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M. Sc. Botany (Semester Pattern)

First Semester

Course No.	Name of the Course	Total
PG 101	Biology & Diversity of Viruses, Bacteria and Fungi	50
PG 102	Biology & Diversity of Algae, Bryophytes and Pteridophytes	50
PG 103	Biology & Diversity of Gymnosperms	50
PG 104	Plant Ecology	50
PG 105	Practical I – based on Course PG 101 & 104	50
PG 106	Practical II – based on Course PG 102 & 103	50
	Total	300

Second Semester

Course No.	Name of the Course	Total
PG 201	Plant Development & Reproduction	50
PG 202	Morphology & Taxonomy of Angiosperms	50
PG 203	Utilization & Conservation of Plant Resources	50
PG 204	Cell Biology of Plants	50
PG 205*	Practical I – based on Course PG 201 & 202	50
PG 206	Practical II – based on Course PG 203 & 204	50
	Total	300

*N.B.: PG 205 will include the following points:

1. Numbers of representative families (about 25) shall be taken up in the practical classes describing the plants up to species level.
2. Study of the primary and secondary anamoly of root and stem in dicots and monocots.

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M.Sc. Botany (Semester Pattern)

Third Semester

Course No.	Name of the Course	Total
PG 301	Plant Physiology	50
PG 302	Plant Biochemistry & Metabolism	50
PG 303	Cytogenetics & Genetics	50
PG 304	Molecular Biology of Plants	50
PG 305	Practical I – based on Course PG 301 & 302	50
PG 306	Practical II – based on Course PG 303 & 104	50
	Total	300

Fourth Semester

Course No.	Name of the Course	Total
PG 401	Plant Cell, Tissue & Organ Culture	50
PG 402	Biotechnology & Genetic Engineering	50
PG 403	Elective I*	50
PG 404	Elective II*	50
PG 405	Practical I – based on Course PG 401 & 402	50
PG 406	Practical II – based on Course PG 403 & 404	50
	Total	300

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M. Sc. Botany (Semester System)

First Semester
Course PG 101: Biology & Diversity of Viruses, Bacteria and Fungi

UNIT I: Viruses: characteristics and ultrastructurte of virions, isolation and purification of viruses; chemical nature, replication, transmission of viruses; economic importance.
UNIT II: Archaebacteria and Eubacteria: General account; ultrastructure, nutrition and reproduction; biology and economic importance; cyanobacteria – salient features and biological importance.
UNITIII: Classification of bacteria, Actinomycetes, *Mycoplasma, Rickettsiae, Chlamydiae* and their significance.
UNIT IV: Mycology: classification and general characters of fungi; substrate relationship in fungi; cell ultrastructure; unicellular and multicellular organization; cell wall composition; nutrition(saprobic, biotrophic, symbiotic); reproduction (vegetative, asexual,sexual), heterothallic; parasexuality; recent trends in classification.
UNIT V: Phylogeny of Fungi: Phylogeny of fungi; general account of Mastigomycotina, Zygomycotina, Ascomycotina, Basidiomycotina, Deuteromycotina; fungi in industry, medicine and as food; fungul diseases in plants and humans; Mycorriza; fungi as biocontrol agents.

Suggested Readings

Alexopoulus, C.J. Mims, C. W. and Blackwel, M; 1996: Introductory coO' Mycology, Jbon Wjley & Sons Inc.
Clifton, A; 1958: Introduction to Bacteria, Mcgraw- Hills Book Co.New Delhi.
Madigan, M T. Martinko, J. M and Parker Jack; I 997: Brock Biology Of Microorganisms, (8th edition) Prentice Hall, N,J. U.S.A
Mandahar, C. L.; 1978: Introduction to Plant Viruses. Chand & Co.Ltd. Delhi.
Mehrotra, RS. and Aneja, RS.; 1998: An Introduction to Mycology. New Age Intermediate Press.
Rangaswamy, G. and Mahadevan, A; 1999: Diseases of Crop Plants in Indja (4th edjtjon).PrentjceHaJl ofInilia Ltd. New Delbj.
Webster, J.; 1985: Introduction to Fungi Cambridge University Press. Dubey, R C. & Maheshwari, D. K.; 2005: A Text Book of Microbjology, S. Chand Publisher, New Delhi

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M. Sc. Botany (Semester System)

First Semester
Course PG 102: Biology & Diversity of Algae, Bryophytes and Pteridophytes

UNIT I: Algae in diversified habitats; thallus organization; cell ultrastructure; reproduction; criteria for classification of algae, pigments, researve foods, flagella; classification.
UNIT II: Salient features of Protochlorophyta, charophyta, chlorophyta, xanthophyta, bacillariophyta, phaeophyta and rhodophyta; algal blooms; algal biofertilizers; algae as food, feed and industrial uses.
UNITIII: Morphology, structure, reproduction and life history of bryophyta; distribution, classification, general accounts of marchantiales, jungermeniales, anthocerotales, sphagnales, funariales and polytrichales; ecological and economic importance.
UNIT IV: Morphology, anatomy, reproduction and life history of pteridophyta; classification, evolution of stele, heterospory and origin of seed habits.
UNIT V: Introduction to psilopsida, sphenopsida and pteropsida.

