



**BHARATHIDASAN UNIVERSITY  
TIRUCHIRAPPALLI- 620 024**

**M.Sc. Botany**

(For the candidates admitted from the academic year 2014 -15 onwards offered through Centre for Distance Education)

**Course Duration: 2 Years – (Non-Semester System)**

**Eligibility:** UG Degree with Botany

Year	Paper	Title of the Paper	Exam Hours	Marks
<b>I YEAR</b>	Major Paper I	Plant Diversity (Algae, Fungi, Lichens, Bryophytes, Pteridophytes, Gymnosperms and Palaeobotany)	3	100
	Major Paper II	Anatomy, Embryology, Microbiology, Immunology and Plant Pathology	3	100
	Major Paper III	Angiosperm Taxonomy , Ecology, Phytogeography	3	100
	Major Paper IV	<b>Practical I</b> (Paper covering theory paper -I)	4	100
	Major Paper V	<b>Practical II</b> (covering theory papers – II & III)	4	100
				500
<b>II YEAR</b>	Major Paper VI	Cell Biology, Genetics and Plant Breeding	3	100
	Major Paper VII	Plant Physiology, Biochemistry and Biophysics	3	100
	Major Paper VIII	Research Methodology and Plant Biotechnology	3	100
	Major Paper IX	<b>Practical III</b> (covering theory paper VI)	4	100
	Major Paper X	<b>Practical IV</b> (Covering theory papers VII & VIII)	4	100
		<b>TOTAL</b>		<b>1000</b>

**(Passing Minimum 50% both theory and practical)**

**Note: Compulsory Record, Herbarium and field note book should be submitted at the time of practical examination**

## **Major Paper I - Plant Diversity**

(Algae,Fungi,Lichens,Bryophytes,Pteridophytes,Gymnosperms and Palaeobotany)

### **Unit- I : Algae**

General Characteristics of Algae. Classification of Algae (Bold & Wyne 1978, Fritsch, 1935). Thallus variations in Algae, Reproduction in Algae vegetative, asexual and sexual methods. Life Cycle patterns in Algae. Phylogeny and inter relationships of algae. Ecology of Algae- Fresh water, marine, soil, symbiotic and parasitic algae Economic importance algae. Pollution and its effect on algae.

### **Unit- II : Fungi and Lichens**

General Characteristics of Fungi. Classification of Fungi (Alexopolous and Mims, 1961) Thallus organization, cell structure and fruit bodies, Mode of nutrition in fungi. Reproduction, life cycle types, parasexual cycles. Reduction in sexuality in fungi Homothallism & Heterothallism in fungi. Hormonal control in sex organ development in fungi. Economic importance of fungi. Lichens- general features. thallus organization vegetative and sexual reproduction. Economic importance of Lichens .

### **Unit- III : Bryophytes**

Classification of Bryophytes (Watson, 1955). General characteristics of major groups Marchantiales, Jungermaniales, Anthocerotales, Sphagnales, Funariales and Polytrichales. Range of vegetative structures. Evolution of gametophytes & sporophytes. Reproductions- Vegetative and sexual methods. Spore dispersal mechanism in bryophytes, Fossil bryophytes. Economic importance of bryophytes.

### **UNIT- IV : Pteridophytes**

General features and origin of Pteridophytes. Classification of Pteridophytes (Reimer 1954). Range of morphology, structure, reproduction and evolution of gametophytes and sporophytes of the following orders, Rhyniales , Psilotales, Lycopodiales, Isoetales, Calamitales, Equisetales, Ophiloglossales. Osmundales, Filicales and Salviniiales. Stelar evolution in Pteridophytes. Heterospory and seed habit. Soral evolution in Pteridophytes.

### **UNIT - V : Gymnosperms and Palaeobotany**

A general account of the characteristic features of Gymnosperms. Classification of Gymnosperms (Sporne 1965). A general structure and interrelationships and Pteridospermales, Bennettitales, Pentoxylales, Cycadales, Coniferales, Ginkgoales, Welwitschiales, Ephedrales & Gnetales. Geological time scale. Methods of Fossilization.

## **Books for References**

### **Algae**

- Bold, H. C. and Wynne, M. J. (1978). Introduction of Algae-Structure and Reproduction. Prentice Hall, New Jersey.
- Chapman, C.J. and Chapman, D.J. (1981). The Algae. 2nd ed. Macmillan, London.
- Fritsch, F. E. (1976). Structure and Reproduction of the Algae. Vol. I & II. Cambridge University Press, London.
- Kumar, H. D. (1989). Introductory Phycology. East-West Press, Madras.
- Kumar, H. D. and Singh, H. N. (1982). A Textbook of Algae. East-West Press, Madras.
- Round, F. E. (1981). The Ecology of Algae. Cambridge University Press, London.
- Sharma, O. P. (1986). Textbook of Algae. Tata McGraw Hill, New Delhi.
- Smith, G. M. (1976). Cryptogamic Botany. Vol. I. Algae and Fungi. Tata McGraw Hill, New Delhi.
- Vashishta, B. R. *et al.* (2008). Botany for Degree Students - Algae. S. Chand and Co. New Delhi.

