

M. Sc BOTANY: I SEMESTER – THEORY SYLLABUS

BOT: HCT 1.1 ALGAE, FUNGI, BACTERIA AND VIRUSES		64 hours
1	<p>Algae: Introduction and contributions of Phycology, General characters and classification of algae (Fritsch, 1945 and Van den Hoek 1995); Distribution of algal communities-freshwater, marine and terrestrial; algae from usual environments. Thallus ultrastructure organisation, reproduction and life cycle patterns of Cyanophyceae (Microcystis, Nostoc, Oscillatoria and Scytonema), Chlorophyceae (Chlorella, Spirogyra, Volvox, Desmids and Coleochatae), Charophyceae (Chara and Nitella), Xanthophyceae (Vaucheria and Botrydium), Bacillariophyceae (Pennales and Centrales), Phaeophyceae (Ectocarpus, Porphyra and Sargassum) Rhodophyceae (Batrachospermum and Polysiphonia). Economic importance of algae. Biochemicals from algae: enzymes, vitamins, antibiotics, sterols and liposomes.</p>	16 h
2	<p>Fungi: General characteristics and classification, morphological, structural diversity and reproduction in Myxomycotina (Stemonitis), Mastigomycotina (Saprolegnia) Zygomycotina (Mucor and Rhizopus), Ascomycotina (Yeast, Aspergillus, Peziza), Basidiomycotina (Puccinia, Agaricus, Lycoperdon) Deuteromycotina (Cercospora, Alternaria and Rhizoctonia). Homothallism and Heterothallism, Economic importance of fungi: Agriculture- biofertilizers and biopesticides, Pharmaceuticals-antibiotics and hormones, Industrial- organic acids and mushroom cultivation, Nutrition- edible fungi.</p> <p>Lichens: General characteristics and classification, ecological significance and Economic importance,</p>	16 h
3	<p>Bacteria: General characters, classification, Ultrastructure of bacterial cell, Reproduction in Bacteria: Fission, sexual reproduction (genetic Recombination) – Conjugation, Transformation and Transduction. Bergey’s Manual of Systematic Bacteriology, Role of Bacteria in Agriculture and Nitrogen fixation. Bacterial diseases: Citrus canker, Black arm, boll rot and blight of Cotton, Bacterial leaf blight of paddy. Bacterial Plasmids and their characteristics. Spirochaetes, Rickettsiae and Chlamydiae.</p>	16 h
4	<p>Viruses: General characters, Morphological and structural diversity, classification, nomenclature and ultrastructure of TMV and Bacteriophages, Reproduction, Infection and multiplication of Phage (Lytic cycle). Viroids and Prions. Viral diseases: TMV, YBMV and PRSV (Papaya ring spot).</p> <p>Mycoplasma: General Characters, Ultrastructure studies and classification. Mycoplasma diseases and management: Little leaf of <i>Vinca rosea</i>, Grassy shoot of Sugarcane.</p> <p>Phytoplasma – a brief account. Mycoplasma like organisms (MLOs).</p>	16 h

REFERENCES:

1. Bold and Wynne. 1985. Introduction to algae – structure and reproduction. Prentice – Hall, India.
2. Desikachary. 1959, Cyanophyta, ICAR. New Delhi.
3. Dixon. 1973. Biology of Rhodophyta. Oliver and Boyd, London.
4. Dodge JD. 1973. The Fine Structure of Algal Cells, Academic Press, INC. London.
5. Fritsch FE. 1961, Structure and reproduction in algae, Vol - I, & II Cambridge University Press, London.
6. Bruns TD, White TJ and Taylor JW. 1991. Fungal molecular systematics. Annu. Rev. Ecol. Syst, 22: 525-64.
7. Burnell JH and Trinci APJ. 1979. Fungal walls and hyphal growth, Cambridge University Press. Cambridge.
8. Chandhniwala. 1996. K.M. Infectious fungi, Anmol Publications, Pvt. Ltd.
9. Bergey, D. H (1923). Bergey's manual of determinative bacteriology: a key for the identification of organisms of the class schizomycetes. The Williams & Wilkins Company. Baltimore:
10. Contract, F. H., Kimball, P.C. and Jay, L. 1998. Virology. Prentice Hall, Englewood Cliff, New Jersey.
11. Dimmock, N. J., Easton A. J. and Leppard K. N. 2007. Introduction to Modern Virology (VI Ed.), Blackwell Publishing, UK.
12. Alexopoulos CJ and Mims CW. 1989. Introductory Mycology, Wiley Eastern Ltd., New Delhi.
13. Powar CB and Dagainawala. 1991. General Microbiology, Vol – I and Vol – II Himalaya publishing house, Bombay.
14. Dubey RC and Maheshwari DK. 2002. A Text book of Microbiology, S.C.Chand and Company, Ltd. Ramnagar, New Delhi.
15. Ananthnarayan R and Panikar JCK. 1986. Text book of Microbiology. Orient Longman ltd. New Delhi.