Suggested Readings

Smith G. M.~ Cryptogamic Botany VoL I(2nd edition)~ TataMcGraw-Hill Publishing Company Ltd. Bombay -New Delhi.
Kumar H. D. 1988: Introductory Phycology. Affiliated East-West Press Ltd. New Delhi.
Paribar~ N.S. 1991: Bryophyta. Central Book Depot. Allahabad.
Brower~ 1926: Primitive Land Plants~ Cambridge At the University Press.
Kashyap~ 1972 LivelWorts of Western Himalayas and Punjab. Researchco Publication.
Smith, G. M.~ Cryptogamic Botany VoL n (2nd edition)~ TataMc Graw -Hill Publishing Company~ Bombay -New Delhi.
Puri P. 1980~ Bryophyta -Morphology, Growth & Differentiation. Atma Ram & Sons, Delhi.
Chopra & Kumar~ 1988: Biology of Bryophyta; Wiley Eastern Ltd.
Ram Udar; 1970: An Introduction to Bryophyta; Shashidhar Malviya Prakashan
Watson; 1968: Structure and life of Bryophyta; Hutchinson & Co. Ltd.
Campbell; 1939: The evolution of land plants; Stanford University.
Spome, K.R. 1991. The Morphology ot Ptenaopnyres.
Parihar N.S. 1996 Biology and Morphology of Pteridophytes, CentralBook Depot. Allahabad.
Smith G. M.; Cryptogamic Botany Vol. II; T ata Mc Graw –Hill Publishing Co. Bombay -New Delhi
Arnold C. A; An Introduction to Paleobotany; Tau Mc Graw –Hill Publishing Co. New Delhi.
Stewart, W. N. and RathweIL G. W. 1993. Paleobotany and the Evolution of Plants. Cambridge University Press.
Eames A J.; Morphology of Vascular Plants-Lower Groups.Tata Mc Graw -Hill Publishing Co. New Delhi
Rashid A. 1999; An introduction to Pteridophytes; Vikas Publishing House Pvt. Ltd..
Parihar; 1965: Pteridophyta; Central Book Depot. Allahabad.

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M. Sc. Botany (Semester System)

First Semester
Course PG 103: Biology & Diversity of Gymnosperms

UNIT I: Introduction: Gymnosperms, the vesseless and fruitless seed plants; evolution of gymnsperms; complexity of female gametophytes.
UNIT II: Classification of gymnosperms and their distribution in India. Economic importance of gymnosperms
UNITIII: Gerenal account of pteridospermales, cycadeoidales and cordaitales.
UNIT IV:Structure, reproduction and interrelationships of cycadales, ginkgoales and coniferales.
UNIT V: Structure, reproduction and interrelationships of ephedrales, welwitschiales and gnetales.

Suggested Readings

Bhatnagar, S.P. and Moitra, A; 1996: Gymnosperms. New Age International Pvt. Ltd., New Delhi.
Singh H.; 1978: Embryology of Gymnosperms, Encyclopedia of Plant Anatomy X. Gebruder Bortraeger, Berlin.
Spome K R; 1991: The Morphology of Gymnosperms; Hutchinson Univ. Library; London.
Foster A S. & Gifford E. M; Comparative morphology of vascular Plants; Vakils, Feffer, & Simons Private Ltd. Bombay. Chamberlain; Gymnosperms -Structure & Evolution; CBS Publishers & Distributors Delhi.
Shukla A C. & Mishra S. P.; Essentials of Paleobotany; Vikas Publishing House Pvt. Ltd. Delhi-Bombay-:6angalore-Calcutta-Kanpur .

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M. Sc. Botany (Semester System)

First Semester
Course PG 104: Plant Ecology

UNIT I: **Population Ecology**: Ecology & ecosystem: Definitions, Organization and components, Population & Environment; Population ecology, density & distribution, Natality, Mortality, Survivorship curves, Age structure & pyramids, Fecundity schedules, Life tables; Population growth – exponential and logistic curves; Intra specific competition and self regulation; r-and k-strategists.

UNIT II: **Community organization**: Concepts of community and continuum; Analysis of community analytical and synthetic characters, Community coefficients and indices of diversity, interspecific association negative and positive associations; Concept of ecological niche; Concepts of biodiversity; evolution and differentiation of species – allopatric & sypatric speciation; ecads and ecotypes.

UNITIII: **Ecosystem development and stability**: Temporal changes cyclic and non cyclic; Succession processes & types; Mechanism of succession facilitation, Tolerance and inhibition models; Concept of climax persistence resilience and resistance; Ecological perturbation natural and anthropogenic, Ecosystem restoration.

UNIT IV:**Fate of energy in ecosystems**: Trophic organization and structure, Food chains & webs; energy flow pathways, Ecological efficiencies consumption, assimilation and production trophic; Primary production methods of measurement, Global patterns, Limiting factors.

UNIT V: **Fate of matter in ecosystems**: Recycling pathways; Relationship between energy flow and recycling pathways; Nutrient exchange and cycling; Global biogeochemical cycles of C, N, P and S; Physical, chemical and Biological characteristics of soil.

