

NATIONAL COLLEGE (AUTONOMOUS), TIRUCHIRAPPALLI - 620 001

Nationally Accredited at 'A' Level by NAAC



**M. Sc. BOTANY**  
**COURSE STRUCTURE UNDER C.B.C.S.**

(Applicable to the candidates admitted from the academic year 2013-14 onwards)

Sem.	Course	Course Title	Instru. hours/ week	Cre- dit	Exam hr	Marks			Total
						Int.	External		
							W	O	
I	Core Course - I	Plant Biodiversity-I (Algae, Fungi, Lichens and Bryophytes)	6	5	3	25	75		100
	Core Course - II	Plant Biodiversity-II (Pteridophytes, Gymnosperms and Paleobotany)	6	5	3	25	75		100
	Core Course - III	Microbiology, Plant Pathology and Immunology	6	5	3	25	75		100
	Core Course - IV	Practical-1 (Core Courses I, II & III)	6	5	3	25	70	5	100
	Elective Course-I	Biofertilizers, Mushroom Technology and Vermicomposting	6	4	3	25	75		100
	<b>Total</b>			<b>30</b>	<b>24</b>				
II	Core Course - V	Anatomy, Wood Science and Embryology	6	5	3	25	75		100
	Core Course - VI	Angiosperm Taxonomy and Morphogenesis	6	5	3	25	75		100
	Core Course - VII	Ecology, Phytogeography and Conservation Biology	6	5	3	25	75		100
	Core Course - VIII	Practical-2 (Core Courses V, VI & VII)	6	5	3	25	70	5	100
	Elective Course-II	Industrial Microbiology	6	4	3	25	75		100
	<b>Total</b>			<b>30</b>	<b>24</b>				
III	Core Course - IX	Cytogenetics and Plant Breeding	6	5	3	25	75		100
	Core Course - X	Plant Physiology, Biochemistry and Biophysics	6	5	3	25	75		100
	Core Course - XI	Practical-3 (Core Courses XI & X)	6	5	3	25	70	5	100
	Elective Course-III	Genetic Engineering	6	4	3	25	75		100
	Elective Course-IV	Plant Tissue Culture	6	4	3	25	75		100
	<b>Total</b>			<b>30</b>	<b>23</b>				
IV	Core Course - XII	Biotechnology	6	5	3	25	75		100
	Core Course - XIII	Research Methodology	6	5	3	25	75		100
	Elective Course-V	Horticulture	6	4	3	25	75		100
	Project Work		12	5					100
	<b>Total</b>			<b>30</b>	<b>19</b>				
	<b>Grand Total</b>		<b>120</b>	<b>90</b>					<b>1900</b>

W: Written; O : Oral

There will be oral test for all Practical Examinations. The oral test will carry 5 marks in the external component.

**PLANT BIODIVERSITY I - P13BO1  
(ALGAE, FUNGI AND BRYOPHYTES)**

**Semester : I**

**Core Course: I**

**Instruction Hours/Week: 6**

**Credit: 5**

**Unit-I: ALGAE** (Teaching - 1 h / week)

General trends and criteria for Algal classification (Fritsch). Salient features of Chlorophyceae, Xanthophyceae, Bacillariophyceae, Phaeophyceae, Rhodophyceae and Myxophyceae. Economic importance of algae - Food and feed, Single Cell Protein. Industrial products (Agar-Agar, Carrageenan, Iodine, Vitamins)

**Unit-II: ALGAE** (Teaching - 1 hr/ week)

Range of thallus structure, Lifecycle patterns in algae and alternation of generations and origin and evolution of sex in algae.

Ecology of Algae: Freshwater algae, marine algae, soil algae and symbiotic algae. Algae as pollution indicators, algal blooms. Cultivation of fresh water and marine algae. Fossil algae.

**Unit-III: FUNGI** (Teaching-1 hr/ week)

General features, occurrence, distribution, mode of nutrition in fungi, culture of fungi. homokaryon and heterokaryon, homothallism and heterothallism, hormonal control in sex organ development, reproduction, life cycle types, parasexual cycles and spore dispersal mechanisms. in fungi.

**Unit-IV: FUNGI** (Teaching-2 hrs/ week)

Classification of fungi (Alexopoulos and Mims, 1979), General characters of major classes: Mastigomycotina, Zygomycotina, Ascomycotina, Basidiomycotina and Deuteromycotina. Thallus organization, cell structure fruit bodies. Economic importance of fungi. Fossil fungi. Lichen - General features, classification (Miller, 1984), structure, reproduction and economic importance.

**Unit-V: BRYOPHYTES** (Teaching-1 h / week)

General features, distribution, classification of Bryophytes (Reimer). Comparative study on the structure, and reproduction of Hepaticopsida, Anthocerotopsida and Bryopsida. Evolution of gametophytes and sporophytes. Economic importance of bryophytes. Fossil bryophytes.

## 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.
- Darley, W. M. (1982). Algal Biology: A Physiological Approach. Blackwell Scientific Publications. Oxford, London.
- Fritsch, F. E. (1976). Structure and Reproduction of the Algae. Vol. I & II. Cambridge University Press, London.
- Ian Morris (1967). An Introduction to the Algae. Hutchinson University Library, 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. Ltd., New Delhi.
- Venkataraman *et al.* (1974). Algal Form and Function. Today and Tomorrow Publishers, 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 Pvt. Ltd., New Delhi.
- Bold, H. C. *et al.* (1980). Morphology of Plants and Fungi. Harper and Row Publishing Inc., 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 Ltd., 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. Ltd., New Delhi.