BOT: HCT. 1.2 BRYOPHYTES, PTERIDOPHYTES AND GYMNOSPERMS		
64 hours		
1	<p>Bryophyta: General Characters, Classification (Rothmuler), origin and distribution, Morphological, structural diversity and reproduction in Marchantiales (Marchantia), Jungermanniales (Porella), Metzgeriales (Aneura), Anthocerotales (Anthoceros), Sphagnales (Sphagnum), Bryales (Funaria and Polytrichum). Ecology and economic importance of Bryophytes. Fossil Bryophytes. Economic importance: with special reference to chemical constituents, bryophytes as indicator of pollution, Succession of bryophytes. Evolutionary trends in Sporophytes and gametophytes of Bryophytes.</p>	16 h
2	<p>Pteridophyta: General characters, Classification, origin and distribution, Morphological, structural diversity and reproduction in Psilotales (Psilotum), Lycopodiales (Lycopodium), Selaginellales (Selaginella), Equisetales (Equisetum). Fossil Pteridophytes: Psilophytales, Lepidodendrales and Calamitales.</p>	16 h
3	<p>Pteropsida: Vegetative habits, anatomy and reproduction in Ophioglossales, Osmundales, Filicales, Marsiales and Salviniiales; Stelar evolution in Pteridophytes; Heterospory and seed habit; Telome concept; Economic importance of Pteridophytes; Recent developments in Pteridophytes.</p>	16 h
4	<p>Gymnosperms: Introduction, classification and distribution; Morphology, anatomy and Reproduction in Cycadales - Cycas and Zamia, Ginkgoales - Ginkgo biloba, Coniferales - Pinus and Araucaria, Gnetales- Gnetum and Ephedra; General account of vegetative and reproductive organs of Pteridosperms; Pentoxylales and Bennettitales-their affinities; Economic importance of Gymnosperms; Endangered and endemic taxa and their conservation.</p>	16 h

REFERENCES:

1. Puri, P. 1980. Bryophytes. Atma Ram and Sons, Delhi.
2. Parihar, N. S. 1996. Bryophytes. Central Book Depot, Allahabad.
3. Bernard Goffinet and Jonathan Shaw, A. 2009. Bryophyte Biology. Cambridge University Press, New York.
4. Parihar, N. S. 1996. Biology and Morphology of Pteridophytes. Central Book Depot, Allahabad.
5. Sporne, K. R. 1991. The Morphology of Pteridophytes. B.I. Publishing Pvt. Ltd., Bombay
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7. Sporne, K.R. 1962. The morphology of Pteridophytes: the structure of ferns and allied plants. Hutchinson & Co. (<https://archive.org/details/morphologyofpter00spor>)
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9. Andrews, H. N. 1961. Studies in Paleobotany, John Wiley, New York.
10. Bhatnagar, S. P. and Moitra, A. 1996. Gymnosperms. New Age International Ltd., New Delhi.
11. Chamberlain, C. J. 1986. Gymnosperms – Structure and Evolution, CBS Publishers, New Delhi.
12. Chopra, G. L and Verma, V. 1988. Gymnosperms. Pradeep Publications, Jalandar.
13. Harris, T. M. 1973. Cycas and the Cycadales, Central Book Depot, Allahabad.
14. Shukla, A. C. & Misra, S. P. 1975. Essentials of Paleobotany. Vikas publishing house Pvt., Ltd., New Delhi.
15. Sporne, N. E. 1965. The Morphology of Gymnosperms. Hutchinson and Company (Publishers) Ltd., U. K.

BOT: HCT. 1.3 PLANT SYSTEMATICS AND PHYTOGEOGRAPHY		64 hours
1	<p>Taxonomy: Pre-Darwinian, Post Darwinian, Phylogenetic systems of classification- Cronquist, Takthajan and Thorne and APG systems of classification; Herbarium: Brief account on the herbaria of World and India, Preparation of herbarium specimens, Maintenance and importance of Herbaria; Botanical gardens- A brief account on the botanical gardens of India & World- their importance; Botanical Survey of India.</p>	16 h
2	<p>Plant Nomenclature: Principles, procedures, rules and recommendations; ICN- Principles, priority, valid publication, effective publication and citation; ICNCP- Classification, documentation and registration of cultivated plant species; Taxonomic study of Nymphaeaceae, Magnoliaceae, Casuarinaceae, Caryophyllaceae, Euphorbiaceae, Fabaceae, Malvaceae, Capparaceae, Asteraceae, Rubiaceae, Apocynaceae, Lamiaceae, and Arecaceae. Araceae, Liliaceae, Arecaceae, Poaceae.</p>	16 h
3	<p>Principles of Phytogeography: Origin of islands and continents- Pangea, Panthalasa, Laurasia, Gondwana land; Plate tectonics and continental drift; theory of tolerance; Endemism; Major terrestrial biomes in the world. Phytogeographical regions of the World & India; General characters of flora of India; Native taxa; Naturalization of exotic taxa.</p>	16 h
4	<p>Floristics: Six major floristic regions of world; Australian Kingdom, Cape Kingdom, Antarctic Kingdom, Palaeotropical Kingdom, Neotropical Kingdom, Boreal Kingdom; Floristic regions of India; eight floristic regions: the western Himalayas, the eastern Himalayas, Assam, the Indus plain, the Ganga plain, the Deccan, Malabar and the Andamans. Plant distribution and migration- Contism, dricontinism and endemic distribution; Age and area hypothesis; Wills theory; Vicaridess and theory of tolerance.</p>	16 h

REFERENCES:

1. A dictionary of flowering plants and ferns: Airy-Show, H.K
(Cambridge,1983)
2. An introduction to plant nomenclature: Bennet, S.S.R. (Dehradun 1979)
3. The evolution and classification of flowering plants: Cronquist, A
(London 1968)
4. An introduction to plant taxonomy: Jeffery, C (Cambridge Univ Press
1982)
5. Taxonomy of Angiosperms: Jhori, B.M. & Bhatnagar, S P (Narosa, New
Delhi. 1994)
6. Plant Systematics: Jones, S. B. & Luchsinger, A. E. (McGrew Hill 1979)
7. Taxonomy of vascular plants: Lawrence, G H M (Mac Millen, London
1951).
8. Taxonomy of angiosperms: Naik, N (1984)
9. Vegetation of the Earth- Ecological systems of the geo-biosphere:
Heinrich Walter (2002)
10. An Advance text book on biodiversity: Krishnamurthy KV (IBH, New
Delhi, 2003)

BOT: SCT. 1.4.1 BIODIVERSITY AND CONSERVATION		64 hours
1	Biodiversity: Definition, concept and importance of biodiversity; Species biodiversity, genetic diversity, ecosystem diversity; Rio de Janeiro Earth Summit 1992, biodiversity and agenda 21; Biodiversity of the World, India and Karnataka; Hotspots of World and India; Mega biodiversity centres of World and India.	16 h
2	Loss of biodiversity: Casual factors of threat, impact of habitat loss and habitat fragmentation; Categories - rare, endangered, vulnerable, threatened and extinct plant species; Red Data Book; Environmental impact assessment and sustainable development.	16 h
3	Biodiversity conservation: Objectives, implication and action plans; International and National organizations for conservation of natural resources; in situ conservation- protected areas, biosphere reserves, national parks, sanctuaries and sacred groves; ex situ- conservation, botanical gardens, gene banks, medicinal & herbal gardens.	16 h
4	Legal aspects of biodiversity conservation: Policy, priority setting and future strategies with emphasis to India and Raichur region.	16 h

REFERENCES:

1. Global Biodiversity Assessment: Heywood V M and Watson RT (Cambridge Univ Press, 1985).
2. Biodiversity: Implications for global security: Swaminathan MN & Jain RS (Macmillan, 1982).
3. Understanding biodiversity, life sustainability and equity: Kothari (1987).
4. Essentials of Conservation Biology: Longman, Richard B, Primack (1993)
5. Global Biodiversity Assessment: Heywood VH & Watson RT (1995).
6. Natural Products from Plants: Peter B, Kaufman *et al.* (1999).
7. Biodiversity and its Conservation in India: Negi S S (1993).
8. Introduction to environment impact assessment: Glasson J, Therivel R & Chadwick A(UCL, London 1995).
9. Red Data Book of Indian Plants vols I-III: Nayar MP & Sastry ARK (1987, 1989, 1990).
10. The Useful Plants in India: CSIR (1986).

BOT: SCT. 1.4.2 MICROBIAL TECHNOLOGY		64 hours
1	<p>Microbial Technology: Introduction to microbiology, Spontaneous generation theory, Biogenesis theory, Branches of Microbiology and Scope of microbiology. Factors influencing soil microbial population; Biology of symbiotic and non-symbiotic nitrogen fixation, preparation of different types of inoculants- nitrogen fixers, phosphate solubilizers, PGPR- plant growth promoting rhizobacteria; Cyanobacteria and other bacteria, and their applications in agriculture; Microbes in GM crop production; Microbes as biocontrol agents – <i>Baculoviruses</i>, <i>Bacillus thuringiensis</i>, <i>Bacillus sphaericus</i>, <i>Bacillus popillae</i>; Microbe derived inhibitors</p>	16 h
2	<p>Microbes in industry: Antibiotic resistance in bacteria; Industrial production of organic compounds - ethanol, acetone, citric acid, lactic acid, amino acids; Microbial enzymes-amylase, protease, pectinase and lipase; Microbes in food and dairy - Pasteurization, sterilization of milk, fermented dairy products, Foods made by microbial activity-cheese making, pickles; Microbes in food spoilage, food poisoning, food infection; Microbial toxins and their impact on human health; Probiotics and their importance in health care, production of SCP and their nutritional value; Edible mushrooms and their cultivation.</p>	16 h
3	<p>Immunology: An overview of immune system, Scope of immunology, Phagocytes, Natural killer cells, mast cells, basophils, Dendritic cells and other cells of the innate immune system. Immunity: Types: Innate immunity: (nonspecific) physical, biochemical and genetic factors involved in governing innate immunity, molecules of innate immunity – complement, acute phase proteins and interferons; Acquired immunity: (specific) natural, artificial, passive immunity, Humoral or antibody mediated immunity, cell mediated immunity</p>	16 h
4	<p>Immune responses during bacterial, parasitic and viral infections, congenital and acquired immunodeficiency syndrome; Vaccines.</p> <p>Antigens: nature and types. Antibodies – Structure of IgG. Classes of antibodies and their functional diversity b) Human blood types and Rh factors c) Antigen-antibody reactions-salient features. Agglutination reaction – Widal test, Neutralisation test, Opsonisation. Precipitation reaction-VDRL Test. Immunotechniques – RIA, ELISA. Complement system (in brief) – complement fixation test</p>	16 h