Suggested Readings

Smith. R.L. 1996. Ecology and Field Biology. Harper Collins. New York.
Muller-Dombois. D. and Ellenberg. H.1974. Aims and Methods 01 Vegetation Ecology, Wiley, New York
Begon. M.. Harper, J.L. and Townsend, C.R. 1996. Ecology. Blackwell Science. Cambridge.
Ludwig. J. and Reynolds. J.F. 1988. Statistical Ecology. John Wiley & Sons.
Odum. E.P. 1971. Fundamentals of Ecology. Saunders, Philadelphia.
Odum, E.P. 1983. Basic Ecology. Saunders, Philadelphia.
;Barbour, M.G., Burk, J.H. and Pitts, W.O. 1987. Terrestrial Plant Ecology. Cummings Publication Company, California.
Kormondy, E.J. 1996. Concepts of Ecology. Prentice-Hall of India Pvt. Ltd., New Delhi.
Chapman, J.L. and Reiss, M.J. 1988. Ecology: Principles and Applications. t::ambridge University Press, Cambridge, U.K.
Moldan, B. and Billharz, S. 1997. Sustainability Indicators. John Wiley & Sons, New York.

Treshow. M. 1985. Air Pollution and Plant Life. Wiley Interscience.
Heywood, V.H. and Watson. R.T. 1995. Global Biodiversity Assessment. Cambridge University Press.
Mason, C.F. 1991. Biology of Freshwater Pollution. Longman. '
Hill. M.K. 1997. Understanding Environmental Pollution. Cambridge University Press. .
Brady, N.C. 1990. The Nature and Properties of Soils. MacMillan.

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M. Sc. Botany (Semester System)

Second Semester
Course PG 201: Plant Development & Reproduction

UNIT I: Unique features of plant development; differences between animal and plant development. Organization of shoot apical meristem (SAM); control of tissue differentiation, especially xylem and phloem; secretory ducts and laticifers. Wood development in relation to environmental factors.

UNIT II: Leaf growth and differentiation. Organization of root apical meristem (RAM); cell fates and lineages; vascular tissue differentiation; lateral roots; root hairs. Root – microbe interaction.

UNITIII: Vegetative options and sexual reproduction; flower development; genetics of floral organ differentiation; homeotic mutants in *Arabidiopsis* and *Antirrhinum*; sex determination. Structrue of anthers, microsporogenesis, role of tapetum, pollen development and gene expression.

UNIT IV: Male sterility; pollen germination, pollen tube greet and guidance. Pollen storage, pollen allergy and pollen embryos. Ovule development, megasporogenesis; organization of embryo sac; structure of embryo sac cells.

UNIT V: Flora characterisitics; pollination mechanisms and vectors; breeding systems; structure of pistil; pollen stigma interactions; sporophytic and gametophytic self-incompatibility. Double fertilization. Endosperm development during early, maturation and dessication stages; embryogenesis; storage proteins of endosperms and embryo. Polyembryoni, apomixis. Dynamics of fruit growth; biochemistry and molecular biology of fruit maturation.

Suggested Readings

Bhojwani,S.S.and Bhatnagar,S.P.2000. The Embryology of Angiosperms(4th revised and enlarged edition). Vikas Publishing House,New Delhi.
Burgess.J.1985.An introduction to Plant Cell Development.Cambridge University Press, Cambridge.
Fageri,K.and Van der Pijl,L1979. The Principles of Pollination Ecology .Pergamon Press, Oxford.
Fahn, A 1 982.Plant Anatomy.(3rd edition).Pergamon Press,Oxford.
F osket, D .E.1994 .Plant Growth and Development. A Molecular Approach.Academic Press, San Diego.
Howell, S.H.1998. Molecular Genetics of Plant Development, Cambridge University Press, Cambridge.
Leins,P., Tucker,S.C.and Endress,P .K.1988.Aspects of Floral Development. J. Cramer, Germany.
Lyndon, R.F.1990.Plant Development. The Cellular Basis. Unin Hyman .London.

Murphy, T. M. and Thompson, W. E. 1988 Molecular Plant Development. Prentice Hall, New Jersey.
Proctor, M. and Yeo,P.1973.The Pollination of Flowers. William Collins Sons, London.
Raghvan, V .1997 .Molecular Embryology of Flowering Plants. Cambridge University Press, Cambridge.
RaghVan, V. 1999. Development Biology of Flowering P Jants. Springer-verlag.
Atwell,B.J.,Kriedermann,P.E.and Jurnbull,C.G.N.(eds)1999.PIants in Action: Adaptation in Naturre, Perfonnance in Cultivation, MacMillan Education,Sydney,Australia.

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M. Sc. Botany (Semester System)

Second Semester
Course PG 202: Morphology & Taxonomy of Angiosperms

UNIT I: Morphology of stamens and carpels; carpel evolution. Morphology of inferior ovary; placentation types and their origin.
UNIT II: The species concept: taxonomic hierarchy; species, genus, family and other categories; principles used in assessing relationships, delimitation of taxa and attribution of rank. Salient features of Interantional code of Botanical Nomenclature.
UNITIII: Taxonomic evidence: morphology, anatomy, palynology, embryology, cytology, phytochemistry, genome analysis and nucleic acid hybridization. Relevance of taxonomy to conservation.
UNIT IV:Taxonomic tools: herbarium, floras, histological, cytological, phytochemical, serological, biochemical and molecular techniques; Computers and GIS. Local plant diversity and its socio-economic importance.
UNIT V: Systems of angiosperm classification: phenetic versus phylogenetic systems; cladistics in taxonomy; relative merits and demerits of major systems of classification. Endemism, hot spots, hottest hot spots; plant explorations; invasions and introductions.

