Revised w.e.f 2003.2004 B.Sc. Zoology

Theory Botany

RECOMMENDATIONS

i) There will be three theory papers in each class of B.Sc.-I, II & III and each in turn will be of 50 marks.In theory there will be one **compulsory** question covering the entire syllabus/sections.

ii) All the questions will be of equal marks.

iii) Students should be asked to attempt only five questions in all.

iv) Out of the five questions in each theory paper, there will be one Compulsory question from the entire syllabus/sesctions while the remaining eight questions should constitute one section- A,B & C. Students should be asked to attmept at least one question from each section.

v) Besides the theory examination, there shall be 45 marks from the various aspects of the practical examination and 5 marks for the internal assessment in each year of the B.Sc. class.

vi) Model test papers in theory and practicals be got set and circulated to all the concerned teachers in the colleges

The details are as under:

Theory Examination: : 50 marks

Total No. of questions =5

(1 Compulsory +4)

Practical Examination =50 Marks

Practical =45 Marks

Internal Assessment = 5 Marks = 5

B.Sc.-I

Course I:PHYCOLOGY AND MICROBIOLOGY

Phycology:

General characters, classification and economic importance; important features and life history of Chlorophyceae-*Volvox, Oedogonium*; Bacillariophyceae-Diatoms, general account; Xanthophyceae-*Vaucheria*; Phaeophyceae-*Ectocarpus*; Rhodophyceae-*Polysiphonia.*

Microbiology:

Viruses and Bacteria: General account of Viruses and Mycoplasma; Bacteria-structure, nutrition, reproduction and economic importance; general account of Cyanobacteria; TMV (Tobacco Mosaic Virus), Citrus Canker, AIDS.

Suggested Readings:

Clifton, A. 1958. Introduction to the Bacteria. McGraw-Hill Book Co., New York.

Kumar, H.D. 1988. Introductory Phycology. Affiliated East-West Press Ltd., New Delhi.

Mandahar, C.L. 1978. Introduction to Plant Viruses. Chsnd & Co. Ltd. Delhi.

Morris, I. 1986. An Introduction to Mycology. New Age Intermediate Press,

Morris, I. 1986. An Introduction to Algae. Cambridge University Press, U.K.

Round, F.E. 1986. The Biology of Algae. Cambridge University Press, U.K.

Suggested Laboratory Exercise:

Morphological study of representative members of Algae, Bacteria and Viruses: *Microcystis, Oocystis, Pediastrum, Hydrodictyon, Ulva,, Pithophora, Stigeoclonium, Drapranaldiopsis. Closterium, Cosmarium, Chara, Stemonitis.*

Symptomology of some diseased specimens: red rot of sugarcane, wilts, paddy blast, citrus canker, bacterial blight of paddy, angular leaf spot of cotton, tobacco mosaic, little leaf of brinjal, seasame phyllody, mango malformation.

Gram staining of bacteria.

Sterilization methods, preparation of slants. Amended Annexure, Paper I may be enclosed

B.Sc.-I

Course II: Mycology, Plant Pathology and Lichens

Mycology:

General characters, classification and economic importance; important features and life history of Mastigomycotina-*Albugo, Phytophthora*; Zygomycotina-*Rhizopus;* Ascomycotina-*Saccharomycetes, Eurotium, Neurospora, Peziza;* Basidiomycotina-*Puccinia, Agaricus*; Deuteromycotina-*Cercospora, Colletotrichum.*

Plant Pathology:

Definition, symptom, classification and etiology of following diseases: White rust, Late Blight of Potato, Early Blight of Potato, Apple Scab, Loose Smut of Wheat, Rust of Wheat, Red Rot of Sugarcane.

Lichens:

General Account of Lichens.

Suggested Readings:

Alexopoulos, C.J., Mims, C.W. and Blackwel, M. 1996. Introductory Mycology. John & Wiley & Sons Inc.

Mehrotra, R.S. and Aneja, R.S. 1998. An Introduction to Mycology. New Age Intermediate Press.

Rangaswamy, G. and Mahadevan, A. 1999. Diseases of Crop Plants in India (4th Edition). Prentice Hall of India Pvt. Ltd., New Delhi.

Webster, J. 1985. Introduction to Fungi. Cambridge University Press.

