

## M.Sc., PLANT BIOLOGY & PLANT BIOTECHNOLOGY syllabus

S.No	Paper	Title of Paper	Hrs / week Theory : Practical	Marks		Credits
				Exter nal	Inte rnal	
		<b>SEMESTER I</b>				
1	Major I	Algae, Fungi, Microbiology	5 + 4	75	25	4
2	Major II	Bryophytes, Pteridophytes, Gymnosperm & Paleobotany	5 + 4	75	25	4
3	Major III	Plant Anatomy, Embryology, Palynology	4 + 4	75	25	4
4	Major- Elective I	Modern Plant pathology	4 + 0	75	25	3
5	Practical-I	Covering Paper I II, III		60	40	4
		<b>SEMESTER II</b>				
6	Major IV	Taxonomy of Angiosperms and Ethnobotany	4+3	75	25	4
7	Major V	Cytology and Genetics	4+3	75	25	4
8	Major VI	Industrial Biotechnology	4+4	75	25	4
9	Major- Elective II	Genetic Engineering and Molecular biology	4+0	75	25	3
10	<b>Non-major Elective I</b>	Biostatistics	4+0	75	25	3
11	Practical II	Covering Paper IV, V, VI		60	40	4
		<b>SEMESTER III</b>				
12	Major VII	Research Methodology and Instrumentation	4+4	75	25	4
13	Major VIII	Plant Tissue Culture	4+3	75	25	4
14	Major IX	Ecology and Phytogeography	4+3	75	25	4
15	Major Elective III	Bioinformatics	4+0	75	25	3
16	<b>Non-major Elective II</b>	Nanotechnology	4+0	75	25	3
17	Practical III	Covering Paper VII, VIII & IX		60	40	4
		<b>SEMESTER IV</b>				
19	Major X	Plant Physiology and Biochemistry	5+5	75	25	4
20	Major Elective IV	Pharmacognosy	4+0	75	25	3
21	Major Elective V	Applications of Algae	4+0	75	25	3
22	Practical IV	Covering Paper X		60	40	4
23		<b>Project</b>	12	80	20	4

**M.SC. PLANT BIOLOGY & PLANT BIOTECHNOLOGY**  
**PATTERN OF QUESTION PAPER**

Time : 3 hrs

Max Marks: 75

**SECTION – A**

**(10 x 1 = 10)**

**Answer any Ten Questions out of Twelve:**

(Questions must cover all the units)

- 1.
- 2.
- 3.
- 4.
- 5.
- 6.
- 7.
- 8.
- 9.
- 10.
- 11.
- 12.

**SECTION – B**

**(5 x 5 =25)**

**Answer any five Questions out of Seven:**

(Questions must cover all the units)

- 13.
- 14.
- 15.
- 16.
- 17.
- 18.
- 19.

**SECTION – C**

**(4 x 10 =40)**

**Answer any four Questions out of six:**

(Questions must cover all the units)

- 20.
- 21.

22.

23.

24.

25.

<b>Paper</b>	<b>Title of Paper</b>
Major I	Algae, Fungi, Microbiology
Major II	Bryophytes, Pteridophytes, Gymnosperm & Paleobotany
Major III	Plant Anatomy, Embryology, Palynology
Major IV	Taxonomy of angiosperms and Ethnobotany
Major V	Cytology and Genetics
Major VI	Industrial Biotechnology
Major VII	Research Methodology and Instrumentation
Major VIII	Plant Tissue Culture
Major IX	Ecology and Phytogeography
Major X	Plant Physiology and Biochemistry
<b>ELECTIVE</b>	
Major-Elective I	Modern Plant pathology
Major-Elective II	Genetic Engineering and Molecular biology
Major Elective III	Bioinformatics
Major Elective IV	Pharmacognosy
Major Elective V	Applications of Algae
<b>ELECTIVE NON MAJOR</b>	<b>OFFERED TO OTHER DEPARTMENTS</b>
Non-major Elective I	Bio Informatics (M.Sc Statistics)
Non-major Elective II	Basics of Genetic Engineering (M.sc Physics)
<b>ELECTIVE NON MAJOR</b>	<b>OFFERED BY OTHER DEPARTMENTS</b>
Non-major Elective I	Biostatistics (M.Sc Statistics)
Non-major Elective II	Nanotechnology (M.sc Physics)
<b>*SOFT SKILL</b>	<b>* AFTER COLLEGE HOURS</b>
	Communication Skill
	Personality Development
	Health Management
	HR skill

## ALGAE, FUNGI, MICROBIOLOGY

### SEMESTER I

#### Paper-I

Theory: 5 Hrs

Practicals: 4 Hrs

Credits: 4

#### Unit I:

**Algae:** Classification (F.E. Fritsch 1945, Bold & Wynne 1978). Molecular taxonomy of algae. Contributions of Indian algologists. Pigments, Flagella and Life cycles in algae.