### **Fungi**

- Alexopoulos, C. J. and Mims, C. W. (1979). Introductory Mycology. Wiley Eastern Ltd., New York.
- Bessey, E. A. (1979). Morphology and Taxonomy of Fungi. Vikas Publishing House, New Delhi.
- Bold, H. C. *et al.* (1980). Morphology of Plants and Fungi. Harper and Row Publishing, New York.
- Burnet, J. H. (1971). The Fundamentals of Mycology. ELBS Publications, London.
- Mehrotra, R. S and Aneja, K. R. (1990). An Introduction of Mycology. Wiley Eastern, New Delhi.
- Sharma, P. D. (1987). The Fungi. Rastogi and Co., Meerut.
- Vashishta, B. R. and Sinha, A. K. (2007). Botany for Degree Students - Fungi. S. Chand and Co..

### **Lichens**

- Hale, M. E. Jr. (1983). Biology of Lichens. Edward Arnold, Maryland.

### **Bryophytes**

- Cavers, F. (1911) The Interrelationship of Bryophytes. Cambridge, UK.
- Parihar, N. S (1972). An Introduction to Embryophyta-I: Bryophyta. Central Book Depot, Allahabad.
- Prem Puri (1973). Bryophytes: A Broad Perspective. Atma Ram and Sons, New Delhi.

- Smith, G. M. (1971). *Cryptogamic Botany. Vol. II. Bryophytes and Pteridophytes.* Tata McGraw Hill, New Delhi.
- Vashishta, B. R. *et al.* (2008). *Botany for Degree Students: Bryophyta.* S. Chand and Co. Ltd., New Delhi.
- Watson, E. V. (1971). *The Structure and Life of Bryophytes.* B.I. Publications, New Delhi.
- **Pteridophytes**
- Bower, F.O. (1939). *The Ferns (Vol. I, II, III).* Today and Tomorrow's Printers, New Delhi.
- Eames, A. J. (1936). *Morphology of Vascular Plants - Lower Groups.* Tata McGraw Hill, Delhi.
- Ingold, C. T. (1939). *Spore Discharge in Land Plants.* Oxford, UK.
- Parihar, N. S. 1985. *The Biology and Morphology of Pteridophytes.* Central Book Depo Allahabad.
- Rashid, A. (1986). *An Introduction to Pteridophyta.* Vani Educational Books, New Delhi.
- Sharma, O. P. (1990). *Text Book of Pteridophyta.* Macmillan India Ltd., India.
- Smith, G. M. (1971). *Cryptogamic Botany. Vol. II. Bryophytes and Pteridophytes.* Tata McGraw Hill, New Delhi.
- Sporne, K. R. (1972). *The Morphology of Pteridophytes.* B. I. Publications, Madras.
- Sundararajan, S. (2007). *Introduction to Pteridophyta.* New Age International Publishers, New Delhi.
- Vashishta, P. C. *et al.* (2008). *Botany for Degree Students: Pteridophyta.* S. Chand and Co. Ltd., New Delhi.

### **Gymnosperms**

- Chamberlain, C. J. (1957). *Gymnosperms Structure and Evolution.* University Chicago Press, New York.
- Coultar, J. M. and Chamberlin, C. J. (1967). *Morphology of Gymnosperms.* Central Book Depot, Allahabad.
- Foster, A. S. and Gifford, E. M. (1965). *Morphology and Evolution of Vascular Plants.* W. H. Freeman & Co.
- Maheswari, P. and Vasil, V. 1960. *Gnetum: A Monograph.* CSIR Publication, New Delhi.
- Sporne, K. R. (1974). *The Morphology of Gymnosperm.* B.I. Publications, New Delhi.
- Vasishta, P. C. *et al.* (2006). *Botany for Degree Students: Gymnosperms.* S. Chand and Co. Ltd., New Delhi.

### **Palaeobotany**

- Nikias, K. J. (1981). *Paleobotany, Paleoecology and Evolution.* Praeger Publishers, USA.

- Seward, A. C. (1919). Fossil Plants. Vol. I, II, III and IV. Cambridge University Press, London.
- Seward, A. C. (1931). Plant Life through the Ages. Cambridge University Press, London.
- Shukla, A. C. and Mishra, S. P. (1982). Essentials of Paleobotany. 2nd ed. Vikas Publishing House Pvt. Ltd., New Delhi.

## Major Paper - II

### **Anatomy, Embryology, Microbiology, Immunology and Plant Pathology**

#### **UNIT - I : Anatomy**

General account and theories of organization of apical meristems of shoot apex and root apex, quiescent centre. Structural diversity and phylogenetic trends of specialization of xylem and phloem. Cambium - origin - cellular structure, cell division, storied and non-storied types. Cambium in budding and grafting - wound healing role. Trichomes, periderm and lenticels.