Suggested Readings
Heywood & Moore, D.M; 1984: CWTent concept *in* Plant Taxonomy Academic Press.
Banson, L.B.; 1957: Plant Classification, Health& Co. Boston.
Davis, P.R & Heywood, V.H 1973: Principles of Angiosperms and Taxonomy, Robert E. Kreiger Pub. *Co.* New *York,* USA
Eames, Al.; 1961: Morphology of Angiosperms, Mc-Graw Hill, New York.
Jeffery, C.; 1968: An Introduction to Plant Taxonomy J. & H. Churchill Limited.
Lawrence, G .H.M.; 1951: Taxonomy of Vascular Plants Macmillan, New York.
Naik V. N.; 1984: Taxonomy of Angiosperms. Tata Mc-Graw Hill Pub. Co. Ltd. New Delhi.
Porter, L.L.; 1959: Taxonomy of Flowering Plants. San Francisco. Radfor~ *AE.* Dickinson, W.C. MasseyJ.R and. Ben. C.R: 1974: VQ~llar Plant SYstematics, Harper & Row, New York

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M. Sc. Botany (Semester System)

Second Semester
Course PG 203: Utilization & Conservation of Plant Resources

UNIT I: **Plant Biodiversity**: Major Biomes of the world, Tropical rain & Seasonal Forests, Temperate rain & Seasonal forests, Boreal forests, Grasslands, Deserts; Aquatic Ecosystems, wetlands, Lakes & Ponds Streams & Rivers, Marine & Estuarine habitats.

UNIT II: **Sustainable Development**: Resource utilization**;** Status & Utilization of Biodiversity; Sustainable development and utilization of resources from forest, Grassland and aquatic habitats; Food forage, Fodder, Timber & Non-wood forest products; Threats to quality & quantity of Resources due to overexploitation.

UNITIII: **Strategies for conservation of resources**: Classifications of resources; Principles of conservation; *In-situ* conservation, sanctuaries, National parks, Biosphere reserves for wildlife conservation; Habitat conservation practices of conservation for forests, ranges, soil and water; Ex-situ conservation, botanical gardens, field gene banks, seed banks, in vitro repositories, cryo-banks.

UNIT IV: **Pollution & Climate Change**: Air, Water and Soil pollution**,** Kinds, Sources, Quality parameters, Effects on structure & function of ecosystems; Management of pollution; Bioremediation; Climate changes sources, Trends & role of greenhouse gases, Effect of global warming on climate, Ecosystem processes & Biodiversity; Ozone layer & Ozone hole.

UNIT V: **Resource monitoring**: Remote sensing concepts & Tools, Satellite remote sensing basics sensors, Visual & digital interpretation, EMR bands and their applications; Indian remote sensing program; Thematic mapping of resources; Application of remote sensing in Ecology & Forestry.

Suggested Readings

Moldan, B. and Billharz, S. 1997. Sustainability Indicators. John Wiley & Sons, New York.
Treshow. M. 1985. Air Pollution and Plant Life. Wiley Interscience.
Heywood, V.H. and Watson. R.T. 1995. Global Biodiversity Assessment. Cambridge University Press.
Mason, C.F. 1991. Biology of Freshwater Pollution. Longman. '
Hill. M.K. 1997. Understanding Environmental Pollution. Cambridge University Press. .
Brady, N.C. 1990. The Nature and Properties of Soils. MacMillan.
Kothari, A 1997. Understanding Biodiversity: Life'Sustainability and Equity. Orient Longman.
Kohli, R., Arya, K.S., Singh, P.H. and Dhillon, H.S. 1994. Tree Directory of Chandigarh. Lovedale Educational, New Delhi.
Nair, M.N.B. et. al (Eds) 1998. Sustainable Management of Non-wood Forest Products. Faculty of Forestry, Universiti Putra Malaysia. 434004 PM Serdong, Selangor, Malaysia.

Paroda, R.S. and Arora, R.K. 1991. Plant Genetic Resources Conservation and Management. IPGRI (Publication) S0uth Asia Office, C/o NBPGR, Pusa Campus, New Delhi.
Pjmentel, D. and Hall, C.W. (eds) 1989. Food.and Natural Resources. Academic Press, London-New York. .
Pinstrup-Anderson, P. et al. 1999. World Food Prospects: Critical Issues for the Early 21 st Century. International Food Policy Research Institute, Washington, D.C., USA.
Plant Wealth of India 1997. Special Issue of Proceedings Indian National Scienece Academy B-63.
Pulcknett, D.L., Smith, N.J.H., Wiliam, J.T. and Murti Annishetty, N. 1987. Gene Banks and Worlds Food. Princeton University Press, Princeton, New Jersey, USA.
Rodgers, N.A. and Panwar, H.S. 1988. Planning a Wildlife Protected Area Network in India. Vol. 1. The Report. Wildlife Institute of India, Dehradun.
Sahni, K.C. 2000. The Book of Indian Trees, 2nd edition. Oxford University Press, Mumbai.
Schery, R. W. 1972. Plants for Man. 2nd ed. Englewood Cliffs, New Jersey. Prentice Hall.
Sharma, O.P. 1996. Hill's Economic Botany (late Dr. A.F. Hills, adapted by O.P. Sharma) Tata McGraw Hill Co. Ltd., New Delhi. .. Swaminathan, M.S. and Kocchar, S.L. (Eds) 1989. Plants and Society. Macmillan ,Publication Ltd., London.
Thakur, R.S., Puri, H.S. and Husain, A.1989. Major Medicinal Plant of India. Central Institute of Medicinal and Anomatic Plants, CSIR, Lucknow.
Thomas, P. 2000. Tress: Their Natiojal History. Cambridge University Press, Cambridge.
Wagner, H., Hikino, Hand Farnswarth, N. 1989. Economic and Medicinal Plant Research. " Vols 1-3 Academic Press, London.
Walter, K.S. and Gillett, H.J. 1998. 1997 IUCN Red List of Threatened Plants. IUCN, the World Conservation Union. IUCN, Gland, Switzerland, and Cambridge, U.K.