**Lichens**

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

**Bryophytes**

Cavers, F. (1911) *The Interrelationship of Bryophytes*. Cambridge, UK.

Ingold, C. T. (1939). *Spore Discharge in Land Plants*. Oxford, UK.

Kashyap, S.R. (1972). *The Liverworts of Western Himalayas and Punjab. Plains I & II*. Research Company Publications, New Delhi.

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.

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**PLANT BIODIVERSITY II – P13BO2**  
**(PTERIDOPHYTES, GYMNOSPERMS AND PALEOBOTANY)**

**Semester : I**

**Core Course: II**

**Instruction Hours/Week: 6**

**Credit: 5**

**Unit-I: PTERIDOPHYTES** (Teaching - 1 h / week)

General features. Classification of Pteridophytes (Reimer, 1954). Range of morphology, structure, reproduction and evolution of gametophytes and sporophytes of the following orders: Rhyniales, Psilotales, Lycopodiales, Selaginellales, Isoetales, Calamitales and Equisetales.

**Unit-II: PTERIDOPHYTES** (Teaching - 2 hrs / week)

Range of morphology, structure, reproduction and evolution of gametophytes and sporophytes of the following orders: Ophioglossales, Marattiales, Osmundales, Filicales and Salviniales. Stellar evolution in pteridophytes, Heterospory and origin of seed habit. Structure, development and evolution of sorus in Filicales.

**Unit-III: GYMNOSPERMS** (Teaching - 1 h / week)

A general account of the characteristic features of Gymnosperms. Classification of Gymnosperms (Sporne, 1965). General structure and interrelationships of Pteridospermales, Bennetitiales, Pentoxylales and Cordaitales.

**Unit-IV: GYMNOSPERMS** (Teaching - 1 h / week)

A general account on the distribution, morphology, anatomy, reproduction of Cycadales, Coniferales, Ginkgoales and Gnetales. Economic Importance of Gymnosperms.

**Unit-V: PALEOBOTANY** (Teaching - 1 h / week)

Concepts of Paleobotany, A general account on Geological Time Scale.

Fossil types: Compressions, incrustation, casts, molds, petrifications, coalballs and compactions. Paloclimates and fossil plants. Age of fossils – radiocarbon dating. Role of fossil in oil exploration and coal excavation, Paleopalynology.

**References****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, New Delhi.
- Ingold, C. T. (1939). Spore Discharge in Land Plants. Oxford, UK.
- Parihar, N. S. (1985). The Biology and Morphology of Pteridophytes. Central Book Depot, 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.

- Coulter, 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.

### **Paleobotany**

- 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.

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### **MICROBIOLOGY, PLANT PATHOLOGY AND IMMUNOLOGY – P13B03**

**Semester : I**

**Core Course: III**

**Instruction Hours/Week: 6**

**Credit: 5**

#### **Unit-I: MICROBIOLOGY** (Teaching - 1 h / week)

Five kingdom system by Whittaker (1969) - Prokaryotic and Eukaryotic microbes - General features of Viruses - Classification, characteristics and ultrastructure, isolation, purification - replication, transmission, virions and prions.

#### **Unit-II: MICROBIOLOGY** (Teaching - 1 h / week)

Bergey's system of Bacterial classification (1984-1991) - Eubacteria, Archaeobacteria, Cyanobacteria and Actinomycetes. General account, ultrastructure, nutrition, growth, reproduction of bacteria.

#### **Unit-III: PLANT PATHOLOGY** (Teaching - 1 h / week)

Plant pathology - Organisms and causal factor responsible for plant diseases - methods of studying plant diseases - Koch's postulates - common terminologies used in plant pathology - symptomology, Etiology, Epidemic disease, Control measures - Host parasite interactions - Mycotoxins - Aflatoxins.

**Unit-IV: PLANT PATHOLOGY** (Teaching - 1 h / week)

Common plant diseases of India (Cucumber mosaic, Synchytrium Anthracnose of mango, Wilt of Cotton, Downy mildew of grapes, White rust of Mustard, Damping off disease of seedlings, Rust of wheat, Blast of paddy.

**Unit-V: IMMUNOLOGY** (Teaching - 2 hrs / week)

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 (immunoelectrophoresis, ELISA and RIA) - Application of immunology in plant systems with special reference to immune cytochemistry.

**References****Microbiology**

- Carpenter, P. L. (1967). Microbiology. Saunders Co., Philadelphia, USA.
- Davis, B. D., Dulbecco, R., Eiser, H. N. and Grinsberg, 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.
- Stanier, R. Y., Adelberg, E. A. and Ingram, J. L. (1978). General Microbiology. Mac Millan & Co., New Delhi.