#### **UNIT - II : Anatomy**

Anatomical characteristics and vascular differentiation in primary and secondary structure of root and stem in Dicot and Monocot. Origin of lateral roots - Root stem transition - Anatomy of Dicot and Monocot leaves. Leaf abscission, stomatal types, nodal anatomy, vascularisation of flower and seeding.

#### **UNIT - III : Embryology**

Microsporangium - Microsporogenesis - Pollen - Stigma - Incompatibility - Methods to overcome incompatibility- Megasporangium - Female gametophyte - Monosporic - Bisporic and Tetrasporic - Fertilization - Endosperm - Types - Endosperm haustoria - functions of endosperms - Embryo development in Dicot and Monocot - Polyembryony - Apomixis - Apospory.

#### **UNIT - IV : Microbiology and Immunology**

Prokaryotic and Eukaryotic microbes - characteristics and ultra structure, isolation, purification, chemical nature - replication, transmission, economic importance, virions and prions, phytoplasma (including mycoplasma). Bergey's system of bacterial classification (1984 - 1991) - Eubacteria, Archae bacteria, Cyanobacteria and Actinomycetes. Immunology - General account of immune systems and immunology - innate and acquired immunity - Antigen and antibody (types, structure, requirements and antigen-antibody interactions) - Detection of antibody (immuno electrophoresis, ELISA and RIA) - Application of immunology in plant systems with special reference to immune cytochemistry.

#### **UNIT - V : Plant Pathology**

Methods of studying plant diseases - Koch's postulates - Host parasite interactions - Mycotoxins - Aflatoxins, Defense mechanisms in plants - integrated disease management. Common plant diseases of India (Tobacco Mosaic, Citrus canker, Rice Blight, Anthracnose of mango, Downy mildew of grapes, White rust of Mustard, Damping off disease of seedlings, Rust of wheat.

## **Books for References :**

### **Anatomy**

- Clowers, F.A.L. (1961). Apical Meristems. Blackwell Scientific Publication, Oxford.
- Cutter, E.G. (1978). Plant Anatomy. Edward Arnold Publishers Ltd., London
- Easu, K. (1953). Plant Anatomy. John Wiley & Sons Inc., New York
- Fahn, A (1989). Plant Anatomy. Maxwell Pvt. Ltd., Singapore.
- Metcalfe and Chalk (1950). Anatomy of the Dicotyledons and Monocotyledons. Vol. I and II. Clarendon Press, Oxford, UK.
- Pandey, B.P. (1989). Plant Anatomy. S. Chand and Co. Ltd., New Delhi
- Singh, V., Pande, P.C. and Jain, D.K. (1987). Anatomy of Seed Plants. Rastogi Publications, Meerut.

### **Embryology**

- Agarwal, S.B. (1990). Embryology of Angiosperms - a fundamental approach. Sahitya Bhawan, Agra
- Bhojwani, S.S. and Bhatnagar, S.P. (1981). Embryology of Angiosperms. Vikas Publishing House Pvt. Ltd., New Delhi.
- Dwivedi, J.N. (1998). Embryology of Angiosperms. Rastogi and Co., Meerut.
- Maheswari, P. (1963). An Introduction to Embryology of Angiosperms. International society of Plant Morphologies, University of Delhi.
- Rashid, A. (1986). An Introduction to Pteridophyta. Vani Educational Books, New Delhi.
- Sorne, K.R. (1972). The Morphology of Pteridophytes. B.I. Publications, Madras
- Sundararajan, S. (2007). Introduction to Pteridophyta. New Age International Publishers, New Delhi.
- Vashishta, P.C. et al. (2008). Botany for Degree Students : Pteridophyta. S. Chand and Co. Ltd., New Delhi.

### **Microbiology**

- Carpenter, P.L. (1967). Microbiology. Saunders Co., Philadelphia, USA.
- Davis, B.D., Dulbecco, R. Eiser, H.N. and Grinberg, H.S. (1980) Microbiology. Harper & Row, New York.
- Dubey, R.C. and Maheshwari, D.K. (2007). A Textbook of Microbiology. S. Chand and Co. Ltd., New Delhi.
- Edmond.P. (1978). Microbiology : An Environment perspective. Macmillan & Co., New Delhi.
- Ketchum, P.A. (1988). Microbiology : Concepts and Applications. John Wiley & Sons, New York.
- Pelczar, M.J. Chan, E.C.S. and Krieg, N.R. (1993) . Microbiology. Tata McGraw Hill Publishing Co. Ltd., New Delhi
- Postage, J. (1975). Microbes and Man. Penguin Book, Baltimore
- Power and Dagainwala (1994). General Microbiology. Himalayan Publishing House, Bombay.
- Salle, A.J. (1974). Fundamental Principles of Bacteriology. Tata McGraw Hill Publishing Co. Ltd., New Delhi.
- Schegal, H.E. (1986). General Microbiology. Cambridge University, London.
- Sharma, P.D. (1992). Microbiology. Rastogi & Co., Meerut.
- Staley, J.T. et. al. (1991). Bergey's Manual of Systematic Bacteriology. Vol.I to IV. Williams & Wilkins, London.