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M. Sc. Botany (Semester System)

Second Semester
Course PG 204: Cell Biology of Plants

UNIT I: Structural organization of the plant cell; specialized plant cell types. Structure and functions of cell wall; biogenesis; growth. Cytoskeleton: organization and role of microtubules and microfilaments; motor movements.

UNIT II: Plasma membrane: structure, models and functions; sites for ATPases; ion carriers, channels and pumps; receptors. Structure of plasmodesmata, role in movement of molecules; comparison with gap junctions.

UNITIII: Cholorplast: structure, genome organization, gene expression, nucleo-chloroplastic interactions; mitochondira: structure, genome organization, biogenesis. Plant vacuoles: tonoplast membrane, ATPases, trasporters, as storage organelle. Other cell organelles: golgi apparatus, lysosomes, endoplasmic reticulum.

UNIT IV:Nucleus: structure. Cell cycle: control mechanisms; role of cyclins and cyclin-dependent kinases; mechanisms of programmed cell death. Chromosome structure and packaging of DNA; euchromatin and heterochromatin; karyotype analysis and evolution; banding patterns; specialized types of chromosomes.

UNIT V: Origin, meiosis and breeding behaviour of duplication, deficiency, inversion and translocation heterzygotes; origin, occurrence, production and meiosis of haploids, aneuploids and euploids; Origin and production of autopolyploids. Allopolyploids; types, genome constitution and analysis.

Suggested Readings

Lewin, B. 2000, Genes VIL Oxford University Press, New York.
Alberts, B., Bray, D., Lewis, J., Ratf, M., Roberts, K., and Watson, J.D. Molecular Biology of the Cell. Garland Publishing:Inc., New York.
Wolfe, S.L. 1993. Molecular and Cellular Biology, Wadsworth Publishing Co., California, USA
Rost, T. et: al. 1998.Plant Biology, Wadsworth Publishing Co., California, U.S.A
Krishanmurthy K V. 2000 Methods in Cell Wall Cytochemistry, CRC Press, Boca Raton, Florida U.S.A
Buchanan, B.B. Groissem, W. and Jones, RL. 2000. Biochemistry And Molecular Biology of Plants. American Society of Plant Physiologists, Maryland, USA
De, D.N. 2000: Plant Cell Vacuoles: An Introduction. CSIRO Publication, ColliJ18W~ Australia.

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M. Sc. Botany (Semester System)

Third Semester
Course PG 301: Plant Physiology

UNIT I: Principles of thermodynamics, free energy and chemical poetential, redox reactions, structure and functions of ATP, Plant water relations, mechanisms of water transport through xylem, root-microbe interactions in facilitating nutrient uptake. Membrane transport proteins.

UNIT II: Phloem transport; phloem loading and unloading, passive and active solute transport. Signal transduction; overview, receptors andg proteins, phospholipids singaling, role of cyclic nucleotides, calcium-calmodulin cascade. Specific signaling mechanisms, for example, two-component sensor regulator system in bacteria and plants. Sucrose-sensing mechanism.

UNITIII: Plant growth regulators and elicitors: Physiological effects andmechanism of action of auxins, gibberellins, cytokinins, ethylene, abscisic acid, brassinosteroids, polyamines, jasmonic acid, and salicylic acid. Hormone receptors, singal transduction and gene expression.

UNIT IV: Flowering process: photoperiodism and its significance, endogenous clock and its regulation. Floral induction and development. Phytochromes and cryptochromes, their photochemical and biochemical properties. Molecular mechanism of action of photomorphogenetic receptors, signaling and gene expression. Role of vernalization.

UNIT V: Stress physiology: Plant responses to biotic and abiotic stress. Water deficit and drought resistance. Salinity stress and resistance. Concepts of freezing, heat and oxidative stresses.

Suggested readings

Hopkins, W.G. 1995. Introduction to Plant Physiology. John Wiley & ,Sons, Inc., New York, USA.

Lodish, H., Berk, A., Zipursky, S.L., Matsudaira, P., Baltimore, D. and Darnell, J. 2000.Molecular cell Biology (fourth edition). W.H. ,Freeman and Company, New York USA.

Moore, T.C. 1989. Biochemistry and Physiology of Plant Hormones (second edition). Springer -Verlag, New York. USA.

Nobel, P.S. 1999. Physiochemical and Environmental Plant Physiology (second edition). Academic Press, San Diego, USA.