## Plant Pathology

- Bilgrami, K. S. and Dube, H. C. (1990). A Textbook of Modern Plant Pathology. Vikas Publishing House Pvt. Ltd., New Delhi.
- Butler, E. J. and Jones, S. G. (1949). Plant Pathology. Macmillan & Co., London.
- Cooper, J. I. (1995). Viruses and the Environment. 2nd ed. Chapman & Hall, London.
- Mehrota, R. S. (1994). Plant Pathology. Tata McGraw Hill Publishing Co. Ltd., New Delhi.
- Pandey, B. P. (1982). A Textbook of Plant Pathology, Pathogen and Plant Diseases. S. Chand and Co. Ltd., New Delhi.
- Rangaswamy, G. (1972). Diseases of Crop Plants in India. Prentice Hall of India Pvt. Ltd.
- Rangaswamy, G. and Soumini Rajagopalan. (1973). Bacterial Plant Pathology. Tamil Nadu Agricultural University, Coimbatore.
- Singh, R. S. (1990). Plant Diseases. 6th ed., Oxford & IBH, New Delhi.
- Smith, K. M. (1957). A Textbook of Plant Virus Diseases. Little Borwn & Co., Boston.
- Southey, J. F. (1965). Plant Nematology. Tech. Bull. No.7, Ministry of Agricultural, Fisheries and Food, Her Majesty's Stationery Office, London.
- Walker, J. C. (1952). Diseases of Vegetable Crops. McGraw Hill Book Co. Inc., New York.

## Immunology

- Annadurai, B. (2008). A Textbook of Immunology and Immunotechnology. S. Chand and Co. Ltd., New Delhi.
- Kuby, J. (2000). Immunology. 4th ed. W. H. Freeman and Co., New York.
- Nandini Shetty. (2008). Immunology Introductory Textbook. New Age International Publishers, New Delhi.
- Wein and Stewart, J. (1997). Immunology, Churchill Livingston, New York.

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## PRACTICAL I - P13BO4P (Covering Core Courses I, II & III)

**Semester : I**

**Core Course: IV**

**Instruction Hours/Week: 6**

**Credit: 5**

### Algae

*Anabaena, Spirulina, Nitella, Padina, Sargassum and Gracilaria.*

### Fungi

*Pilobolus, Taphrina, Xylaria, Pleurotus and Lycoperdon*

### Lichens

*Parmelia and Usnea*

### Bryophytes

Morphological and anatomical study of representative members of the following genera:



*Lunularia, Targionia, Reboulia, and Funaria.*

### **Pteridophytes**

Study of the morphology and anatomy of the vegetative and reproductive parts of the following genera:

*Isoetes, Angiopteris, Osmunda, Pteris, and Nephrolepis.*

### **Gymnosperms**

Study of the morphology and anatomy of vegetative and reproductive parts of the following genera:

*Podocarpus, Cupressus and Ephedra*

### **Paleobotany**

*Lepidodendron, Stigmaria, Lyginopteris and Cordaites*

### **Microbiology**

Isolation of microbes from food, fruits and vegetables - Gram's staining of Bacteria – Bacterial contamination of milk by methylene - blue reduction test

### **Plant Pathology**

Study of the Rust of wheat, Blast of paddy, White rust of mustard, Cucumber mosaic.

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## **BIOFERTILIZERS, MUSHROOM TECHNOLOGY AND VERMICOMPOSTING – P13BO5E**

**Semester : I**

**Elective Course: I**

**Instruction Hours/Week: 6**

**Credit: 4**

### **Unit-I: BIOFERTILIZER** (Teaching - 1 h / week)

Biofertilizers - Introduction, scope and advantages. Isolation and mass cultivation of Cyanobacteria (*Anabaena*) and *Azolla*.

### **Unit-II: BIOFERTILIZER** (Teaching - 1 h / week)

Bacterial biofertilizers: A general account of bacterial biofertilizer organisms. Isolation and mass production of *Azospirillum*, *Azotobacter*, *Rhizobium* and *Phosphobacteria*.

### **Unit-III: BIOFERTILIZER** (Teaching - 2 hrs / week)

Mycorrhizal fungi as biofertilizers: Introduction – Scope - General account of Ecto, Endo and Arbuscular mycorrhizae (AM). Methods of collection - wet sieving and decanting method and inoculum production. Culture of mycorrhizae in Modified Melin - Norkrans (MMN) agar medium - Isolation and method of inoculation of Arbuscular mycorrhizae (AM).

**Unit-IV: MUSHROOM TECHNOLOGY** (Teaching - 1 h / week)

Mushroom Technology - Introduction, History and Scope – edible and poisonous mushrooms - importance and nutritive value of edible mushrooms. Cultivation technology for Button mushroom (*Agaricus bisporus*), and Oyster mushroom (*Pleurotus sajorcaju*) - Harvest - Storage methods. Receptie for mushroom food products.

**Unit-V: VERMICOMPOSTING** (Teaching - 1 h / week)

Classification of Composting, Composting Techniques - Windows - Aerated Static Pile - In-vessel - Pre and Post processing - Composting agent - Desired characteristics - Vermicomposition - Process of vermicomposting - Vermicompost as sustainable biofertilizer.

**References****Biofertilizers**

- Dubey, R. C. (2008). A Textbook of Biotechnology. S. Chand & Co., New Delhi.
- Newton, W. E. *et al.* (1977). Recent Developments in Nitrogen Fixation. Academic Press, New York.
- Schwintzer, C. R. and Tjepkema, J. D. (1990). The Biology of *Frankia* and *Actinorhizal* Plants. Academic Press Inc., San Diego, USA.
- Stewart, W. D. P. and Gallon, J. R. (1980). Nitrogen Fixation. Academic Press, New York.
- Subba Rao, N. S. (1982). Advances in Agricultural Microbiology. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
- Subba Rao, N. S. (2002). Soil Microbiology. 4th ed. Soil Microorganisms and Plant Growth. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
- Subba Rao, N. S. and Dommergues, Y. R. (1998). Microbial Interactions in Agriculture and Forestry. Vol. I, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
- Verma, A. (1999). Mycorrhiza. Springer Verlag, Berlin.
- Wallanda, T. *et al.* (1997). Mycorrhizae. Backley's Publishers, The Netherlands.