Suggested Laboratory Exercises:

Morphological study of representative members of Fungi: *Stemonitis, Peronospora, Albugo, Mucor, Pilobolus,* Yeast,*Emericella, Chaetomium, Pleospora, Morchella, Melamspora, Phallus,* Polyporus,*Drechslera, Phoma, Penicillium, Aspergillus, Colletotrichum.*

Symptomology of some disease specimens: White rust, downy mildew, powdery mildew, rusts, smuts, ergot, groundnut leaf spot and citrus canker.

Identification of fungal cultures: *Rhizopus, Mucor, Aspergillus, Penicillium, Aspergillus, Emericella, Chaetomium, Drechslera, Culvularia, Fusarium, Phoma, Colletotrichum, Graphium.*

Sterilization methods, preparation of media and slants. Amended Annexure-II may be enclosed.

B.Sc.-I

Course III:Bryophytes and Pteridophytes

Bryophyta:

Morphology, Structure, reproduction and life history; distribution; classification, evolution of steleoe; heterospory and origin of seed habit; general account of Marchantiales, Junger-maniales, Anthocerotales, Sphagnales, 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 pteriodophyta; introduction to Psilopsida, Lycopsida, Sphanopsida and Pteropsida.

Amended Annexure Paper III may be enclosed

B.Sc.-II

Course IV: Morphology and Anatomy of Flowering Plants

1. The basic body plan of a flowering plant-modular type of growth.
2. Diversity in plant form in annuals, biennials and perennials: convergence of evolution tree habit in gymnosperms, monocotyledaons and dicotyledons; trees-largest and longest-lived organisms.
3. **The shoot system:** The shoot apical and its histological organization; vascularization of primary shoot in monocotyledons and dicotyledons; formation of internodes, branching pattern; monopodial and sympodial growth; canopy architecture; cambium and its functions; formation of secondary xylem; a general account of wood structure in relation to conduction of water and minerals; characteristics of growth rings, sapwood and heartwood; role of woody skeleton; secondary phloem-structure-function relationships; telome theory; periderm.
4. **Leaf:** Origin, development, arrangement and diversity in size and shapes; internal structure in relation to photosysnthesis and water loss; adaptations to water stress; senescence and abscission.
5. **The root system:** The root apical meristem; differentiation of primary and secondary tissues and their roles; structural modification for storage, respiration, reproduction and for interaction with microbes.

Note to Teachers:

Wherever required, role of environment and hormones in plant development and reproduction should be emphasized.

Suggested Readings:

Bhojwani, S.S. and Bhatnagar, S.P. 2000. The Embryology of Angiosperms. Revised and enlarged edition. Vikas Publishing House, Delhi.

Cutter, E.G. 1969.Plant Anatomy:. Cells and Tissue. Part –I Edward Arnold, London.

Cutter, E.G. 1971. Plant Anatomy: Experiment and Interpretation. Part-II. Organs. Edward Arnold, London.

Esau, K. 1977. Anatomy of Seed Plants, 2nd edition. John Wiely & Sons, New York.

Fahen, A. 1974. Plant Anatomy, 2nd edition. Pergamon Press, Oxford.

Hartman, H.T. and Kestler, D.E. 1976. Plant Propagation: Principles and Practices. 3rd edition. Prentce-Hall of India Pvt. Ltd., New Delhi.

King, J. 1997. Reaching for the Sun: How Plants Work. Cambridge University Press, Cambridge, U.K.

Mauseth, J.D. 1988. Plant Anatomy. The Benjamin/Cummings Publishing Company Inc. Menio Park, California, USA.

Proctor, M. and Yeo, P. 1973. The Pollination of Flowers. William Collins Sons, London.

Raven, P.H., Evert, R.F. and Eichorn, S.E. 1999. Biology of Plants. 5th edition. W.H. Freeman and Co., Worth Publishers, New York.

Thomas, P. 2000. Trees: Their Natural History. Cambridge University Press, Cambridge.