Salisbury FB and Ross CW 1991 Plant Physiology IV edition Wdsworth Publishing co. California usa.

Taiz l and Zeiger E1998 Pant Pysiology II Edition. Sinauer Associates Inc. Publisher MS.

Dennis DT and Terpin DH Lefevere DD and Layzell DV 1997 Plant Metabolism II Ed. Longman England.

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M. Sc. Botany (Semester System)

Third Semester
Course PG 302: Plant Biochemistry & Metabolism

UNIT I: Fundamentals of enzymology: general aspects, allosteric mechanism, regulatory and actice sites, isozymes, kinetics of enzymatic catalysis, Michaelis- Menten equation and its significance, Mechanism of enzyme action.

UNIT II: Photochemistry and photosynthesis: General concepts and historical background, evolution of photosynthetic apparatus, photosynthetic pigments and light –harvesting complexes. Photooxidation of water, mechanism of electron and proton transport, Carbon assimilation; Calvin cycle, photorespiration and its significance, C4-cycle, CAM pathway, physiological and ecological considerations. Biosynthesis of starch and sucrose.

UNITIII: Respiration and lipid metabolism: Overview of plant respiration, glycolysis, TCA cycle, electron transport and ATP synthesis. Oxidative pentose phosphate pathway, glyoxylate cycle, alternative oxidase system.

UNIT IV: Structure and functions of lipids, fatty acid biosynthesis, synthesis of membrane lipids, structural lipids and storage lipids and their catabolism. Sulphate uptake, transport and assimilation.

UNIT V: Nitrogen fixation, nitrogen and sulphur metabolism: Overview, biological nitrogen fixation, nodule formation and nod factors. Mechanism of uptake and reduction, ammonium assimilation.

Suggested readings

Hopkins, W.G. 1995. Introduction to Plant Physiology. John Wiley & ,Sons, Inc., New York, USA.

Lodish, H., Berk, A., Zipursky, S.L., Matsudaira, P., Baltimore, D. and Darnell, J. 2000.Molecular cell Biology (fourth edition). W.H. ,Freeman and Company, New York USA.

Moore, T.C. 1989. Biochemistry and Physiology of Plant Hormones (second edition). Springer -Verlag, New York. USA.

Nobel, P.S. 1999. Physiochemical and Environmental Plant Physiology (second edition). Academic Press, San Diego, USA.

Salisbury FB and Ross CW 1991 Plant Physiology IV edition Wdsworth Publishing co. California usa.

Taiz l and Zeiger E1998 Pant Pysiology II Edition. Sinauer Associates Inc. Publisher MS.

Dennis DT and Terpin DH Lefevere DD and Layzell DV 1997 Plant Metabolism II Ed. Longman England.

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M. Sc. Botany (Semester System)

Third Semester
Course PG 303: Genetics & Cytogenetics

UNIT I: Genetics of prokaryotes and eukaryotic organelles; genetic recombination in phage; mapping the bacteriophage genome; genetic transformation, conjugation and transduction in bacteria. Genetics of mitochondria and chloroplasts; cytoplasmic male sterility.

UNIT II: Genetic recombination and genetic mapping; Recombination, independent assortment and crossing-over, molecular mechanism of recombinatio. Chromosome mapping, linkage groups, genetic markers, construction of molecular maps, somatic cell genetics- an alternative approach to gene mapping.

UNITIII: Mutations: spontaneous and induced mutations, physical and chemical mutagens, molecular basis of gene mutations. Transposable elements in prokaryotes and eukaryotes. Mutations induced by transposons, site-directed mutagenesis. DNA damage and repair mechanisms.

UNIT IV:Cytogenetics of aneuploids and structural heterozygotes, effect of aneuploidy on phenotype in plants, transmission of monosomics and trisomics and their use in chromosome mapping of diploid and polyploidy species. Complex translocation heterozygotes. Robertsonian translocations. B-A translocations.

UNIT V: Molecular Cytogenetics; Nuclear DNA content, c-value paradox, *cot* curve and its significance, restriction mapping – concept and techniques, multigene families and their evolution. Transfer of whole genome, examples from wheat and *Brassica;* genetic basis of inbreeding and heterosis; exploitation of hybrid vigour.

Suggested Readings

Alberts, B. Bray, D. Lewis, J. Raff: M. Roberts, K. and Watson,J. D. 1989 Molecular Biology of the Cell (2nd edition). Garland Publishing Inc., New York. U. S. A.
Atherly, AG. Girton, J.R and Mc Donald, J.E. 1999. The Science of Genetics: Saunders College Publishing, Fort Worth, U.S.A.
Burnham, C.R 1962. Discussions in Cytogenetics, Burgess Publishing Co. Minnesota.
Busch. H. and Rothblum. L. 1982. Volume X. The Cell Nucleus rDNA Part A. Academic Press.
Hartl, D.L. and Jones, E. W. 1998. Genetics: Principles and Analysis (4th edition). Jones & Bartlett Publishers, Massachusetts, USA
Khush, G.S. 1973. Cytogenetics of Aneuploids. Acedemic Press, New York, London.
Karp, G. 1999 Cells and Molecular Biology: Concepts and Experiments John Wiley & Sons, Inc. U. S.A
Lewin: B. 2000 Gene VII. Oxford University Press, New York, U.S.A
Lewis, R. 1997. Human Genetics: Concepts and Applications. (2nd edition). WCB McGraw Hill, U.S.A