REFERENCES:

1. Michel J, Pelczar Jr. EC and Krieg CR. 2005. Microbiology, Mc.Graw-Hill, New Delhi.
2. Powar CB and Daginawala. 1991. General Microbiology, Vol – I and Vol – II Himalaya publishing house, Bombay.
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4. Reddy S and Ram. 2007. Microbial Physiology. Scientific Publishers, Jodhpur, 385pp.
5. Sullia SB and Shantharam S. 1998. General Microbiology. Oxford and IBH publishing Co.Pvt.Ltd. New Delhi.
6. Schlegel HG. 1986. General Microbiology. Cambridge University Press. London, 587pp.
7. Sharma R. 2006. Text book of Microbiology. Mittal Publications. New Delhi. 305pp.
8. Sharma PD. 1999. Microbiology and Plant Pathology. Rastogi publications. Meerut, India.
9. Roger S, Ingrahan Y, Wheelis JL, Mark L and Page PR. 1990. Microbial World 5th edition. Prentice-Hall India, Pvt. Ltd. New Delhi.
10. Waste Water Microbiology 2nd Ed: G Bitton
11. Environmental Biotechnology: S N Jogdand
12. Industrial Microbiology: Agrawal and Parihar
13. Handbook of microalgal culture: Biotechnology and Applied Phycology: Amos Richmond (2004).
14. Microalgae: Biotechnology and Microbiology: Wolfgang Becker E. (1994).
15. Soil Microbiology Science: Subba Rao, N S (1999)
16. Biosurfactants: Kosaric, N (Marcel Dekker Inc 1993)
17. Sullia SB. and Shantharam S. 2005. General Microbiology, Oxford and IBH, New Delhi.
18. Vasanthkumari R. 2007. A textbook of Microbiology, BI Publications Pvt. Ltd., New Delhi.

PRACTICALS

BOT : CPP. 1.5 (HCT-1.1) Diversity of Viruses, Bacteria, Algae and Fungi

1. Preparation of stains and fixatives.
2. Study of morphology and reproductive structures of Fungi (Aspergillus, Septate and nonseptate fungi).
3. Staining Bacteria: Simple, Negative and Gram staining.
4. Study of Algae: Characterization and identification- Oscillatoria, Spirogyra, Chara, Sargassum, Polysiphonia.
5. Culturing of algae in laboratory.
6. Study of Bacterial motility by hanging drop method.
7. Microbial count using Haemocytometer.
8. Media preparation and isolation of Fungi from soil by serial dilution plate method.
9. Study of local plant disease caused by viruses and bacteria.

Note: Every student has to submit 5 specimens/herbaria at the practical examination in addition to certified practical record.

BOT: CPP. 1.6 (HCT - 1.2) Diversity of Bryophyta, Pteridophyta and Gymnospermae.

1. Thallus structure, anatomy and reproductive features of Marchantia, Anthoceros, Porella, Funaria and Polytrichum.
2. Habit, anatomy and reproductive features of Psilotum, Lycopodium, Selaginella, Equisetum, Ophioglossum and Osmunda.
3. Habit anatomy and reproductive features of Pteris, Marselia, and Salvinia.
4. Habit anatomy and reproductive features of Zamia, Ginkgo, Araucaria, Podocarpus, Agathis, Ephedra and Gnetum.
5. Types of fossils and fossiliferous rocks.
6. Study of available fossil specimen and slides of Pteridophytes and Gymnosperms.

Note: Submission of Herbarium specimen (05).

BOT: HCP. 1.7 (HCT - 1.3) Plant Systematics and Phytogeography

1. Description of plants using technical terms
2. Identification of plants to family level.
3. Identification of plants to species level using flora
4. Preparation of Dichotomous key for identification
5. Listing of endangered species
6. Floristic regions of India.
7. Evolutionary concepts
8. Drawing maps of continental drift
9. Listing plants of GUG campus
10. Studying species distribution and its measurements
11. Examples of exotic / invasive species

Note: Submission of 5 Maps / Photographs /herbaria during practical examination

BOT: SCP. 1.8.1 (SCT - 1.4.1) Biodiversity and Conservation.

1. Field survey of important plants of the region.
2. Study of the characters and threatened plants included in the theory.
3. Survey of important timber yielding trees of the region.
4. Determination of the minimum size of the quadrat suitable for an area using
5. 'Species area curve' method.
6. Determination of Importance Value Index (IVI) of the plant species in the community by quadrant method.
7. Study of Phytogeographic maps of world and India.
8. Map of Hot spots, Continental drift.
9. Study of Endangered plants species of Gulbarga region.