## Major Paper- III

### Angiosperm Taxonomy, Ecology and Phytogeography

#### Unit- I :

A brief history and classification of angiosperms (Linnaeus, Engler & Prantl, Hutchinson and Takhtajan). Chemotaxonomy and Numerical taxonomy with examples. International code of Botanical Nomenclature- Typification, Principles of Priority and the limitations, Effective and Valid publications. Author citation, Retention, Choice and rejection of Names – A Brief account of B.S.I, Kew and its role. Monographs, periodicals and floras. A General account on keys.

#### Unit- II :

Study of the following families and their Economic Important Plants. Annonaceae, Magnoliaceae, Moraceae, Menispermaceae, Violacea, Portulacaceae, Polygalaceae, Caryophyllaceae Rhamnaceae, Vitaceae, Sapotaceae, Meliaceae, Moringaceae, Myrtaceae, Aizoaceae, Sapindaceae, Boraginaceae, Nyctaginaceae, Santalaceae, Aristolochiaceae, Lamiaceae, Commelinaceae, Poaceae, Oleaceae, Gentianaceae, Cyperaceae.

#### Unit- III :

Basic ecological Principles, process components of ecology (Ecological niche, autecology, synecology, Hydrosphere and its role) – Types and functions of Ecology, Terrestrial ecology and Aquatic ecology. Energy flow in ecological system, Threats to Ecology –Land use pattern and its importance. Macro and Micro climatic role in determination of ecology. Succession, Bio indicators. Rare, Endangered, endemic and threatened species.

#### Unit- IV :

Dynamics of Ecosystem – Types of ecosystem, components productivity and Biogeochemical cycle Plant biodiversity – Ecosystem diversity, species diversity, genetic (or) Gene diversity. Forest ecosystem, sericulture, agroforestry Forest Management Techniques- sustainable utilisation. Conservation methods- national parks, sanctuaries, reserve forest and biosphere reserve. Indian forest Act. Forest conservation Act, Gene bank .

#### Unit- V :

Phytogeographical classification in India and World – Study of geographical pattern, world flora, types, patterns and distribution. continental drift and plant distribution Human influence and phytogeography. Role of GIS, GPS, Remote sensing and its application.



## References

### Taxonomy

- Bhattacharyya, B. (2005). Systematic Botany. Narosa Publishing House, New Delhi.
- Dahlgren, R. (1984). The Families of Monocotyledons: Structure, Evolution and Taxonomy. Springer Verlag.
- Davis, P. H. and Heywood, V. H. (1967). Principles of Angiosperm Taxonomy. Oliver and Boyd, London.
- Gamble, J. S. (1933). Flora of the Presidency of Madras. Botanical Survey of India, Calcutta.
- Greuter, W. *et al.* (1989). International Code of Botanical Nomenclature. International Association of Plant Taxonomy, Leiden.
- Heywood, V. H. (ed.) (1968). Modern Methods in Plant Taxonomy. Academic Press, New York.
- Hutchinson, J. (1969). The Genera of Flowering Plants. Clarendon Press, Oxford, UK.
- Jeffery, C. (1969). An Introduction to Plant Taxonomy - J & A Churchill Ltd., London.
- Lawrence, G. H. M. (1944). Taxonomy of Vascular Plants. Oxford & IBH Publications, New Delhi.
- Pandey, B. P. (2007). Economic Botany. S. Chand & Co. Ltd., New Delhi.
- Pandey, B. P. (2007). Taxonomy of Angiosperms. S. Chand and Co. Ltd., New Delhi.
- Porter, C. L. (1967). Taxonomy of Flowering Plants. Euasia Publishing House, New Delhi.
- Rendle, A. B. (1925). Classification of Flowering Plants. Vol. I & II. Cambridge University Press, London.
- Sambamurthy, A. V. S. S. and Subramanian, N. S. (1989). A Text Book of Economic Botany. Wiley Eastern Ltd., New Delhi.
- Samuel, B. Jones Jr. and Arlene E. Luchsinger (1987). Plant Systematics. 2nd ed. McGraw Hill Publishing Co. Ltd., New Delhi.
- Singh, V. and Jain, K. K. (1989). Taxonomy of Angiosperms. Rastogi Publications, Meerut.
- Takhtajan, A. L. (1969). Flowering Plants: Origin and Dispersal. Oliver & Boyd, UK.
- Tiagi, Y. D. and Kshetrapal, S. (1988). An Introduction to the Taxonomy of Angiosperms. Ramesh Book Depot, Jaipur.

- Vashista, P. C. (2006). Taxonomy of Angiosperms. S. Chand and Co. Ltd., New Delhi.