Suggested Laboratory Exercises:

1. Study of any commonly occurring dicotyledonous plant (e.g. *Solanum nigrum* or *Kalanchoe*) to understand the body plan and modular type of growth.
2. Life forms exhibited by flowering plants (by a visit to a forest or a garden). Study of tree-like habit in *Cycas*, Bamboos, Banana, Traveller's tree(*Ravenala madagascariensis*) or yucca and comparison with true trees as exemplified by conifers and dicotylendons.
3. L.S. shoot tip to study the cytohistological zonation and origin of leaf primordia.
4. Monopodial and sympodial type of branching in stems (especially rhizomes).
5. Anatomy of primary and secondary growth in monocots and dicots using hand sections (or prepared slides). Structure of secondary phloem and xylem. Growth rings in wood. Microscopic study of wood in T.S., T.L.S. and R.L.S.
6. Field study of diversity in leaf shape, size, thickness, surface properties. Internal structure of leaf. Structure and development of stomata (using epidermal peels of leaf).
7. Anatomy of root. Primary and Secondary Structure.
8. Examination of a wide range of flowers available in the locality and methods of their pollination.
9. Structure of anther, microsporogenesis (using slides) and pollen grains (using whole mounts). Pollen viability using *in vitro* pollen germination.
10. Structure of ovule and embryo sac development (using serial sections).
11. Test of self-incompatibility (using *Petunia axillaris, Brassica campestris, B. oleracea* or a suitable material) using field pollination.
12. Nuclear and Cellular endosperm. Embryo development in monocots and dicots (using slides/dissections).
13. Simple experiments to show vegetative propagation (leaf cuttings in *Bryophyllum, Sansevieria, Begonia;* stem cutting in Rose, Salix, Money plant Sugar-cane and *Bougainvillea*).
14. Germination of non-dormant and dormant seeds.

Suggested Readings (for Laboratory Exercises):

Steeves, T.A. and Sussex, I.M. 1989. Patterns in Plant Development (2nd Edition). Cambridge University Press, Cambridge.

Raven, P.H., Evert, R.F. and Eichhorn, — 1992. Biology of Plants (5th Edition). Worth Publishers, New York.

Bhojwani, S.S. and Bhatnagar, S.P. 2000. The Embryology of Angiosperms. Revised and enlarged edition. Vikas Publishing House, Delhi.

Mauseth, J.D. 1988. Plant Anatomy. The Benjamin/Cummings Publishing Company Inc. Menio Park, California, USA.

B.Sc.-II

COURSE V: REPRODUCTIVE BIOLOGY,GYMNOSPERMS AND ANGIOSPERMS

1. Characteristics of seed plants; evolution of seed habit; seed plants with (angiosperms) and without (gymnosperms) fruits; fossil and living seed plants.
2. General features of gymnosperms and their classification; evolution and diversity of gymnosperms; geological time scale, fossilization and fossil gymnosperms.
3. Morphology of vegetative and reproductive parts; anatomy of root, stem and leaf; reproduction and life cycle of *Pinus, Cycas* and *Ephedra*.
4. **Flower:** A modified shoot; structure, development and varieties of flower; functions; structure of anther and pistil; the male and female gametophytes; types of pollination; attraction and rewards for pollinators; pollen-pistil interaction, self incompatibility; double fertilization; formation of seed-endosperm and embryo; fruit development and maturation.
5. **Significance of seed:** Suspended animation; ecological adaptation; unit of genetic recombination and reproduction and replenishment; dispersal strategies.6.
6. **Vegetative reproduction:** Vegetative propagation; grafting, economic aspects.

Note to Teachers:

The teacher should prevent students from collecting plants from the wild and submitting them for the practical examination. Instead, the students should be asked to prepare field reports.

Suggested Readings:

Bhatnagar, S.P. and Moitra, A. 1996. Gymnosperms, New Age International Limited, New Delhi.

Gifford, E.M. and Foster, A.S. 1988. Morphology and Evolution of Vascular Plants. W.H. Freeman & Co. New York.

Jeffery, C. 1982. An Introduction to Plant Taxonomy. Cambridge University Press, Cambridge, London.

Sprone, K.R. 1965. The Morphology of Gymnosperms. Hutchinson & Co. (Publishers) Ltd. London.

Stewart, W.M. 1983. Paleobotany and the Evolution of Plants. Cambridge University Press, Cambridge.

Suggested Laboratory Exercises:

Gymnosperms:

Cycas

i. Habit, armour of leaf bases on the stem (if specimen is not available show photograph), very young leaf (circinate vernation) and old foliage leaves, scale leaf, bulbils, male cone (specimen); microsporophyll, mature seed.

ii. Study through permanent slides- normal root (T.S.), stem (T.S.) (if specimen is not available show photographs), ovule (L.S.).

iii. Study through hand sections or dissections and making permanent mount – coralloid root (T.S.), rachis (T.S.) leaflet (V.S.), microsporophyll (V.S.), pollen grain (W.M.).