BOT: SCP. 1.8.2 (SCT - 1.4.2) Microbial Technology

1. Method of sterilization, preparation of media and stains.
2. Isolation of bacteria, fungi and actinomycetes, cyanobacteria and VAM
3. Production and estimation of Citric acid by *Aspergillus niger*
4. Extraction and Chromatographic separation of secondary metabolites from bacteria and fungi.
5. Estimation of extracellular amylase activity
6. Estimation of extracellular protease activity
7. Sterilization methods
8. Demonstration of microbial antagonism
9. Determination of spore concentration (Heamocytometer)
10. Immunoelectrophoresis
11. Isolation and characterization of Phosphate solubilizers
12. Estimation of antimicrobial activity using standard (NCCLS/CLSA) guidelines

M. Sc BOTANY: II SEMESTER – THEORY SYLLABUS

BOT: HCT 2.1 ECOLOGY AND ENVIRONMENTAL BIOLOGY		64 hours
1	Ecosystem: Concept and components; Tropic structure; Diversity and characters of major ecosystems- Aquatic, Terrestrial; Productivity- Primary production and measurement of primary productivity; Energy flow in ecosystems; Biogeochemical cycles- Water, Carbon, Nitrogen, Sulphur and Phosphorus.	16 h
2	Communities: Classification, structure and characteristics- Analytic and Synthetic; Plant succession- Views and types; Climatic climax; Genecology- Concepts, ecotypes and ecads; Soil: Formation, profile and properties; Soil erosion and conservation; Plant interaction- Competition and allelopathy; Water bodies and their classification; Methods and importance of rain water harvesting.	16 h
3	Environmental Biology: Definition, scope and importance; Structure and composition of atmosphere- Lithosphere, Hydrosphere and Biosphere; Pollution- Air, Water and Land- Sources of pollutants and their effects on plants; Management of pollutants; Greenhouse effect, ozone depletion and acid rain; Climate change and its effects on vegetation and crop productivity; Environmental Toxicology: Definition, toxic chemicals, pesticides and insecticides; Bioaccumulation and their effects.	16 h
4	Environmental monitoring and management: Biological and physicochemical monitoring; Remote sensing and geographical information system; Biodegradation of pollutants. Environmental protection and conservation: Environmental education and awareness, Environmental Protection Acts, Current environmental issues in India	16 h

REFERENCES:

1. Fundamentals of Ecology: Odum EP (1971)
2. Elements of Ecology and field Biology : Robert Leo, Smith (1980)
3. Concepts of Ecology: Kormondy E J (1989)
4. Ecology and Environment : Sharma PD (1999)
5. A Text book of plant Ecology : Ambasht RS and Ambasht N K (1999)
6. Terrestrial Plant Ecology: Barbour MG, Burk JH and Pitts WD (1987)
7. Ecology : Begon M, Harpur JL and Townsend CR (Blackwell, Oxford 1996)
8. Ecology: Principles and Applications: Chapman JL and Reiss MJ (Cambridge UnivPress1998).
9. Ecology: Paul, John Wiley & Sons (New York 1993)
10. Principles of Environment Science: Enquiry and Applications Cunningham WP andCunningham M A (2nd Edn, Tata McGraw Hill, New Delhi 2004)
11. Natural Resource Management: Jha L K (APHA Pubs, New Delhi 1997)
12. Environmental Science: Kemp M J (Tata McGraw-Hill, New Delhi 1997).
13. Fundamentals of Geographical Information Systems: John Michael & N Demers (2008)
14. Ecology of Natural Resources: Ramade F (John-Wiley & Sons, New York 1991).
15. Essentials of Ecology and Environmental Sciences: Rana S V S (Prentice-Hall 2005)

BOT: HCT 2.2 PLANT ANATOMY AND EMBRYOLOGY		64 hours
1	Anatomy: Organization of primary plant body, Apical meristems and primary growth, Primary xylem – composition, Primary phloem - composition, Shoot Apex: Apical Cell Theory, Tunica Corpus Theory, Cyto-histological Zonation Theory. Root Apex: Histogenic boundries; Quiscent center. Structure and development of the cell wall – Structure (light microscopic and ultramicroscopic structure), composition of the cell wall, Cell wall development. The effect of hormones on cell differentiation, Genetic control of cell growth and development, Role of the cytoskeleton in cell growth and development, Cell shaping by microtubules.	16 h
2	Development of the secondary vascular system of the stem and root. Role of the vascular cambium, the effect of secondary growth on the primary body on leaf and branch traces. Secondary Xylem: Structure of secondary xylem, Secondary xylem of gymnosperms and dicotyledons. Patterns of distribution of xylary elements and rays, Tyloses, Gentic control of differentiation of secondary xylem. Evolution in secondary xylem of dicotyledons. Seconadary phloem: Gross and Ultra structure, development of the phloem. Nature and development of the cell wall of sieve elements. Nature of protoplast of sieve elements, Nature and function of P-protein, Distinctive features of phloem of gymnosperms, The nature and function of companion cells and Strasburger cells, Nodal anatomy, Anamalous secondary growth: Aristolochia, Boerhaavia, Dracaena, Periderm, Secretary tissues in plants.	16 h
3	Embryology: Introduction, Brief history of Embryology with particular reference to the contribution of Indian embryologists, Male gametophyte: Microsporogenesis, tapetum, types, function of tapetum. Pollen morphology – structure, stratification, unit of dispersal, aperture, types arrangement, classification NPC system. Female gametophyte: Types of embryosac development, organisation of an embryosac, Ultrastructural studies, Embryosac haustoria. Pollination: Structure of the style and stigma, histochemical studies, pollen - pistil interaction, compatability/ incompatability ,pollen germination, pollen embryosac.	16 h
4	Fertilization: Post pollination events; Path pollen tube, site of pollen discharge, double fertilization, Embryogenesis: Monocot (Najas), Dicot embryo development (Capsella), genetics of embryo development (Arabidopsis), Endosperms: Types, structure, development and function of Endosperm, Endosperm haustoria. Polyembryony & Apomixis – a brief account, Experimental Embryology: Intra ovarian pollination, in vitro Pollination and in vitro fertilization, ovule and embryo culture and somatic embryogenesis.	16 h