### **Ecology**

- Agrawal, K. C. (1987). Environmental Biology. Agro-botanical Publications, India.
- Ambasht, R. S. (1974). A Textbook of Plant Ecology. 3rd ed. Students' Friends Co., Varanasi, India.
- Ananthkrishnan, T. N. (1982). Bioresources Ecology. Oxford & IBH Publications, New Delhi.
- Billings, W. B. (1965). Plants and the Ecosystem. Wardsworth Publishing Co. Inc., Belmont.
- Jogdand, S. N. (2003). Environmental Biotechnology (Industrial Pollution Management). Himalaya Publishing House, Delhi.
- Kershaw, K. A. (1973). Quantitative and Dynamic Plant Ecology. Edward Arnold Publishers Ltd., London.
- Kormandy, E. J. (1978). Concepts of Ecology. 2nd ed. Prentice Hall of India Pvt. Ltd., New Delhi.
- Krishnan Kannan (1997). Fundamentals of Environmental Pollution. S. Chand and Co. Ltd., New Delhi.
- Kumar, H. D. (1978). Modern Concepts of Ecology. Vikas Publishing House Pvt. Ltd., New Delhi.
- Levitt, J. (1980). Responses of Plants to Environmental Stresses. Academic Press, New York.
- Mistra, R. (1968). The Ecology Workbook. Oxford & IBH Publications, Calcutta.
- Mistra, R. C. (1974). Manual of Plant Ecology. Oxford & IBH Publications, New Delhi.
- Odum, E. P. (1971). Fundamentals of Ecology. W. B. Saunders & Co., Philadelphia, USA.
- Odum, E. P. (1975). Ecology. 2nd ed. Oxford & IBH Publications, New Delhi.
- Puri, G. S. (1960). Indian Forest Ecology. Vol. I & II. Oxford & IBH Publications, New Delhi.
- Smith, J. M. (1974). Models in Ecology. Cambridge University Press, London.
- Suresh K. Dhameja (2004). Environmental Engineering and Management. S. K. Kataria and Sons, Delhi.
- Vashista, P. C. (1974). A Textbook of Plant Ecology. Vishal Publications, Jullunder.

## **Phytogeography**

- Cain, S. A. (1944). *Foundation of Plant Geography*. Harper & Brothers, New York.
- Gates, D. M. (1980). *Biophysical Ecology*. Springer Verlag, New York.
- Good, R. (1953). *The Geography of Flowering Plants*. 2nd ed. Longmans Green & Co. Inc., London.
- MacArthur, R. H. and Wilson, E. O. (1967). *The Theory of Island Biogeography* - Princeton University Press, New Jersey.
- Mani, M. S. (1974). *Ecology and Biogeography of India*. Dr. W. Junk Publishers, The Hague.
- Margalef, R. (1968). *Perspectives in Ecological Theory*. University of Chicago Press, Chicago.

## **Conservation Biology**

- Frankel, O. H., Brown, A. H. D. and Burdon, J. J. (1995). *The Conservation of Plant Diversity*. Cambridge University Press, London.
- Heywood, V. H. (1995). *Global Biodiversity Assessment*. UNEP, Cambridge University Press, London.
- Krishnamurthy, K. V. (2004). *An Advanced Textbook on Biodiversity: Principles and Practice*. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
- Leakey, R. E., Bynum, W. F. and Barrett, J. A. (1979). *The Illustrated Origin Species*. Charles Darwin Hill & Wang, New York.
- Meffe, G. K. and Carroll, C. R. (1994). *Principles of Conservation Biology*. Sinauer Associates. Sunderland, Mass, USA.

## Major Paper- IV

### Practical I (Covering theory paper I)

(Algae, Fungi, Lichens, Bryophytes, Pteridophytes, Gymnosperm and Palaeobotany)

#### Algae

*Spirulina, Anabaena, Volvox, Hydrodictyon, Oedogonium, Acetabularia, Nitella, Vaucheria, Diatoms, Padina, Sargassum, Gelidiella, Gracilaria.*

#### Fungi

*Pythium, Pilobolus, Taphrina, Xylaria, Pleurotus, Lycoperdon, Cercospora, Fusarium, Colletotrichum, Lichens- Parmelia and Usnea.*

#### Bryophytes

Morphological and Anatomical study of the following genera *Marchantia, Reboulia, Targionia, Porella and Polytrichum.*

#### Pteridophytes

Study of morphology and anatomy of the vegetative, reproductive parts of the following genera *Isoetes, Lygodium, Angiopteris, Osmunda, Gleichenia, Adiantum, Dryopteris, Azolla and Salvinia.*

#### Gymnosperms

Study of the morphology and anatomy of vegetative and Reproductive parts of the following genera: *Araucaria, Podocarpus, Ginkgo and Ephedra.*

