biochemistry of Nitrogen Fixation, Nitrogen fixation in Cyanobacteria.

Phytochemistry: Plants as sources of drugs, pharmaceuticals and pharmaceutical aids. Pharmacognosy of drugs derived from alkaloids, glycosides, volatile oils, lipids, gums, resins, tannins and saponins. Drugs of botanical origin: Structure and physical properties and chemistry of secondary metabolites: phenols, phenolic glycosides, saponins, steroids, alkaloids, vitamins and harmones and natural antibiotics.

Methods for screening natural sources for bioactive principles.

References Books:

Dennis, D. T., D. H. Turpin, D. D. Lefebvre and D. B. Layzell : Plant Metabolism. Addison Wesley Longman Ltd. England.

Doby, G. : Plant Biochemistry. Inter Science Publishers, New York

Dey, P. M. and J. B. Harborne: Plant Biochemistry. Academic Press, London.

Lehninger, A. L., D. L. Nelson and M. M. Cox 2000: Principles of Biochemistry. CBS Publishers and Distributors, New Delhi.

Sadasivam, S. and A. Manickam : Biochemical Methods. 2nd edition. New Age International (P) Ltd. New Delh.

Voet, D., J. G. Voet and C. W. Pratt : Fundamentals of Biochemistry. John Wiley & sons, Inc. New York.

Zubay, G. : Biochemistry. Vol. 1 – 3. Wm. C. Brown Publishers, Oxford, England

Chadwick, D.J. & Marsh, J.: Bioactive compounds from plants

Wiley Chichester, CIBA Foundation Symposium 185: Ethnobotany and the search for new drugs

J.B. Harborne: Phytochemical methods

J.C. Willis: Pharmacognosy

C.K. Kokate: Pharmacognosy

Trease, G.E and Evans, W.C.: Pharmacognosy

BOT-604 : PHYTORESOURCE UTILIZATION & CONSERVATION

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

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

Ethnomedicobotany: Basic approaches to study traditional knowledge on herbal medicine; Scope and potential applications.

Collection methods of ethnomedicobotanical data: Field methods and scrutiny of Herbarium specimens and folklore; verification of data; collection of materials for voucher specimen and for phytochemical screening; application of ethnomedicobotany.

Creating indigenous knowledge base of traditional medicines of plant origin.

Forest products :

Important timber yielding planting.

Timber types, identification diagnostic features, structure & quality

Important fire wood plants

Non Timber forest products bamboos, rattans, fibers pulp; gums, resins, tanins, lotex, fruits & tubers.

Innovations for meeting world food demands.

Plants used as avenue trees for shade, pollution control and aesthetics.

Principles of conservation; extinctions; environmental status of plants based on International Union for Conservation of Nature.

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

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

Reference Books :

Anonymous. National Gene Bank: Indian Heritage on Plant Genetic Resources (Booklet). National Bureau of Plant Genetic Resources, New Delhi.

Arora, R. K. and Nayar, E. R. Wild Relatives of Crop Plants in India. NBPGR Science Monograph.

Baker, H. G. Plants and Civilization. C. A. Wadsworth, Belmont.

Bole, P. V. and Vaghani, Y. Field Guide to Common Indian Trees. Oxford University Press, Mumbai.

Chandel, K. P. S., Shukla, G. and Sharma, N. Biodiversity in Medicinal and Aromatic Plants in India : Conservation and Utilization. National Bureau of Plant Genetic Resources, New Delhi.

Cristi, B. R. CRC Handbook of Plant Sciences and Agriculture. Vol. I. In-situ conservation. CRC Press, Boca Raton, Florida, USA

Council of Scientific & Industrial Research. The Useful Plants of India. Publications and Information Directorate, CSIR, New Delhi.

Plant Wealth of India. Special Issue of Proceedings India National Science Academy B – 63

Rodgers, N. A. and Panwar, H. S. Planning a Wildlife Protected Area Network in India. Vol. 1. The Report Wildlife Institute of India, Dehradun.

Sahni, K. C. The Book of India Trees, Oxford University Press, Mumbai.

Sharma, O. P. Hill's Economic Botany. Tata McGraw Hill Co. Ltd., New Delhi.

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Swaminathan, M. S. and Kocchar, S. L. Plants and Society. Macmillan Publication Ltd., London.

Thakur, R. S., Puri, H. S. and Husain, A Major Medicinal Plants of India. Central Institute of Medicinal and Anomatic Plants, CSIR, Luchnow. S.K. Jain: A Manual of Ethnobotany

S.K. Jain: Glimpses of Indian Ethnobotany

S.K.Jain, B.K. Sinha and R.C.Gupta: Notable plants in Ethnomedicine of India
Ethnobotany

J.K. Maheswari: Dictionary of Indian Folk medicine and Ethnobotany

S.K. Jain: Useful plants of India

Wiley Chichester, CIBA Foundation Symposium 185: Ethnobotany and the search for new drugs

BOT-605: LAB – I PRACTICALS

BOT-606: LAB – II PRACTICALS

BOT-607: VIVA VOCE

IV SEMESTER

BOT-701: PROJECT WORK & VIVA - VOCE