REFERENCES:

1. Cutter, D.G. (1971) Plant anatomy- Part-1. Cell and Tissues. Edward Arnold, London.
2. Pandey, (20010. Plant anatomy, S. Chand Limited
3. Raghavan V. (1997) molecular embryology of flowering plants. Cambridge University press, Cambridge.
4. Santra S. C., Chatterjee, T.P. & Das A.P. College Botany practical vol. I. New central book agency, Calcutta.
5. Shivanna K.R. and Sawhney V.K. (eds) 1997. Pollen Biotechnology for crop production and improvement. Cambridge University Press, Cambridge.
6. Cutter, D.G. 1971. Plant Anatomy, Part II, Cell and tissues, Edward Arnold, London.
7. Beck, C. 2010. An Introduction to plant structure and Development. 2nd ed. Cambridge Univ. Press. New York.
8. Bhojwani S. S. and Bhatnagar S. P. (2000) The Embryology of Angiosperms. Vikas Publishing House. New Delhi
9. Cutter, E. G. (1969 & 1971) Plant anatomy: Experiments and interpretations vol I & II. Edward Arnold, London.
10. Fahn, plant anatomy (4th Ed.) Pergamon press, Oxford.
11. Maheshwari P. (1950) An introduction to Embryology of angiosperms. Mc graw Hill, New york.
12. Metcalf and Chalk, Anatomy of dicotyledons, Vol.I, anatomy of monocotyledons Vol.II
13. Eames E. J. and Macdaniels (1947) An introduction to plant anatomy. Mc Graw Hill, New york & London.
14. Chand, S. 2005. Plant Anatomy, S, Chand and Company Ltd., New Delhi.
15. Cutler Botha and Stevenson (2007)-Plant anatomy and applied approach. Blackwell Publishing, USA.
16. Esau, K. (1965) Plant anatomy. Wiley publishers.
17. Easu, K.1996. Anatomy of seed plants, First Wiley prints, New Delhi.

BOT: SCT. 2.3.1 MEDICINAL AND AROMATIC PLANTS		64 hours
1	Ethnobotany and ethno medicine: History and importance of ethnobotany and ethnomedicine in modern health care system; Basic concepts and development of Traditional systems of medicine- Ayurveda, Tibetan, Unani, Siddha systems and ethno medicines of Hyderabad Karnataka Region.	16 h
2	Herbal drugs: Methods of preparation and their use in the treatment of coronary, respiratory, urinary, gastrointestinal, gynecological, nervous, diabetics, cancer and other common disorders; Plants used as general tonics; Medicinal food plants- Cereals, pulses, vegetables and wild food plants.	16 h
3	Cultivation and microbial association: Cultivation of medicinal and aromatic plants - <i>Chlorophytum borivillianum</i> , <i>Cassia angustifolia</i> , <i>Stevia rebaudiana</i> , <i>Aloe vera</i> , <i>Gloriosa superba</i> , <i>Withania somnifera</i> , <i>Mentha piperata</i> , <i>Ocimum sanctum</i> and <i>Cymbopogon flexuosus</i> . Methods employed in disease and pest control, harvesting and storage of crude drugs; Post-harvest care, deterioration and disintegration of active compounds by microbes.	16 h
4	Pharmacognosy: Raw drug analysis, microscopic and macroscopic characteristics; Preliminary chemical analysis of <i>Mentha piperata</i> , <i>Ocimum sanctum</i> , <i>Withania</i> , <i>Rauwolfia</i> ; Phytochemistry- Classification and properties of alkaloids, steroids, terpenoids, lectins, non-proteinous amino acids; Controversial drugs and IPR related to medicinal and aromatic plants.	16 h

REFERENCES:

1. Anatomy and Activities of Plants- A guide to the study of flowering plants: Clegg CJ and Cox G (1974)
2. Indian Medicinal Plants: Kirtikar KR and Basu B D (1932)
3. Indian Materia Medica Vol I & II: Nadkarni A K(1954)
4. Ayurvedic drugs and their plant sources: Sivarajan V V and Indira B (Oxford & IBH, New Delhi 1994).
5. Pharmacognosy 12th edn: Trease G E and Evans W L (Bailliere Tindall, London 1983).
6. Some controversial drugs in Indian Medicine: Vaidya B (Chaukamba Orientalia, Varanasi 1982)
7. Phytochemical Methods: Harborne J. Edr (Chapman & Hall, London 1984).
8. The chemotaxonomy of plants: Smith P M (Edward Arnold, London 1976).