Pinus

i. Habit, long and dwarf shoot showing cataphylls and scale leaves, T.S. wood showing growth rings, male cone, 1st year, 2nd year and 3rd year female cones, winged seeds.

ii. Study through permanent slides-root (T.S.), female cone (L.S.), Ovule (L.S.), embryo (W.M.) showing polycotyledonous condition.

iii. Study through hand sections or dissections-young stem (T.S.), old stem (wood) (T.L.S. and R.L.S.), needle (T.S.), Male cone (T.S.) and pollen grains (W.M.).

Ephedra

i. Habit and structure of whole, male and female cones.

ii. Permanent slides-female cone (L.S.).

iii. Hand sections/dissections-node (L.S.), internode (T.S.), macerated stem to see vessel structure; epidermal peel mount of vegetative parts to study stomata, male cone (T.S. and L.S.), pollen grains.

B.Sc.-II

1. **COURSE VI: SYSTEMATICS OF ANGIOSPERMS:**

1. Angiosperms; origin and evolution. Some examples of primitive angiosperms.
2. Angiosperm taxonomy; brief history, aims and functional components (taxonomy, holotaxonomy); identification, keys, taxonomic literature.
3. Botanical nomenclature; Principles and rules; taxonomic ranks; type concept; principle of priority.
4. Classification of angiosperms; salient features of the systems proposed by Bentham and Hooker and Engler and Prantl.
5. Major contributions of cytology, phytochemistry and taximetrics to taxonomy.
6. Diversity of flowering plants as illustrated by members of the families Ranunculaceae, Brassicaceae, Malvaceae, Rutaceae, Fabaceae, Apiceae,

Acanthaceae, Apocynaceae, Asclepiadaceae, Solanaceae, Lamiaceae, Chenopodiaceae, Euphorbiaceae, Liliaceae and Poaceae.

Suggested Laboratory Exercises:

The following species are suitable for study. This list is only indicative. Teachers may select plant available in their locality.

1. Ranunculaceae: *Ranunculus, Delphinium.*
2. Brassicaceae: *Brassica, Alyssum, Iberis, Coronopus.*
3. Malvaceae: *Hibiscus, Abution.*
4. Rutaceae: *Murraya, Citrus.*
5. Fabaceae: Faboideae: *Lathyrus, Cajanus, Melilotus, Trigonella*; Caeselpiniodeae: *Cassia.*
6. Apiaceae: *Coriandrum, Foeniculum, Anethum.*
7. Acanthaceae: *Adhatoda, Peristrophe.*
8. Apocynaceae: *Vinca, Thevetia, Nerium.*
9. Asclepiadaceae: *Calotropis.*
10. Solanaceae: *Solanum, Withania, Datura.*
11. Lamiaceae: *Ocimum, Salvia.*
12. Chenopodiaceae: *Chenopodium, Beta.*
13. Euphorbiaceae: *Euphorbia, Phyllanthus.*
14. Liliaceae: *Asphodelus, Asparagus.*
15. Poaceae: *Avena, Triticum, Hordeum, Poa, Sorghum.*
16. Orchidaceae: *Zeuxine*

Suggested Readings:

Davis, P.H. and Heywood, V.H. 1963. Principles of Angiosperm Taxonomy. Oliver and Boyd, London.

Heywood, V.H. and Moore, D.M. (eds.) 1984. Current concepts in Plant Taxonomy. Academic Press, London.

Jones, S.B. (Jr). and Luchsinger, A.E. 1986. Plant Systematics (2nd edition). McGraw-Hill Book Co, New York.

Meheshwari, J.K. 1963. Flora of Delhi. CSIR, New Delhi.

Radford, A.E. 1986. Fundamentals of Plant Systematics. Harper and Row, New York.

Singh, G. 1999. Plant Systematics: Theory and Practice. Oxford and IBH Pvt. Ltd., New Delhi.

Stace, C.A. 1989. Plant Taxonomy and Biosystematics (2nd edition). Edward Arnold, London.

B.Sc.-III

COURSE VII: CELL BIOLOGY AND GENETICS

Structure and Function of Nucleus: Ultrastructure; nuclear membrane; nucleolus.

Chromosome Organization: Morphology, centromere and telomere; chromosome alternations; deletions, duplications, translocations, inversions; variations in chromosome number, aneuploidy, polyploidy; sex chromosomes.

DNA the genetic material: DNA structure, replication; DNA-protein interaction; the nucleosome model; genetic code; satellite and repetitive DNA.