**Mushroom Technology**

- Alice, D., Muthusamy and Yesuraja, M. (1999). Mushroom Culture. Agricultural College, Research Institute Publications, Madurai.
- Marimuthu, T. *et al.* (1991). Oster Mushroom. Department of Plant Pathology. Tamil Nadu Agricultural University, Coimbatore.
- Nita Bhal. (2000). Handbook on Mushrooms. 2nd ed. Vol. I and II. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.

Pathak, V. N. and Yadav, N. (1998). Mushroom Production and Processing Technology. Agrobios, Jodhpur.

Tewari Pankaj Kapoor, S. C. (1988). Mushroom Cultivation. Mittal Publication, New Delhi.

Tripathi, D. P. (2005). Mushroom Cultivation. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.

### **Vermicomposting**

Benny Joseph (2005). Environment Studies. Tata McGraw-Hill Publishing Co. Ltd., New Delhi.

Dubay, R. C. (2009). A Textbook of Biotechnology. S. Chand & Co. Ltd., New Delhi.

Jogdand, S. N. (2003). Environmental Biotechnology. Himalaya Publishing House, New Delhi.

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## **ANATOMY, WOOD SCIENCE AND EMBRYOLOGY – P13B06**

**Semester : II**

**Core Course: V**

**Instruction Hours/Week: 6**

**Credit: 5**

### **Unit-I: ANATOMY** (Teaching - 2 hrs / week)

General account and theories of organisation of shoot apex and root apex, quiescent centre and modern concept on meristems. Structural diversity, functional complexity and phylogenetic trends in specialization of complex permanent tissues (xylem and phloem). Cambium - origin - structure, storied and non-storied types. Formation of cork cambium, and periderm. Anomalous secondary growth in dicot and monocot

### **Unit-II: ANATOMY** (Teaching - 1 h / week)

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. Stomatal types, nodal anatomy and petiole anatomy. Trichomes and their significance.

### **Unit-III: WOOD SCIENCE** (Teaching - 1 h / week)

Identification and classification of wood - Chemical composition of wood - Physical properties of wood - Mechanical properties of wood - Defects of wood - Wood preservation – Seasoning of wood. Economic Importance of Wood.

**Unit-IV: EMBRYOLOGY** (Teaching - 1 h / week)

Microsporangium - Microsporogenesis, Microspores - arrangement - morphology - ultrastructure - Microgametogenesis - Pollen - Stigma - Incompatibility - Methods to overcome incompatibility - Megasporangium - Megagametogenesis - Female gametophyte - Monosporic - Bisporic and Tetrasporic - Nutrition of embryo sac and fertilization.

**Unit-V: EMBRYOLOGY** (Teaching - 1 h / week)

Endosperm - Types - Endosperm haustoria - Cytology and physiology of endosperms, functions of endosperms - Embryo development in Dicot and Monocot, Nutrition of embryo - Polyembryony - Causes, Apomixis - Causes, Apospory.

**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.
- Metcalf 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.

**Wood Science**

- Brown *et al.* (1981). Textbook of Wood Technology. Tata McGraw-Hill, New Delhi.
- Brown, H. P. (1985). Manual of Indian Wood Technology. International Books and Periodicals Supply Service, New Delhi.
- Chowdhury, K. A. and Ghose, S. S. (1958). Indian Woods. Publication Division, Government of India, New Delhi.
- Franz, F. P., Kollmann and Wilfred A. Cote, Jr. (1968). Principles of Wood Science and Technology. Vol. I: Solid Wood. Springer-Verlag, New York.
- Franz, F. P. Kollmann (1988). Wood Science and Technology. Vol. I and II. Springer-Verlag, New York.
- Pearson and Brown (1984). Commercial Timbers of India. Government of India Publication, New Delhi.
- Tieuran, H. D. (1951). Wood Technology. Pituran Publishing Co., New York.

Vaux, H. J. (1949). Textbook of Wood Technology. Vol. I. McGraw Hill, New York.

Vaux, H. J. (1952). Textbook of Wood Technology. Vol. II. McGraw Hill, New York.

### **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.

Raghavan, V. (1976). Experimental Embryogenesis in Vascular Plants. Academic Press, London.

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## **ANGIOSPERM TAXONOMY AND MORPHOGENESIS – P13B07**

**Semester : II**

**Core Course: VI**

**Instruction Hours/Week: 6**

**Credit: 5**

### **Unit-I: TAXONOMY** (Teaching - 1 h / week)

Introduction - History of classification - Carolus Linnaeus, Cronquist and Takhtajan, Biosystematics, Chemotaxonomy, Numerical Taxonomy and Molecular Taxonomy (DNA markers).

### **Unit-II: TAXONOMY** (Teaching - 1 h / week)

International code of Botanical Nomenclature - Typification, Principles of priority and their limitations. Effective and valid publications - Author citation, retention, choice and rejection of names. A general account on keys - Herbarium preparation and management. A brief account of B.S.I. and its role.

### **Unit-III: TAXONOMY** (Teaching - 1 h / week)

Diagnostic characters of Menispermaceae, Caryophyllaceae, Rhamnaceae, Sapindaceae, Aizoaceae, Gentianaceae, Boraginaceae, Aristolochiaceae, Casuarinaceae, Cyperaceae.