BOT: SCT 2.3.2 METHODS IN PLANT SCIENCES		64 hours
1	<p>Microbiological methods: Microscopy (Optical, Phase contrast, Fluorescence, Confocal and Electron – TEM & SEM). Microbial Technique: Sterilization, fungal and Bacterial stains, culture media, Staining techniques simple, negative and Gram's staining and endospore, isolation of microbes from soil, air, water and other substrates. Microbial enumeration techniques- Heamocytomter, Dilution plate technique, selective culture media. Micrometry and different types.</p>	16 h
2	<p>Aerobiological techniques: Spore sampling techniques- Slides, Petri plates, vertical cylinder, Anderson sampler and Burkard spore trap. Microtomy and staining: Microtomy and double staining of plant sections. Radioisotope Techniques: Types of isotopes, radioactive decay. Detection and measurement of radioactivity- GM counter, scintillation counter, autoradiography. Isotopes used in biology, safety methods in handling radioisotopes.</p>	16 h
3	<p>Centrifugation, principles and application: Sedimentation coefficient, types of centrifuges, differential centrifugation, density-gradient, analytical, and ultracentrifugation and their applications. Chromatography, principles and application: Paper chromatography, Thin layer chromatography (TLC), 2-Dimensional chromatography, HPTLC. Detection methods. Column chromatography, gel filtration, adsorption, partition, affinity, ion exchange and HPLC. Gas chromatography</p>	16 h
4	<p>Electrophoresis: Principle and applications; SDS-PAGE, isoelectric focussing, 2D electrophoresis. Agarose Gel Electrophoresis: Preparation, separation and determination of molecular size of DNA, denaturing agarose gel electrophoresis and their applications. pH meter: Principle, Glass electrode, Reference electrode, Combination Electrode; Spectroscopy: Principles and application: Beer and Lambert law, Colorimetry and UV-Visible spectrophotometry, Flame photometry and Atomic absorption spectrophotometry.</p>	16 h

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1. Upadhyay, Upadhyay, Nath, 2002. Biophysical Chemistry-Principals and Techniques (3rd edition). Himalaya Publishing House.
2. P.K. Bajpai (2012). Biological Instrumentation & methodology (Tools and Techniques of Biology) S Chand & Company Pvt Ltd.
3. Wilson & Walker 2000. Practical biochemistry: Principles & Techniques. Cambridge Univ. Press, New York.
4. Williams and Wilson, K. 1991. A Biologist's guide to principles and techniques of practical biochemistry, 2nd ed. Edward Arnold.
5. Lain, D. Campbell and Raymond A. Dwek Biological Spectroscopy Benjamin/Cumming Pub. Co., California, London.
6. Cantor, C.R. and Schimmel, P.R. Biophysical Chemistry by, W.H. Freeman & Co.,
7. Glasel, A and Deutscher, M.P. 1995. Introduction to Biophysical Methods for Protein and Nucleic Acid Research. Academic Press.
8. Principles of gene manipulation- An introduction to genetic engineering: Bold R W and Primerose S B (Black Well, London)
9. Introduction to plant Biotechnology: Oxford and IBH, New Delhi.
10. Experimental Biology-A Laboratory Manual: Datta A (Narosa, New Delhi 2009).
11. Research methodology for Biological Sciences: Gurumani N (2006).
6. Microscopy and microtechniques: Marimuthu R (2011)
12. Principles and Methods of plants molecular Biology, Biochemistry and Genetics: Pratibha Devi (Agrobios, India 2000).
13. Gel electrophoresis of Nucleic acid – A practical approach. III edition Rick Wood D and Hames B D (Oxford. New York 1990)
14. Bioinstrumentation: Veera kumara (MJP Publication 2006)
15. Genome Analysis – A Laboratory manual Vol.-I: Analyzing DNA- Birren et al. (Panima, New Delhi/Blore 2006).

BOT: OET. 2.4.1 BIOFERTILIZERS AND BIOPESTICIDES		64 hours
1	<p>Biofertilizers: Introduction and scope, Definition and classification; Role of biofertilizers in modern agriculture, Bacterial biofertilizers- Symbiotic nitrogen fixers: Root nodules, General account of <i>Azospirillum</i>, <i>Azotobacter</i>, <i>Frankia</i>, <i>Phosphobacteria</i> and <i>Rhizobium</i>. Mass production of <i>Azospirillum</i>, <i>Azotobacter</i> and <i>Phosphobacteria</i>, host specificity and life cycle, Organisms and their importance and asymbiotic nitrogen fixation.</p>	16 h
2	<p>Cyanobacteria (BGA) as biofertilizers: General account of <i>Anabaena</i>, <i>Cylindrospermum</i>, <i>Gloeocapsa</i>, <i>Lyngbya</i>, <i>Nostoc</i>, <i>Plectonema</i> and <i>Tolypothrix</i>. Symbiotic association of cyanobacteria; Heterocyst and nitrogen fixation Field application of cyanobacterial inoculants; <i>Azolla</i> as biofertilizer.</p>	16 h
3	<p>Mycorrhizae as Biofertilizer: Mycorrhizal association, types of mycorrhizal association, taxonomy, occurrence and distribution, phosphorus nutrition, growth and yield, colonization of VAM, methods of isolation and multiplication- wet sieving and decanting method, inoculum production through trap culture. Culturing of Mycorrhizae in modified Melin-Norkran's agar medium (MMN). Application of mycorrhizae; Tricoderma as biofertilizer.</p>	16 h
4	<p>Biopesticides: History and concept of biopesticides. Importance, scope and potential of biopesticide. Definitions, concepts and classification of biopesticides viz. pathogen, botanical pesticides, and biorationales. Mass production of Trichogramma, Cryptolaemus, Crysoperla, Mass HaNPV, and EPN. Importance of <i>Verticillium/Beauveria/Metarhizium/Nomuraea/Paecilomyces/Hirsutellathompsoni/Trichoderma/Pseudomonas/Bacillus</i> organic matter decomposers. Testing of quality parameters and standardization of biopesticides.</p>	16 h