Cell Division: Mitosis; meiosis.

Genetic Inheritance: Mendalism; laws of segregation and independent assortment; linkage analysis; allelic and non-allelic inheritance.

Gene Expression: Structure of gene; transfer of genetic information; transcription, translation, protein synthesis; tRNA; ribosomes; regulation of gene expression in prokaryotes and eukaryotes; proteins, 1D, 2D and 3D structure.

Genetic Variations: Mutations, spontaneous and induced; transposable genetic elements; DNA damage and repair.

Extranuclear Genome: Presence and function of mitochondrial and plastid DNA; plasmids.

Structure and Function of other Organalles: Golgi, ER, peroxisomes, vacuoles.

The Cell Envelops: Plasma membrane; bilayer lipid structure; functions; the cell wall.

- Teachers should cover historical aspects and the basic experiments that led major discoveries.

Suggested Readings:

Alberts, B., Bray, D., Lewis, J. Raff, M., Roberts, K. and Watson, I.D. 1999. Molecular Biology of Cell. Garland Publishing, Co., Inc., New York.

Atherly, A.G., Girton, J.R. and McDonald, J.F. 1999. The Science of Genetics. Saunders College Publishing. Fort Worth, USA.

Gupta, P.K. 1999. A Text Book of Cell and Molecular Biology. Rastogi Publications, Meerut, India.

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., Berk, A., Zpursky, S.L., Matsudaria, P., Baltimore, D. and Darnell, J. 2000. Molecular Cell Biology. W.H. Feeman & Co., New York, USA.

Russel, P.J. 1998. The Benjamin/Cummings Publishing Co. Inc. USA.

Stent, G.S. 1986. Molecular Genetics. CBS Publications.

Wolfe, S.L. 1993. Molecular and Cell Biology. Wadsworth Publishing Co. California, USA.

Suggested Laboratory Exercises:

1. To study cell structure from onion leaf peels; demonstration of staining and mounting methods.
2. Comparative study of cell structure in onion cells, *Hydrilla* and *Spirogyra*. Study of cyclosis in *Tradescantia* staminal cells.
3. Study of plasmids to examine pigment distribution in plants (e.g. *Cassia*, *Lycopersicon* and *Capcicum*).
4. Examination of electron micrograph of eukaryotic cells with special reference to organelles.
5. Study of electron micrograph of viruses, bacteria, cyanobacteria and eukaryotic cells for comparative cellular organisation.
6. Examination of various stages of mitosis and meiosis using appropriate plant material (e.g. onion root tips, onion flower buds).
7. Preparation of karyotypes from dividing root tip cells and pollen grains.
8. Cytological examination of special types of chromosomes: bar body, lampbrush and polytene chromosomes.
9. Working out the laws of inheritance using seed mixtures.
10. Working out the mode of inheritance of linked genes from test cross and/or f2 data.

Suggested Readings

Fukui, K. and Nakayama, S. 1996. Plant Chromosomes: Laboratory Methods. CRC Press, Boca Raton, Florida.

Gunning, B.E.S. and Steer, M.W. 1995. Plant Cell Biology: Structure and Function. Jones and Bartlett Publishers. Boston, Massachusetts.

Harris, N. and Oparka, K.J. 1994. Plant Cell Biology: A Practical Approach. IRL Press , Oxford, UK.

Sharma, A.K. and Sharma, A. 1999. Plant Chromosomes: Analysis, Manipulation and Engineering. Harwood Academic Publishers, Australia.

B.Sc.-III

COURSE VIII: PLANT PHYSIOLOGY, BIOCHEMISTRY AND BIOTECHNOLOGY

Basics of enzymology: Discovery and nomenclature; characteristics of enzymes; concept of holoenzyme, apoenzyme, coenzyme and cofactors; regulation of enzyme activity; mechanism of action.

Plant-water relations: Importance of water to plant life; physical properties of water; diffusion and osmosis; absorption, transportation of water and transpiration; physiology of stomata.

Mineral nutrition: Essential macro- and micro-elements and their role; mineral uptake, deficiency and toxicity symptoms.

Transport of organic substances: Mechanism of phloem transport; source-sink relationship; factors affecting translocations.

Photosynthesis: Significance; historical aspects; photosynthetic pigments; action spectra and enhancement effects; concept of two photosystems; Z-scheme; photophosphorylation; Calvin cycle; C-4 pathoway; CAM plants; photorespiration.