#### Palaeobotany

*Lyginopteris, Lagenostoma, Pentoxylon.*

## Major Paper- V

### Practical II (Covering theory papers II and III)

#### Anatomy

- Dissection of shoot apex in Hydrilla and whole mount.
- Examination of LS of shoot and root apices
- Examination of different types of pits - secondary wall thickening - annular, helical and scalariform and pitted thickening.
- Wood structure - TS, TLS and RLS - showing variations in vessel elements, fibres axial parenchyma and ray parenchyma.
- Identification of different types of stomata - Monocot and Dicot types

#### Embryology

- Slides showing developmental stages of anther, embryosac, endosperm and embryo
- Study of different types of pollen grains.
- Dissection of endosperm haustoria - Cassia, Cucumis, Peltophorum
- Dissection of Embryo - Abelmoschus, Cyamopsis, Tridax

#### Microbiology

Isolation of microbes from soil - Serial dilution and Plating - Isolation of Microbes from food, fruits and vegetables - Gram's staining of Bacteria found in milk, curd, root - nodule - Effect of different antibiotics on bacterial growth (antibiotic sensitivity) - Microbial analysis of milk by methylene - blue reduction test.  
Immunology - Blood group determination (Demonstration)

#### Plant Pathology

Study of the following diseases:

Rust of Wheat, White Rust of Mustard, Anthracnose of Mango - Citrus Canker, Rice Blight Tobacco mosaic, Cucumber mosaic - Little leaf of brinjal

#### Angiosperm Taxonomy

Study of the plants belonging to the families.

Annonaceae, Magnoliaceae, Moraceae, Menispermaceae, Polygalaceae, Violaceae, Portulacaceae, Caryophyllaceae, Rhamnaceae, Vitaceae, Sapotaceae, Meliaceae, Moringaceae, Myrtaceae, Aizoaceae, Sapindaceae, Boraginaceae, Nyctaginaceae, Santalaceae, Aristolochiaceae, Lamiaceae, Liliaceae, Commelinaceae, Poaceae, Oleaceae, Gentianaceae, Cyperaceae

- Determine the binomial of plants with the help of Gamble's flora
- Submission of 30 herbarium specimens with field note book and the report.

10 marks for Field visit, Field note book and Herbarium

10 marks for Record.

### **Ecology:**

Analysis of vegetation by using quadrat/ line transect to find out frequency and interpret the vegetations in terms of Raunkaier's frequency formula. Estimation of species diversity and dominance Index.

- Estimation of Dissolved oxygen content in the given water sample
- Estimation of primary production in the given water sample by the light – dark bottle method
- Estimation of carbonate, bicarbonate and chloride content in water samples.
- Estimation of the quantity of plants present in the given water sample

### **Phygeography**

A study of plant distribution maps- Continuous, discontinuous, circum polar, circum tropical, endemic distribution. Remote sensing- study of satellite maps.

## Major Paper- VI

### Cell Biology, Genetics and Plant Breeding

#### Unit-I: Cell Biology

Structural organisation of the plant cell - Cell wall - primary and secondary – Plasma membrane - structure, models and functions, channels, pumps and receptors - plasmadesmata. Ultrastructure of Chloroplast and Mitochondria. Chloroplast and Mitochondria's genomes

#### Unit-II: Cell Biology

Structure and functions of Glycosomes, Peroxisomes, Spherosomes and Lysosomes. Ultrastructure of Nucleus, structure and organisation of Chromosomes. DNA types - Replication methods and DNA repair mechanisms. RNA types and functions - Lac operon and Trp operon - Programmed cell death (PCD).

#### Unit-III: Genetics

Linkage and crossing over - Tetrad analysis - Sex determination in plants - Sex limited and sex linked inheritance - Cytoplasmic inheritance - Male sterility, mechanisms and its applications.

#### Unit-IV: Genetics

Mutation - Biochemical basis, induction, mutagenic agents - Physical and chemical mutagens, reverse and suppressed mutations. Polyploidy - types, induction, role in plant breeding. Population genetics - Hardy and Weingberg Law.

#### Unit-V: Plant Breeding

Genetic variability and its role in plant breeding - Breeding methods in self pollinated, cross pollinated, vegetatively propagated and apomitic plants. Inbreeding depression - Role of heterosis and hybrid vigour in plant breeding. Plant breeding techniques. Somaclonal variation in crop improvement. RFLP in plant breeding.

#### References

##### Cell Biology

- David Freifelder (2000). Molecular Biology. 2nd ed. Narosa Publishing House, New Delhi.
- De Robertis, E. D. P. and De Robertis, E. M. F. (1980). Cell and Molecular Biology. Saunders International Education, Philadelphia.
- Du Praw, E. J. (1969). Cell and Molecular Biology. Academic Press, New York.