Malacinski, G. M. and Freifelder, D. 1998. Essentials of Molecular Biology *(3M* edition). Jones and Barlett Publishers, Inc. London.
Russel, P.J. 1998. Genetics (5th edition). The Benjamin / Cummings Publishing Company Inc., U. S. A
Snustead, D. P. and Simmons, M. J. 2000. Principles of Genetics (2nd edition). Jhon Wiley & Sons Inc., U.S.A

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M. Sc. Botany (Semester System)

Third Semester
Course PG 304: Molecular Biology of Plants

Unit I: DNA structure; A, B and Z forms; replication; damage and repair; transcription; plant promoters and transcription factors; splicing; messenger RNA transport; ribosomal RNA biosynthesis.

Unit II: Gene structure and expression; genetic fine structure; cis-trans test; fine structure analysis of eukaryotes; introns and their significance; RNA splicing; regulation of gene expression in prokaryotes and eukaryotes.

Unit III: Ribsosomes: structure and site of protein synthesis; mechanism of translation, initiation, elongation and termination; structure and role of transfer RNA; protein sorting; targeting of proteins to organelles.

Unit IV: Cell cycle and apoptosis, control mechanisms; role of cyclins and cyclin dependent kinases; retinoblastoma and E2F proteins; cytokinesis and cell plate formation; mechanism of programmed cell death.

Unit V: Immunotechniques, In situ hybridization – concepts and techniques, physical mapping of genes on chromosomes. In situ hybridization to locate transcript in cell types; FISH; Flow cytometry and confocal microscopy.

Suggested Readings

Lewin, B. 2000, Genes VII, Oxford University Press, New York.
Alberts, B., Bray, D., Lewis, J., Raff, M., Roberts, *K.,* and Watson, J.D. 1999.Molecular Biology of the Cell. Garland Publishing:Inc., New York.
Wolfe, S.L. 1993. Molecular and Cellular Biology, WadsworthPublishing Co., California, USA.
Rost, T. et al. 1 998.Plant Biology, Wadsworth Publishing Co.,California, U.S.A
Krishanmurthy K. V. 2000 Methods in Cell Wall Cytochemistry, CRCPress, Boca Raton, Florida U.S.A
Buchanan, B.B. Gruissem, W. and Jones, RL. 2000. Biochemistry And Molecular Biology of Plants. American Society of Plant Physiologists, Maryland, USA
De, D.N. 2000 Plant Cell Vacuoles: An Introduction.CSIRO Publication, Collingwood, Australia.
Kleinsmith, L.J. and Kish, V.M. 1995. Principles of Cell and Molecular Biology (2nd Edition). Harper Collins College Publishers, New York, USA
Lodish H. Bert, A,zipursky, S.L.,Matsudaira, p.,Baltimore, D. and Darnell, J. 2000.Molecular Cell Biology, W.H.Freeman and Co., NewYork, U.S.A
Pollard, T. S. and EaJ-nshaw, W. C. 2002 Cell Biology. Saunders,Philadelphia, U.S.A
Twyman, R. M. 2003. Advanced Molecular Biology. Viva BooksPrivate Ltd. New Delhi.

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M. Sc. Botany (Semester System)

Fourth Semester
Course PG 401: Plant Cell, Tissue & Organ Culture

UNIT I: Plant cell and tissue culture: general introduction, history, scope, concept of cellular differentiation and totipotency.
UNIT II: Techniques of tissue culture. Organ culture – meristem, anther and embryo. In vitro fertilization.
UNITIII: Organogenesis and adventive embryogenesis; fundamental aspects of morphogenesis, somatic embryogenesis and androgenesis. Mechanisms, techniques and utility.
UNIT IV:Somatic hybridization, protoplast isolation, fusion and culture, hybrid selection and regeneration; possibilities and achievements and limitations of protoplast research.
UNIT V: Application of plant tissue culture; clonal propagation; artificial seeds; production of hybrids, somaclones and somaclonal variation; production of secondary metabolites/ natural products; cryopreservation and germplasm storage.

Suggested Reading

Butenko, R.G. 2000. Plant Cell Culture. University Press of Pacific.
Collin, H.A. and Edwards, S. 1998. Plant Cell Culture. Bios Scientific Publishers, Oxford, UK.
Dixon, R.A. (Ed.) 1987. Plant Cell Culture: A Practical Approach. IRL Press, Oxford.
Gelvin, S.B. and Schilperoort, R.A. (Eds), 1994. Plant Molecular Biology Manual, 2nd edition, Kluwer Academic Publishers, Dordrecht, The Netherlands.
George, E.F. 1993. Plant Propagation by Tissue Culture. Part 1. The Technology, 2nd edition.Exeg.etics Ltd., Edington, UK.
George, E.F. 1993. Plant Propagation by Tissue Culture. Part 2. In Practice, 2nd edition. Exegetics Ltd., Edington UK.
Glick, B.R. and Thompson, J.E. 1993. Methods in Plant Molecular Biology and Biotechnology. GRC Press, Boca Raton, Florida.
Glover, D.M. and Hames, B.D. (Eds), 1995. DNA Cloning 1 : A Practical Approach; Core Techniques, 2nd edition. PAS, IRL Press at Oxford University Press, Oxford.