### **Unit-IV: MORPHOGENESIS** (Teaching - 1 h / week)

Definition - Morphogenesis and its relation to morphology - Turing's diffusion reaction theory - Morphogenetic factors - growth regulators - genetic and environment - Polarity -

Molecular basis of morphogenesis - Cytosol and cytoskeleton, microtubules and microfilaments - Cellular level morphogenesis.

**Unit-V: MORPHOGENESIS** (Teaching - 2 hrs / week)

Nuclear-Cytoplasmic interaction - transplantation experiments with *Acetabularia* - Sach's and Erriera's laws - Asymmetric divisions and their significance. Morphogenesis at tissue level - Differentiation, dedifferentiation and redifferentiation of vascular tissue *in vivo*, *in vitro* (eg.: wound healing process). Plant galls and their importance.

**References**

**Taxonomy**

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### **Morphogenesis**

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- Brouder, L. W. (1986). Development Order: A Comprehensive Treatise. Vol.2. The Cellular Basis of Morphogenesis. Plenum Press, New York.
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## **ECOLOGY, PHYTOGEOGRAPHY AND CONSERVATION BIOLOGY – P13B08**

**Semester : II**

**Core Course: VII**

**Instruction Hours/Week: 6**

**Credit: 5**

### **Unit-I: ECOLOGY** (Teaching - 1 h / week)

Concept and dynamics of ecosystem: Types of ecosystem, components, Food chain, Food web and energy flow - Trophic level, ecological pyramids. Productivity and biogeochemical cycles (N, P, C, S). Ecological amplitude of a species and adaptation - Ecads, ecotypes, ecospecies, Raunkiaer's Life Forms.

### **Unit-II: ECOLOGY** (Teaching - 1 h / week)

Types of forests and forest conservation - Utilization of energy resources - Non-renewable and renewable.

Environmental pollution - Air, water, soil, thermal and radiation. Cumulative effect of pollution on global environment, Ozone depletion, Greenhouse effect and their consequences. Climatic factors. Ecological indicators.

**Unit-III: PHYTOGEOGRAPHY** (Teaching - 1 h / week)

Phytogeography: Range - Dispersal and migration barriers hypothesis, Continental drift hypothesis, Land - Bridges hypothesis, Age and Area hypothesis, Endemism. Introduction to Remote Sensing and its uses. Vegetation types of India.

**Unit-IV: CONSERVATION BIOLOGY** (Teaching - 1 h / week)

Conservation Biology - Introduction - Ecosystem and Species based approaches - Social approaches - Sacred groves - Chipko movement - Forest management, Biodiversity awareness programmes, Biodiversity Education Resources and Sustainable Development - Role of IUCN, UNESCO, WWF, ICSU in Conservation Programme.

**Unit-V: CONSERVATION BIOLOGY** (Teaching - 2 hrs / week)

*In situ* conservation (Afforestation, Social Forestry, Agro Forestry, Botanical Gardens, Biosphere Reserves, National Parks, Sanctuaries, Sacred Groves and Sthalavrikshas) and *ex situ* conservation (Cryopreservation, Gene Banks, Seed Banks, Pollen Banks, Sperm Banks, DNA Banks, Tissue Culture and Biotechnological strategies) - Environmental Education.

**References****Ecology**

- Agrawal, K. C. (1987). Environmental Biology. Agro-botanical Publications, India.
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### **Phytogeography**

- Cain, S. A. (1944). Foundation of Plant Geography. Harper & Brothers, New York.
- Gates, D. M. (1980). Biophysical Ecology. Springer Verlag, New York.
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### **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.
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**PRACTICAL II – P13BO9P**  
**(Covering Core Courses V, VI & VII)**

**Semester : II**

**Core Course: VIII**

**Instruction Hours/Week: 6**

**Credit: 5**

**Anatomy and Wood Science**

Dissection of shoot apex in *Hydrilla* and whole mount.

Wood structure - TS, TLS and RLS - showing variations in vessel elements, fibres axial parenchyma and ray parenchyma.

Identification of different types of stomata (Spotters)

Anomalous secondary growth in *Nyctanthus* and *Aristolochia*.

**Embryology**

Slides showing developmental stages of anther, embryosac and embryo.

Study of different types of pollen grains.

Study of endosperm types (Spotters)

Dissection of Embryo - *Abelmoschus*, *Tridax*

**Taxonomy**

Study of the plants belonging to the following families:

Menispermaceae

Caryophyllaceae

Rhamnaceae

Sapindaceae

Aizoaceae

Gentianaceae

Boraginaceae

Aristolochiaceae

Casuarinaceae

Commelinaceae

Identification of binomial of the plants with the help of Gamble Flora.

ICBN problems to be worked out.

Submission of **10 herbarium specimens** with field note book and tour report.

The students should undertake as part of their course a tour and field study of vegetation under the guidance of the staff for three to five days within the state and neighbouring states. Students who have not undertaken the above activities shall

forfeit the appropriate marks allotted for this purpose (10 marks) for practical examination.

### **Morphogenesis**

Superficial 'V' shaped wounding of young stem and studying the wound healing response in Dicot.

Bisecting aerial root apices and studying their further behaviour.

Study of one fungal gall (Club - Root of Cabbage) and insect gall (*Pongamia* leaf - gall)

### **Ecology**

Estimation of dissolved oxygen content in water samples.

Estimation of chloride content in water samples.

### **Phytogeography and Conservative Biology**

Study of vegetation by Quadrat method.