- Gomperts, B. D. (1976). *The Plasma Membrane: Models for its Structure and Function*. Academic Press, New York.
- Gustafson, J. P. (1984). *Gene Manipulation in Plant Improvement*. Plenum Press, New York.
- Leadbetter, M. C. (1970). *Introduction to the Fine Structure of Plant Cells*. Springer Verlag.
- Levin, B. (1974). *Gene Expression*. Vol. I. Bacterial Genomes. Vol. II. Eucaryotic Chromosomes. Wiley Interscience. London.
- Levin, B. (1998). *Genes*. VI. Oxford University Press, London.
- Rastogi, S. C., Sharma, V. N. and Anuradha Tandon, V. N. (1993). *Concepts in Molecular Biology*. Wiley Eastern Ltd., New Delhi.
- Rost, T. L., Gifford, Jr. and Ernest, M. (1977). *Mechanism and Control of Cell Division*. Academic Press, New York.
- Segal, H. L. and Doyle, D. J. (1978). *Protein Turnover and Lysosomal Functions*. Academic Press, New York.
- Verma, P. S. and Agarwal, V. K. (1998). *Concept of Molecular Biology*. S. Chand and Co. Ltd., New Delhi.

### **Genetics**

- Dayanasagar, V. R. (1990). *Cytology and Genetics*. Tata McGraw Hill Publishing Co. Ltd., New Delhi.
- Gardner *et al.* (2004). *Principles of Genetics*. John Wiley and Sons Inc., Singapore.
- Gardner, E. J. (1972). *Principles of Genetics*. John Wiley & Sons Inc., New York.
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### **Plant Breeding**

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- Vasishtha, P. C. and Gill, P. S. (1998). Genetics: Speciation and Plant Breeding. Pradeep Publications, Jalandhar.
- Vijendra Das, L. D. (1998). Plant Breeding. New Age International Publishers, New Delhi.

## Major Paper- VII

### PLANT PHYSIOLOGY, BIOCHEMISTRY AND BIOPHYSICS

#### Unit- I : Plant Physiology

Plant – Water Relations – Water Transport Processes – Diffusion, Osmosis, Water Potential – Transpiration and its Significance, Mechanism of stomatal movement. Mineral Nutrition : Nutrient Uptake and Transport Mechanism.

Photosynthesis: Ultra Structure of Photosynthetic Apparatus, Photochemical reactions, Electron Transport Pathway, Photophosphorylation.

C4 – Carbon Cycle, Crassulcean Acid Metabolism, HMP, Photorespiration and dark respiration.

#### Unit- II : Plant Physiology

Respiration Glycolysis, TCA Cycle , Electron Transport in Mitochondria, oxidative Phosphorylation – Pentose Phosphate Cyanide Resistance Respiration.

Nitrogen Metabolism : Biological Nitrogen Fixation, Reduction of N<sub>2</sub> to Ammonia Nif Genes, Nitrate and Ammonium Assimilation.

Growth and Development : Physiological Role and Mechanism of Action of Plant Growth Regulators: auxins, Cytokinins, Gibberellins Abscissic Acid and Ethylene. Physiology of Flowering- Photoperiodism and Vernalization. Seed Dormancy and Seed Germination, Senescence and Fruit Ripening.

#### Unit- III : Biochemistry

Classification, Structure of Mono, di and Polysaccharides, Amino Acids and Proteins: Structure, Characteristics and Classification of Amino Acids – protein and Non Protein Amino Acid Biosynthesis Structure of Proteins Bond and Polypeptide Chain, Primary, Secondary, Tertiary and Quaternary Structure Lipids: Classification and Structure, Biosynthesis of Fatty Acids, Saturated and Unsaturated Fatty Acids, Oxidation of Fatty Acids, Nucleic Acids:

#### Unit- IV : Biochemistry

Enzymes- General aspects (Classification, Nomenclature and Structure) Enzymatic, Catalysis Michaelis Menton Equation and its Significance Kinetics Regulatory mechanisms, Isoenzymes.

## **Unit- V : Biophysics**

Thermodynamics, Laws- Redox Potential – Redox coupling, Bioenergetics – ATP, Entropy and Enthalpy Photo Biology: Dual Nature of Light, Characteristics of solar Radiation, Solar Energy, Efficiency of Atoms, Absorption Spectra in Molecules – Energy states and De-excitation.

### **Reference Books:**

#### **PLANT PHYSIOLOGY**

1. Jain V.K. (1990) Plant Physiology S. Chand & Co New Delhi
2. ar H.D. and Singh H.N. (1990 Plant metabolism)
3. Fang F.K. (1982) Light Reaction path of Photosynthesis Vol. 35 molecular biology, Biochemistry and Biophysics – Springer.
4. Malik C.P. and Srinivastra (1995) Plant Physiology
5. Verma S.K. (1999) Plant Physiology S. Chand & Co, New Delhi
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7. Delvin R.M. (1969) Plant Physiology Holt, Rinehart & Winston & Affiliated east west Press (P) Ltd New Delhi
8. S. Salisbury F.B & C.W. Ross (1999) Plant Physiology CBS Publishers & Printers, New Delhi.

#### **BIOCHEMISTRY**

1. Lehninger A.L. (1985) Biochemistry Worth Publishers
2. Freifelder D (1985) Essentials of Modern biochemistry – Jones & Barlet.
3. Breet. C.T. and Hillman, J.R. (1985) Biochemistry of plant cell walls - Cambridge University Presses U.K.