Respiration: ATP-the biological energy currency; aerobic and anaerobic respiration; Kreb cycle; electron transport mechanism (chemi-osmotic theory); redox potential; oxidative phosphorylation; pentose phosphate pathway.

Nitrogen and lipid metabolism: Biology of nitrogen fixation; importance of nitrate reductase and its regulation; ammonium assimilation; structure and functions of lipids; fatty acid biosynthesis; β-oxidation; saturated and unsaturated fatty acids; storage and mobilization of fatty acids.

Growth and development: Definitions; phases of growth and development; kinetics of growth; seed dormancy, seed germination and factor of their regulation; plant movements; concept of photoperiodism; physiology of flowering; florigen concept; biological clocks; physiology of senescence, fruit ripening; plant hormones-auxins, gibberellins, cytokinins, abscisic acid and ethylene, history of their discovery, biosynthesis and mechanism of action; photomorphogenesis; phytochromes and cryptochromes, their discovery, physiological role and mechanism of action.

Genetic engineering: Tools and techniques of recombinant DNA technology; cloning vectors; genomic and cDNA library; transposable elements; techniques of gene maping and chromosome walking.

Biotechnology: Functional definition, basic aspects of plant tissue culture; cellular totipotency, differentiation and morphogenesis; biology of *Agrobacterium*, vectors for gene delivery and marker gene; salient achievement in crop biotechnology.

Suggested Readings:

Bhojwani, S.S. 1990. Plant Tissue Culture: Applications and Limitations. Elsevier Science Publishers, New York. USA.

Dennis, D.T., Turpin, D.H., Lefebvre, D.D. and Layzell (eds.) 1997. Plant Metabolism (2nd Edition). Longman, Essex, England.

Galston, A.W. 1989. Life Processess in Plants. Scientific American Library, Springer-Verlag, New York, USA.

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

Lea, P.J. and Leegood, R.C. 1999. Plant Biochemistry and Molecular Biology. John Wiley and Sons, Chichester, England.

Mohr, H. and Schopfer, P. 1995. Plant Physiology, Springer-Verlag, Berlin, Germany.

Old, R.W. and Primrose, S.B. 1989. Principles of Gene Manipulation. Blackwell Scientific Publications, Oxford, UK.

Raghwan, V. 1986. Embryogenesis in Angiosperms: A Developmental and Experimental Study. Cambridge University Press, New York, USA>

Salisbury, F.B. and Ross, C.W. 1992. Plant Physiology (4th Edition). Sinauer Associates, Massachusetts, USA.

Vasil, I.K. and Thorpe, T.A. 1994. Plant Cell and Tissue Culture. Kluwer Academic Publishers, The Netherlands.

Suggested Laboratory Exercises:

1. To study the permeability of plasma membrane using different concentrations of organic solvents.
2. To study the effect of temperature on permeability of plasma membrane.
3. To prepare the standard curve of protein and determine the protein content in unknown samples.
4. To study the enzyme activity of catalase and peroxidase as influenced by pH and temperature.
5. Comparison of the rate of respiration of various plant parts. Separation of chloroplast pigments by solvent method.
6. Determining osmotic potential of vacuolar sap by plasmolytic method.
7. Determining the water potential of any tuber.
8. Separation of amino-acids in a mixture by paper chromatography and their identification by comparison with standards.
9. Bioassay of auxin, cytokinin, GA, ABA and ethylene using appropriate plant material.
10. Demonstration of technique of micropropagation by using different experiments, e.g. axillary buds, shoot meristems.
11. Demonstration of the technique of anther culture.
12. Isolation of protoplasts from different tissues using commercially available enzymes.
13. Demonstration of root and shoot formation from the apical and basal portion of stem segments in liquid medium containing different hormones.

Suggested Readings (for laboratory exercises):

Devi, P. 2000. Principles and methods of Plant Molecular Biology, Biochemistry and Genetics. Agrobios, Jodhpur, India.

Dixon, R.A. (Ed.) 1987. Plant Cell Culture: A Practical Approach. IRL Press, Oxford.

Glick, B.R. and Thompson, J.E. 1993. Methods in Plant Molecular Biology and Biotechnology. CRC Press, Boxa Raton, Florida.

Hall, R.D. (Ed.) 1999. Plant Cell Culture Protocols. Humana Press, Inc., New Jersey, USA.

Moore, T.C. 1974. Research Experiences in Plant Physiology: A laboratory Manual. Springer-Verlag, Berling.