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## **INDUSTRIAL MICROBIOLOGY – P13BO10E**

**Semester : II**

**Elective Course: II**

**Instruction Hours/Week: 6**

**Credit: 4**

### **Unit-I** (Teaching - 1 h / week)

General Introduction, history and development of industrial microbiology, scope of industrial microbiology. Microorganisms in industry - Sterilization - Preparation of media - Isolation and culture methods for microorganisms - Principles of storage of microbes at low temperature in liquid nitrogen.

### **Unit-II** (Teaching - 2 hrs / week)

Principle of fermentation: factors involved in fermentation, differences between biochemical and chemical processes; biochemical reactions, operational consideration. Fermenter configuration and various types of fermentors; principle, design and operation characteristics of fermentors.

### **Unit-III** (Teaching - 1 h / week)

Methylophiles: Methanogens and methylophiles, Mechanism of methane production - Economic importance of methylophiles. Hydrogen fuel. Single Cell oil, Microbial leaching. Sulphur utilizing bacteria.

### **Unit-IV** (Teaching - 1 h / week)

Microbial production of food; Microbial Single Cell Protein (SCP). Fermented dairy products, fermented meats, leavening of breads, alcoholic beverages - beer, distilled liquors and wines

**Unit-V** (Teaching - 1 h / week)

Production of pharmaceuticals: Human Proteins, Vaccines and Vitamins.

Antibiotics and their mode of action with reference to Penicillin, Streptomycin, and Erythromycin.

**References**

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## CYTOGENETICS AND PLANT BREEDING – P13BO11

**Semester : III**

**Core Course: IX**

**Instruction Hours/Week: 6**

**Credit: 5**

**Unit-I: CELL BIOLOGY** (Teaching - 1 h / week)

Structural organisation of Plasma membrane - Structure, models and functions - Ultrastructures of Chloroplast and Mitochondria, Chloroplast and Mitochondrial genomes - Structure and functions of Glyoxisomes, Peroxisomes and Lysosomes.

**Unit-II: CELL BIOLOGY** (Teaching - 1 h / week)

Ultrastructure of Nucleus, structure and organisation of Chromosomes. DNA types - Replication methods and DNA repair mechanisms. RNA types and functions - Genetic code - Programmed cell death (PCD).

**Unit-III: GENETICS** (Teaching - 1 h / week)

Linkage and crossing over - Sex determination in plants - Sex limited and sex linked inheritance - Cytoplasmic inheritance - Male sterility and mechanism of inheritance, Application of cytoplasmic and genetic male sterilities.

**Unit-IV: GENETICS** (Teaching - 1 h / week)

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** (Teaching - 2 hrs / week)

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

**References**

**Cell Biology**

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### **Genetics**

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### **Plant Breeding**

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Vasishta, 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.

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### **PLANT PHYSIOLOGY, BIOCHEMISTRY AND BIOPHYSICS – P13BO12**

**Semester : III**

**Core Course: X**

**Instruction Hours/Week: 6**

**Credit: 5**

#### **Unit-I: PLANT PHYSIOLOGY** (Teaching - 2 hrs / week)

Water and its relation in plants: Properties of water - chemical potential and water potential and bulk movement of water.

Mineral nutrition in plants – Modern concepts of mineral salt absorption and its translocation - modern concepts of mineral salt absorption and translocation.

Stomata: Physiology – opening and closing mechanism

Photosynthesis: Light reactions – cyclic and noncyclic types – Emerson Enhancement Effect – photophosphorylation. CO<sub>2</sub> fixation – C<sub>3</sub>, C<sub>4</sub>, C<sub>3</sub>-C<sub>4</sub> -intermediates and CAM types

#### **Unit-II: PLANT PHYSIOLOGY** (Teaching - 1 h / week)

Respiration: Glycolysis, Krebs cycle and Respiratory electron transport chain - Oxidative Phosphorylation - Gluconeogenesis. Photorespiration – pathway and its significance

Mechanism of nitrogen fixation, Biological nitrogen fixation – nitrate uptake and assimilation.

Plant growth regulators: Structure, synthesis and mode of action of Auxin, Gibberellin, Cytokinin and Phytochrome

#### **Unit-III: BIOCHEMISTRY** (Teaching - 1 h / week)

Classification, structure, properties and function carbohydrates, and protein. Protein configuration – Ramachandran's plot.

Enzyme: Classification, coenzymes, isoenzymes, cofactors. Enzyme kinetics

#### **Unit-IV: BIOCHEMISTRY** (Teaching - 1 h / week)

Classification, structure, properties and function of lipids and nucleic acids. Secondary metabolites - general account - biosynthesis and function of terpenes, phenols, alkaloids, flavonoids.

**Unit-V: BIOPHYSICS** (Teaching - 1 h / week)

Bioenergetics: Energy and work - entropy and enthalpy. Laws of thermodynamics. Redox potential, redox couples. ATP bioenergetics,

Photobiology: Dual nature of light, characteristics of solar radiation, Absorption spectra in molecules, energy states, De-excitation.

**Reference****Plant Physiology**

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- Fang, F. K. (1982). Light Reaction Path of Photosynthesis. Vol. 35. *Molecular Biology, Biochemistry and Biophysics*. Springer Verlag.
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**Plant Biochemistry**

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### **Biophysics**

Casey, E. J. (1962). Biophysics: Concepts and Mechanics. Van Nostrand Reinhold Co. and East-West Press, New Delhi.

Lehninger, A. L. (1971). Bioenergetics: The Molecular Basis of Biological Energy Transformation. Addison Wiley.