REFERENCES:

1. Gautam, R.D. (2006). Biological suppression of insect pests. Kalyani Publisher, New Delhi.
2. Huffaker, C.B. and Messenger, P.S. (1976). Theory and Practice of Biological control. Academic Press, New York.
3. Ignacimuthu, S.S. and Jayaraj, S. (2003). Biological Control of Insect Pests. Phoenix Publ. New Delhi.
4. Saxena, A.B. (2003). Biological Control of Insect Pests. Anmol Publ. New Delhi.
5. Huffaker, C.B. and Messenger, P.S. (1976). Theory and Practice of Biological control. Academic Press, New York.
6. Pepper HJ and Perlman D. 1979. Microbial Technology. 2nd Ed. Academic Press.
7. A century of Nitrogen Fixation Research Present status and Future projects. 1987. F.J. Bergersen and J.R. Postgate The Royal Soc., London.
8. Biology and Biochemistry of Nitrogen fixation. 1991. M.J. Dilworth, and A.R. Glenn, Elsevier, Amsterdam.
9. Nitrogen Fixation in plants. 1986. R.O.D. Dixon, and C.T. Wheeler, Blackie USA, Chapman and Hall, New York.
10. A treatise on dinitrogen Fixation Section IV. Agronomy and Ecology 1977. R.W.F Hardy, and A.H. Gibson John Wiley & Sons, New York.
11. Bioresearches technology for sustainable agriculture. 1999. S. Kannaiyan, Assoc. Pub. Co., New Delhi.
12. Biofertilizer Technology, Marketing and usage- A source Book -cum-glossary 1995. Motsara, I. M.R., P. Bhattacharyya and Beena Srivastava, FDCO, New Delhi.
13. Symbiotic nitrogen fixation in plants, 1976. P.S. Nutman, Cambridge Univ. Press, London.
14. Hand book for Rhizobia; Methods in legume Rhizobium Technology, 1994. P. Somasegaran and H.J. Hoben Springer-Verlag, New York.
15. Biofertilizers in Agriculture and Forestry 1993. N.S. Subba Rao Oxford and IBH Publ. Co., New Delhi.

PRACTICALS

BOT: HCP. 2.5 (HCT - 2.1) Ecology and Environment Biology

1. Determination of leaf area by Planimeter method.
2. Determination of available soil moisture by Moisture meter.
3. Determination of stomatal index.
4. Determination of organic content of soil.
5. Determination of soil pH using pH meter.
6. Water quality analysis- DO, COD, BOD, Chlorides, Sulphates, TDS, Carbon dioxide.
7. Determination of minimum size of the quadrat by species area curve method.
8. Study of frequency of herbaceous plants by applying Law of frequency.
9. Study of plant abundance and density by quadrat method.
10. Meteorological instruments and their working principles.

BOT: HCP. 2.6 (HCT - 2.2) Plant anatomy and Embryology

1. Preparation of fixatives and stains for anatomical studies.
2. Preparation of double stained permanent slides.
3. Preparation and identification of the Transverse section of the following plants: *Tridax procumbens*, *Boerhaavia diffusa*, *Nyctanthus arborterrestris*, *Leptadenia reticulate*, *Aristolochia indica*, *Salvadora persica*.
4. Preparation and identification based on TS, TLS and RLS of the following wood: *Michelia champaca*, *Dalbergia sisso*, *Tectona grandia*, *Azadirachta indica*, *Mangifera indica* and *Tecoma stans*.
5. Epidermal studies- trichomes and stomata
6. Preparation of Microtome section and staining procedure.
7. Identification of different developmental stages of Embryosac.
8. Identification of different developmental stages of Anther.
9. Histochemical studies for cellulose, callose, chitins, PAS reaction, Lignin.
10. Embryo and endosperm mounting.

Note: submission of 10 permanent slides.

BOT: SCP. 2.7.1 (SCT 2.3.1) Medicinal and Aromatic Plants

1. Identification of medicinal plants
2. Preliminary tests for the occurrence of secondary metabolites
3. Separation of Alkaloids (TLC)
4. Estimation of Phenols
5. Estimation of essential oils
6. Identification of raw drugs- Pharmacognostic studies.
7. Identification of controversial drugs
8. Collection and identification of endemic medicinal plants.
9. Documentation of plants used in Ayurveda, Sidda, Unani, Tibatian and Homeopathy
10. Study of medicinal fruits, vegetables and aromatic plants.

BOT: SCP. 2.7.2 (SCT 2.3.2) Methods in Plant Science

1. Demonstration of sterilizing methods.
2. Demonstration of serial dilution technique
3. Isolation of bacteria and fungi from soil and plant parts.
4. Plasmid culture.
5. Demonstration of pH meter and UV spectra
6. Chromatography- separation of pigments.
7. Separation of proteins by SDS-PAGE
8. Separation of DNA on agarose gel electrophoresis
9. Separation of RNA on formaldehyde agarose gel electrophoresis
10. Study of statistical analysis