Ninfa, A.J. and Ballou, D.P. 1998. Fundamental Laboratory Approaches for Biochemistry and Biotechnology. Fitzgerald Science Press, Inc., Maryland, USA.

Roberts, J. and Tucker, G.A. (Eds.) 2000. Plant Hormone Protocols. Humana Press, New Jersey, USA.

Scott, R.P.W. 1995. Techniques and Practice of Chromatography. Marcel Dekker, Inc., New York.

Smith, R.H. 2000. Plant Tissue Culture: Techniques and Experiments. Academic Press, New York.

Wilson, K. and Goulding, K.H. (Eds.) 1986. A Biologist Guide to Principles and Techniques of Practical Biochemistry, Edward Arnold, London, UK.

B.Sc.-III **Course-IX**

Ecology and Utilization of Plants

ECOLOGY

Plants and environment: Atmosphere (gaseous composition), water (properties of water and water cycle), light(global radiation, photosynthetically active radiation), temperature, soil (development, soil profiles, physico-chemical properties), and biota.

Morphological, anatomical and physiological responses of plants to water (hydrophytes and xerophytes), temperature (thermoperiodicity and vernalization), light (photoperiodism, heliophytes and sciophytes) and salinity.

Population ecology: Growth curves, ecotypes, ecads.

Community ecology: Community characteristics, frequency, density, cover, life forms, biological spectrum, ecological succession.

Ecosystems: Structure: abiotic and biotic compounds; food chain, food web, ecological pyramids, energy flow, biogeochemical cycles of carbon, nitrogen and phosphorus.

Biogeographical regions of India.

Vegetation types of India: Forests and grasslands.

UTILIZATION OF PLANTS

Food plants: Rice, wheat, maize, potato, sugarcane.

Fibres: Cotton and jute.

Vegetable oil: Groundnut, mustard and coconut.

General account of sources of firewood, timber and bamboos.

Spices: General account.

Medicinal plants: General account.

Beverages: Tea and coffee.

Ruber.

Suggested Readings (for Ecology):

Odum, E.P. 1983. Basic Ecology. Saunders, Philadelphia.

Kormondy, E.J. 1996. Concepts of Ecology. Prentice-Hall of India Pvt. Ltd., New Delhi.

Makenzie, A. *et al.* 1999. Instant Notes in Ecology. Viva Books Pvt. Ltd., New Delhi.

Suggested Readings (for Utilization of Plants):

Kocchar, S.L. 1998. Economic Botany in Tropics (2nd Edition). Macmillan India Ltd., New Delhi.

Sambamurthy, A.V.S.S. and Subramayam, N.S. 1989. A Text Book of Economic Botany. Wiley Eastern Ltd. New Delhi.

Sharma, O.P. 1996. Hill's Economic Botany (Late Dr. A.F. Hill, adapted by O.P. Sharma). Tata McGraw Hill Co. Ltd., New Delhi.

Simpson, B.B. and Conner-Ogorzaly, M. 1986. Economic Botany-Plants in our World. McGraw Hill, New York.

Suggested Laboratory Exercises (Ecology):

1. To determine minimum number of quadrats required for reliable estimate of biomass in grassland.
2. To study the frequency of herbaceous species in grassland and to compare the frequency distribution with Raunkair's Standard Frequency Diagram.
3. To measure the aboveground plant biomass in protected and grazed grassland.
4. To determine Kemp's constant for dicot and monocot leaves and to estimate the leaf area index of a grassland community.
5. To determine moisture content and water holding capacity of grassland and woodland soil.
6. To study the vegetation structure through profile diagram.
7. To estimate transparency, pH and temperature of different water bodies.
8. To estimate salinity of different water samples.
9. To estimate dust holding capacity of the leaves of different plant species.

Suggested Readings (for laboratory exercises in Ecology):

Krebs, C.J. 1989. Ecological Methodology. Harper and Row, New York, USA.

Ludwig, J.A. and Reynolds, J.F. 1988. Statistical Ecology, Wiley, New York.

APHA-Standard Methods for the Examination of Water and Waste Water. American Public Health Association, Washington, D.C.