Salil Bose, S. (1982). Elementary Biophysics. Vijaya Printers, Madurai.

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### **PRACTICAL III – P13BO13P** (Covering Core Courses IX & X)

**Semester : III**

**Core Course: XI**

**Instruction Hours/Week: 6**

**Credit: 5**

### **Cytogenetics and Plant Breeding**

1. Squash and Smear techniques - Onion root tip and Rheo flower buds.
2. Identification of DNA using Schiffs Reagent/TBO/methyl green.
3. Emasculation, Crossing, Bagging
4. Working problems in population genetics

#### Demonstration using Charts / Models:

1. Regulations of gene expression
2. Isolation of plasmid from *E.coli*
3. Detections of a plasmid containing foreign DNA (Recombinant Ti plasmid)
4. Mapping a cloned gene on a cosmic vector

### **Plant Physiology**

1. Determination of water potential by gravimetric and plasmolytic methods.
2. Determination of chlorophyll-a, chlorophyll-b, total chlorophyll by the Arnon's method, and determination of carotenoids.
3. Estimation of protein by Lowry's method (or) Bradford
4. Estimation of total phenols.
5. Estimation of total nitrogen

### **Biochemistry**

1. Extraction and estimation of lipid
2. Determination of reducing sugars in (grapes) fruit

3. Separation of amino acids by paper chromatography
4. Extraction of amylase and determination of its activity
5. Determination of peroxidase activity.

### Biophysics

pH meter, Spectrophotometer, Centrifuge, Electrophoretic apparatus

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## GENETIC ENGINEERING - P13BO14E

**Semester : III**

**Elective Course: III**

**Instruction Hours/Week: 6**

**Credit: 4**

### Unit-I (Teaching - 1 h / week)

Introduction to Genetic Engineering - Gene cloning - Vectors in gene cloning – Ti Plasmids, Phagemids, Cosmids, Bacteriophages.

### Unit-II (Teaching - 1 h / week)

Isolation, purification, restriction and ligation of DNA. Genome mapping types

### Unit-III (Teaching - 1 h / week)

Direct gene transfer methods (Microinjection, Electroporation - Particle bombardment, lipofection nuclear transplantation) – Use of vector in gene transfer - *Agrobacterium* mediated gene transfer technique, selectable markers and reporters.

### Unit-IV (Teaching - 2 hrs / week)

Principles and applications - DNA finger printing - PCR, RFLP, RAPD Techniques and Microarrays.

### Unit-V (Teaching - 1 h / week)

Application of genetic engineering - Transgenic plants – Resistance to crop diseases – transgenic (*Bt* crops, GM crops) crops resistant to herbicide, drought and salt - advantages and disadvantages of transgenic crops - Terminator techniques

### Reference

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### PLANT TISSUE CULTURE – P13BO15E

**Semester : III**

**Elective Course: IV**

**Instruction Hours/Week: 6**

**Credit: 4**

**Unit-I** (Teaching - 1 h / week)

Introduction - History, Scope and Concepts of basic techniques in plant tissue culture. Laboratory requirements and organisation. Sterilization methods - Media preparation - Culture media (MS, Whites and Gamborg's media).

**Unit-II** (Teaching - 1 h / week)

Cell, tissue and organ culture - Tissue explants for culture - Paper, raft nurse technique, Plating method, Microchamber techniques, cell suspension cultures - Synchronization of suspension culture, cellular totipotency, Cytological, cytochemical and vascular differentiations - Concept of Totipotency

**Unit-III** (Teaching - 2 hrs / week)

Micropropagation - Technical problems in micropropagation.  
Organogenesis - formation of shoots and roots - Role of growth regulators and other factors, somaclonal and gametoclonal variations.  
Somatic embryogenesis - Process of somatic embryogenesis, factors affecting embryogenesis, synthetic seeds.

**Unit-IV** (Teaching - 1 h / week)

Haploid production - Techniques of anther and pollen culture - diploidisation - factors influencing androgenesis - role of haploids in plant breeding.  
Protoplast culture: Isolation of protoplasts (mechanical and enzymatic) - culture of protoplasts – viability - protoplast fusion - selection of somatic hybrids and cybrids. Importance of protoplast culture

**Unit-V** (Teaching - 1 h / week)

*In vitro* production of secondary metabolites - Classification of secondary metabolites, biosynthetic pathways, immobilized cell cultures and biotransformation, elicitors and hairy root culture.

Application of tissue culture in forestry, horticulture, agriculture and pharmaceutical industry.

### References

- Bhojwani, S. S. and Razdan, M. K. (1983). Plant Tissue Culture: Theory and Practice. Elsevier Science Publishers, Netherlands.
- Dodds, J. H. and Roberts, I. W. (1985). Experiments in Plant Tissue Culture. Cambridge University Press, UK.
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- Vasil, I. K. (1986). Cell Culture and somatic Cell Genetics of Plants. 3 Volumes. Academic Press Inc.

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### BIOTECHNOLOGY – P13B016

**Semester : IV**

**Core Course: XII**

**Instruction Hours/Week: 6**

**Credit: 5**

**Unit-I** (Teaching – 2hrs / week)

Basic techniques: Agarose gel electrophoresis - Transformation of *E. coli*.

Cloning strategies: Cloning genomic DNA - Genomic DNA libraries.

Cloning: Properties of cDNA libraries, preparation of cDNA for library construction, full-length cDNA cloning.