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M. Sc. Botany (Semester System)

Fourth Semester
Course PG 402: Biotechnology & Genetic Engineering

UNIT I: Biotechnology and Genetic Engineering: basic concepts, principles and scope. Intellectual Property Rights – possible ecological risks and ethical concerns.
UNIT II: 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
UNITIII: Genetic engineering of plants, aims, strategies for development of transgenics (with suitable examples); *Agrobacterium* – the natural genetic engineer; T-DNA and transposon mediated gene tagging; chloroplast transformation and its utility.
UNIT IV:Microbial genetic manipulation; bacterial transformation; selection of recombinants and transformants; genetic improvements of industrial microbes and nitrogen fixers; fermentation technology.
UNIT V: Genomics and Proteomics; genetic and physical mapping of genes; molecular markers for introgression of useful traits; artificial chromosomes; high throughput sequencing; genome projects; bioinformatics; functional genomics; microarrays; protein profiling and its significance.

Suggested Reading
Gelvin, S.B. and Schilperoort, R.A. (Eds), 1994. Plant Molecular Biology Manual, 2nd edition, Kluwer Academic Publishers, Dordrecht, The Netherlands.
Glick, B.R. and Thompson, J.E. 1993. Methods in Plant Molecular Biology and Biotechnology. GRC Press, Boca Raton, Florida.
Glover, D.M. and Hames, B.D. (Eds), 1995. DNA Cloning 1 : A Practical Approach; Core Techniques, 2nd edition. PAS, IRL Press at Oxford University Press, Oxford.
Brown, T.A. 1999. Genomes. John Wiley & sons, Singapore
Callow, J.A., Ford-Lloyd, B.V. and Newbury, H.J. 1997. Biotechnology and Plant Genetic Resources: Conservation and Use. CAB International, Oxon, UK.
Jolles, O. and Jornvall, H. (eds.) 2000. Proteomics in Functional Genomics. Birkhauser Verlag, Basel, Switzerland.
Primrose, S.B. 1995. Principles of Genome Analysis. Blackwell Science Ltd., Oxford, UK

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Fourth Semester
Course PG 403: Elective I

The concerned university and college may opt for any of the elective paper and frame the course content according to the available resources, as also recommended by the UGC.

List of suggested elective papers

1. Limnology
2. Industrial microbiology
3. Integrated pest management
4. Lichenology
5. Biology of bryophytes
6. Population biology
7. Seed pathology
8. Weed biology
9. Plant pathology
10. Microbial genetics
11. Plant genomics and plant breeding
12. Crop genetics and plant breeding
13. Plant genomics and proteomics
14. Plant propagation
15. Tissue culture
16. Plant protection
17. Biostatistics and computer applications
18. Bioinformatics
19. Plant tissue culture
20. Sustainable development
21. Ecorestoration and ecomanagement of degraded habitats
22. Bioremediation of xenobiotics
23. Floriculture
24. Xenobiotics
25. Floriculture

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M. Sc. Botany (Semester System)

Fourth Semester
Course PG 404: Elective II

The concerned university and college may opt for any of the elective paper and frame the course content according to the available resources, as also recommended by the UGC.

List of suggested elective papers

1. Limnology
2. Industrial microbiology
3. Integrated pest management
4. Lichenology
5. Biology of bryophytes
6. Population biology
7. Seed pathology
8. Weed biology
9. Plant pathology
10. Microbial genetics
11. Plant genomics and plant breeding
12. Crop genetics and plant breeding
13. Plant genomics and proteomics
14. Plant propagation
15. Tissue culture
16. Plant protection
17. Biostatistics and computer applications
18. Bioinformatics
19. Plant tissue culture
20. Sustainable development
21. Ecorestoration and ecomanagement of degraded habitats
22. Bioremediation of xenobiotics
23. Floriculture

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List of suggested Project work/Dissertation work

The following is the list of the proposed areas of dissertation/ project work. The concerned university and college may encourage the students to undertake project work in collaboration with industrial and research organizations.

1. Plant Biodiversity Assessment
2. Conservation of Endangered Species
3. Inventroization of Unexplored Areas and Hotspots
4. Pollution Monitoring
5. Survey of Less-known Economic Plants of India
6. Chromosome Analysis and Indexing of Indian Flora
7. Bioremediation of Xenobiotics
8. Exploitation of Secondary Metabolites
9. Extraction of Allelochemicals
10. Tissue Culture of Economic Plants
11. Assessment of Pollution Toxicity by Bioassay
12. Microbial proteins
13. Enzymes
14. Cosmetic Products from microbes and plants
15. Nutraceuticals from microbes and plants
16. Pharmaceutical Products
17. Ethnobotany
18. Chemotaxonomy
19. Cladistics
20. Protein Profiling
21. DNA Fingerprinting
22. Microarrays
23. FISH (Fluorescent In Situ Hybridization)
24. Mutation
25. Plant Hormones and Growth promoters
26. Bioinformatics
27. Application of PCR
28. Somatic Hybridization
29. Biofertilizers and Bioinoculants
30. Transgenics
31. Exploitation of Rhizospheric microbes including mycorrhizae
32. Recycling of domestic, municipal and industrial wastes
33. Vermicomposting and Biomethanation
34. Environmental Monitoring
35. Assessment of Pollution in different habitats