Suggested Laboratory Exercises (for Utilization of Plants):

1. **Food Plants:** Study of the morphology, structure and simple microchemical tests of the food storing tissues in rice, wheat, maize, potato and sugarcane. Microscopic examination of starch in these plants (excepting sugarcane).
2. **Fibres:** Study of cotton flowers, sectioning of the cotton ovules/developing seeds to trace the origin and development of cotton fibres. Microscopic study of cotton and test for cellulose. Sectioning and staining of jute stem to show the location and development of fibres. Microscopic structure. Tests for lignocellulose.
3. **Vegetable oils:** Study of hand sections of groundnut, mustard and coconut and staining of oil drops by Sudan III and Sudan Black.
4. **Field visits:** To study sources of firewood (10 plants), timber-yielding trees (10 trees) and bamboos. A list to be prepared mentioning special features.
5. **Spices:** Examine black pepper, cloves, cinnamon (hand sections) and opened fruits of cardamom and describe them briefly.
6. **Preparation of an illustrated inventory of 10 medicinal plants used in indigenous systems of medicine or allopathy:** Write their botanical and common names, part used and diseases/disorders for which they are prescribed.
7. **Beverages:** Section boiled coffee beans and tea leaves to study the characteristic structural features.
8. **Rubber:** Collect illustrative materials of *Hevea brasiliensis*; morphology of the plant and taping practices, history of rubber. List of the many uses of rubber.

Suggested Readings (for laboratory exercises for Utilization of Plants):

Kocchar, S.L. 2000. Economic Botany of the Tropics. Macmillan India Ltd., New Delhi.

Council of Scientific & Industrial Research 1986. The useful Plants of India. Publications and Information Directorate, CSIR, New Delhi.

Sharma, O.P. 1996. Hill's Economic Botany. Tata McGraw Hill Co. Ltd., New Delhi.

Swaminathan, M.S. and Kocchar, S.L. (Eds.) 1989. Plants and Society. Macmillan Publications Ltd., London.

Course III : BRYOPHYTES AND PTERIDOPHYTES

Problem 1: Due to oversight the topics," Evolution of stele, Heterpspory seed habitat ,Which belong to Pteridophytes have been included under the Bryophyta.

Solution: Above topics should be included in the Pteridophyta.

Problem 2 : Type specimens in different groups have not been mentioned.

Solution: The following type specimens should be included:

A) Bryophyta:

Marchantiales	Marchantia
Jungermanniales	Porella (Medotheca)
Anthocerotales	Anthoceros
Sphagnales	Sphagnum
Funariales	Funaria
Polytichales	Polytrichum

B) Pteridophytes:

Psilopsida	Psilotum
Lycopsida	Selaginella
Sphenopsida	Equisetum
Pteropsida	Adiantum
	Marsilea

Problem 3) Practicals pertaining to Bryophytes and Pteridophytes have not been mentioned in the syllabus.

Solution: The taxa mentioned in theory syllabus should be covered in practicals . Section cutting and staining techniques may be followed in the practical . Collection and preservation of locally available Bryophytes and Pteridophytes may be done

Annexure III:

Course I: PHYCOLOGY AND MICROBIOLOGY.

1. Problem: The suggested laboratory exercises mentioned in the syllabus do not match with the texa studied in the theory.

Solution:

1. All taxa presently mentioned in the practical syllabus are to be deleted and in their place the following taxa namely Nostoc, Volvox, Oedogonium, Diatoms, Vaucheria Ectocarpus and Polysiphonia may be studied in detail.

2. Mango malformation; little leaf of Brinjle, Gram staining of Bacteria, Citrus canker, Sterilization methods , preparation of slants, T. M. V. (Tobacco Mosaic Virus)

Course II: MYCOLOGY, PLANT PATHOLOGY AND LICHENS.

Problem: The suggested laboratory exercises mentioned in syllabus do not match with the taxa studies in the theory.

Solution:

1. The taxa mainly Albugo , Phytophthora , Yeast , Eurotium , Neurospora , Peziza , Puccinia , Agaricus , Cercospora , Colletotrichum , Polyporus , Morchella , Penicillium , and Mucor may be studied in detail.
2. Diseases:

(i) White rust of Crucifers - (Albugo)
(ii) Late blight of Potato - (Phytophthora infestans)
(iii) Early blight of Potato - (Alternaria solani)
(iv) Apple scab - (Venturia inequalis)
(v) Loose smut of Wheat - (Ustilago tritici)
(vi) Black Rust of wheat - (Puccinia graminis tritici)
(vii) Red rot of Sugarcane - (Colletotrichum falcatum)
(viii) One member of each type of Lichens which are locally available.
(ix) Collection of diseased parts of plant only.