**Unit-II** (Teaching - 1 h / week)

Anti-sense RNA technology - Flavr savr tomato, Gene silencing, Monoclonal antibodies and hybridoma technology - Gene therapy, Immunotoxin and recombinant vaccine.

**Unit-III** (Teaching - 1 h / week)

Sequence - Dependent screening, screening by hybridization, probe design, chromosome walking, screening expression libraries - Immunological, Southern, Western, Northern blotting, DNA foot printing.

**Unit-IV** (Teaching - 1 h / week)

Basic DNA sequencing - Chain terminator sequencing, automated sequencing, Whole genome sequencing - Analysis of sequence data, DNA sequence databases and data base searches, site-directed mutagenesis.

**Unit-V** (Teaching - 1 h / week)

Enzyme Biotechnology - Isolation, purification, immobilization - Enzyme engineering - Engineering of Macromolecules - Protein engineering - Immunotoxins - Drug designing.

**Reference**

- Dubey, R. C. (2008). A Textbook of Biotechnology. S. Chand & Co. Ltd., New Delhi.
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- Sambrook, J., Fritsch, E. F. and Maiatis, T. (2000). Molecular Cloning: A Laboratory Manual. Spring Harbor Laboratory Press, New York.
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**RESEARCH METHODOLOGY – P13BO17**

**Semester : IV**

**Core Course: XIII**

**Instruction Hours/Week: 6**

**Credit: 5**

**Unit-I** (Teaching - 1 h / week)

Choosing the problem for research - Review of Literature - Primary, Secondary and Tertiary sources - Bibliographs - Indexing and abstracting - Reporting the results of research in conference - Oral and Poster presentation.

**Unit-II** (Teaching - 1 h / week)

Planning and preparation of thesis - Research journals - National and International monographs - Reprints - Proof correction - Full paper - Short Communication - Review Paper.

**Unit-III** (Teaching - 1 h / week)

Biostatistics - Scope - Collection - Tabulation and classification of data - Graphical diagrammatic representation - Mean, Median, Mode – Standard Deviation – Standard Error

**Unit-IV** (Teaching - 2 hrs / week)

Probability analysis - Test of significance - 't'-Test - Chi-square test - ANOVA Table - Correlation and its types

**Unit-V** (Teaching - 1 h / week)

Organisation of computer - CPU - Input and output devices - Memory (Internal and external) – General outline on MS Word, Excel and Power Point,) – Internet and its applications .

**References**

Balagurusamy, E. (1985). Programming in BASIC. 2nd ed. Tata McGraw Hill Publishing Co. Ltd., New Delhi.

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Gupta, S. P. (1990). Statistical Methods. S. Chand & Co. Ltd., New Delhi.

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Jayaraman, J. (1985). Laboratory Manual in Biochemistry. Wiley Eastern Ltd., New Delhi.

Khan, I. A. and Khannum, A. (1994). Fundamentals of Biostatistics. Vikas Publishing, Hyderabad.

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Sree Ramulu, V. S. (1988). Thesis Writing. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.

Zar, J. H. (1984). Biostatistics Analysis. Prentice Hall International, New Jersey.

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**HORTICULTURE - P13BO18E**

**Semester : IV**

**Elective Course: V**

**Instruction Hours/Week: 6**

**Credit: 4**

**Unit-I** (Teaching - 2 hrs / week)

Importance and scope of horticulture - Divisions of horticulture - Climate, soil and nutritional needs - Water irrigation - Plant propagation methods - Cutting, layering, grafting, budding. Stock - scion relationship, micropropagation by root induction.

**Unit-II** (Teaching - 1 h / week)

Principles and methods of designing outdoor garden - Hedges, Edges, Fences, Trees, Topiary, Trophy, Climbers, Rockeries, Arches, - Lawn making and maintenance - Water garden - cultivation of water plants.

**Unit-III** (Teaching - 1 h / week)

Indoor gardening - Foliage plants, flowering plants, hanging basket, Bonsai plants.  
Floriculture - Cultivation of commercial flower crops - Rose, Jasmine and Chrysanthemum, Flower decoration - Dry and wet decoration.

**Unit-IV** (Teaching - 1 h / week)

Classification of vegetables, cultivation of important vegetable - Tomato, potato, onion, cabbage and snake guard. Model layout for a kitchen garden.

**Unit-V** (Teaching - 1 h / week)

Fruit crops - Induction of flowering, flower thinning, fruit setting, fruit development. Cultivation of important fruit crops - Mango, Grapes and Guava. Cultivation of tree species - *Eucalyptus* and *Tectona* (Teak).

**References**

- Arora, J. S. (1992). Introductory Ornamental Horticulture. Kalyani Publishers, New Delhi.  
Edmond, J. B. *et al.* (1977). Fundamentals of Horticulture. Tata McGraw Hill Publishers Co. Ltd., New Delhi.  
George Acquaah. (2002). Horticulture Principles and Practices. 2nd ed. Pearson Education, Delhi.  
Kumar, N. (1987). Introduction to Horticulture., Rajalakshmi Publishers, Nagercoil.  
Manibushan Rao, K. (1991). Textbook of Horticulture. Macmillan Publishing Co., New York.  
Rao, K. M. (2000). Text Book of Horticulture. Macmillan India Ltd., New Delhi.

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**PROJECT WORK - P13BOP19**

**Semester : IV**

**Project**

**Instruction Hours/Week: 12**

**Credit: 5**

**PROJECT WORK**

**(Dissertation 75 marks & Viva Voice – 25 Marks)**

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