#### **Bio Physics**

1. Lchinager A.I (1971)Bioenergetics The Molecular basis Biological Energy Transformation – Addition wiley.
2. Casey E.J(1962) Biophysics – Concepts and mechanism – Van Nonstmd reinfold Co & East – West press, New Delhi
3. Daniel M. and Peter R.C (1989) basic biophysics – Agro Botanical Publishers (India)

## **Major Paper VIII**

### **RESEARCH METHODOLOGY AND PLANT BIOTECHNOLOGY**

#### **Unit I**

Microscopy – Principles and application of light, dark field, phase contrast, fluorescence, polarization and electron microscope – SEM – TEM, pH meter, Centrifuge, Colorimeter UV visible spectrophotometer, NMR, MASS. Flame photometer – Atomic Absorption Spectrophotometer.

#### **Unit II**

Chromatography – principle and applications of partition - ion exchange, affinity, GLC, HPLC, GCMS, Radio isotopes – Half life Tracer techniques, auto radiography – scintillation and GM counter, Electrophoresis- SDS – PAGE.

#### **Unit III**

Research – choosing a problem for research, review of literature- primary, secondary and tertiary sources – bibliography indexing and abstracting – Reporting the results of research in conference oral and poster presentation. Planning and preparation of thesis, proof correction – reprints – Research Journals – Impact factor.

#### **Unit IV**

Plant Biotechnology – Basic techniques of genetic manipulation- cutting and joining of DNA molecules restriction enzymes. Cloning vectors pBR 322, Ti, cosmids, phagemids, BAC, YAC Expression and shuttle vectors – Sequence analysis PCR, RAPD, RFLP and DNA finger printing. Gene Transfer techniques – direct plasmid mediated particle bombardment electroporation and microinjection.

#### **Unit V**

Plant tissue culture- sterilization of explants, preparation of media (MS, White's and Gamborg's media) cell tissue and organ culture, cell suspension culture somatic embryos, synthetic seeds. Haploid production- anther culture, protoplast isolation and fusion. Somatic hybridization. Application of plant tissue culture in agriculture, forestry and horticulture.

#### **Reference Books:**

1. Jayaraman J. Laboratory Manual in Biochemistry Wiley Eastern Ltd, New Delhi
2. SASS, J.E (1967) Botanical Micro technizques 3<sup>rd</sup> edition Oxford & IBH Publishing Co New Delhi
3. Krishnamurthy K.V (1988) Methods in Plant Histo Chemistry Viswanatan Co, Madurai
4. Dubey R.C. (2008) A text book of Biotechnology S.Chand & Co. Ltd New Delhi
5. Gupta P.K. (1994) Elements of Biotechnology Rastogi and Co Meerut.
6. Bhojwani, S.S. and Razdan M.K. (1983) Plant tissue culture Theory and practice elseriver science publishers Neterlands.
7. Williams, B.L. and Wilson K. (1983) A biologist's guide to principles techniques of practical biochemistry Edward Arnold London.

## **Major Paper IX**

### **Practical- III**

**(Covering major paper VI)**

#### **Cell Biology, Genetics and Plant Breeding**

Squash and Smear techniques - Onion root tip and Rheo flower buds.

Study of Karyotypes and Ideograms using suitable plant materials.

Identification of DNA using Schiffs Reagent.

Estimation of DNA

Estimation of RNA

Histochemical staining of DNA and RNA.

Regulations of gene expression (with the help of models / charts)

Detections of a plasmid containing foreign DNA (Diagrammatic representation)

Mapping a cloned gene on a cosmic vector (Diagrammatic representation)

Genetics practical will include working problems in genetics

Emasculation, Crossing, Bagging.

## **Major Paper-X**

### **Practical- IV**

**(Covering major papers VII and VIII)**

#### **Plant Physiology**

- Determination of water potential in different tissues.
- Determination of chlorophyll a, Chlorophyll b, and total chlorophyll by the Arnon's method.
- Determination of carotenoids
- Estimation of protein by Lowry's method
- Estimation of total phenols
- Hill reaction – demonstration

## **Biochemistry**

- Extraction and estimation of lipid
- Determination of reducing sugars in (grapes) fruit
- Estimation of amino acids by ninhydrin
- Separation and identification of amino acids by chromatography
- Separation of dyes by Paper / TLC methods
- Extraction of amylase and determination of its activity
- Determination of  $k_m$  value,  $V_{max}$  Michael's constant for amylase
- Determination of peroxidase activity

## **Biophysics**

- Principle and methodology of pH meter, Spectrophotometer, Centrifuge, Electrophoretic apparatus, permanent slide preparation

## **Research Methodology and Biotechnology**

Practice of Bibliographic writing. Preparation and arrangement of index cards. Sterilization technique. Preparation of MS medium, explants isolation - callus induction and shoot proliferation.

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