#### Unit II:

General characteristics of **Cyanophyceae, Chlorophyceae, Phaeophyceae, Bacillariophyceae, Rhodophyceae.**

Structure, reproduction, life cycle of following genera:

- Cyanophyceae** - *Lyngbya*.
- Chlorophyceae** - *Hydrodictyon, Cladophora, Nitella.*
- Phaeophyceae** - *Dictyota, Padina*
- Bacillariophyceae** - *Cyclotella*
- Rhodophyceae** - *Polysiphonia, Gracilaria*

#### Unit III:

**Fungi:** Classification, (Ainsworth) Heterothallism – Sexuality, Parasexuality – Sex hormones.

#### UNIT IV:

Structure, reproduction & Life cycle of the following genera:

- Myxomycotina-*Plasmodiophora*
- Mastigomycotina-*Saprolegnia*
- Zygomycotina-*Rhizopus*
- Ascomycotina-*Taphrina*
- Basidiomycotina-*Puccinia, Ustilago*
- Deuteromycotina-*Alternaria, Colletotrichum*

#### Unit V:

**Microbiology:** Scope and History of microbiology- Characterization, Classification and identification of microorganism. **Microorganisms - Bacteria:** Morphology and fine structure of Bacteria – Cultivation of Bacteria – Reproduction and Growth – Pure cultures and Cultural characteristics of Bacteria – Gram-Negative, Gram-Positive.

# **ALGAE, FUNGI, MICROBIOLOGY**

## **PRACTICALS**

### **Algae:**

1. Study of morphological & anatomical structures of genera mentioned in the theory.
2. Algal mixture – Identification.
3. Measurement of Algal cells with **Ocular Micrometer**.
4. **Camera Lucida** diagrams.
5. A study tour of 4-6 days Algal collection (Collection of not less than 5 specimens for submission)

### **Fungi:**

Study of Morphological & Reproductive structures of genera mentioned in the theory

### **Microbiology:**

1. Preparation of media
2. Isolation and Enumeration of microorganisms from the given soil sample
3. Purification of microbes
4. Bacterial staining

## SUGGESTED REFERENCES

1. Bold H.C. & Wynne M.J. 1976 Introduction to Algae structure and reproduction. Prentice-hall.
2. Fritsch F.E. 1935 & 1945 Structure and reproduction in Algae Vol. I & II, Cambridge University press
3. Marris, I 1967 an introduction to the Algae Hutchinson University Lab
4. Prescott G.W. 1970 How to know freshwater Algae W.C. Braun & Co.,
5. Round F.E. 1966 The Biology of Algae Edward Arnold
6. Dodge J.D. The fine structure of Algal cells. Academic press
7. Chapman F.G. & Chapman D.J. 1973 The Algae. McMillan & Co.,
8. Desikachary T.V. 1972. Taxonomy and Biology of Blue Green Algae. University of Madras
9. Dixon P.S. 1987 Biology of Rhodophyta
10. Smith & Wittick 1987 An introduction of Algae. Blackwell Publication
11. Ainsworth G.C., Sparrow F.K. & Sussman A.S. 1973. The Fungi Academic Press.
12. Alexopolus, C. Jan, C.W. Main 1997. Introduction to Mycology Wileys, New Delhi.
13. Burnett J.H. 1976. Fundamentals of Mycology. Arnold London.
14. Webster, J. 1988. The Fungi C.V.P. Cambridge
15. Day, P.K. 1974. Genetics of host parasite interaction S. Chand & Co.,
16. Baher K.F. & Cook R.J. 1974 Biological control of plant pathogens S. Chand & Co. Ltd.,
17. M.J. Pelczar, Roger D. Reid and E.C.S. Chan. 1977. Microbiology, TATA McGraw-Hill Publishing Company Ltd., New Delhi.
18. A. Mani, A.M. Selvaraj, L.M. Narayanan and N. Arumugam. 1985. Microbiology, SARAS Publications, Nagarcoil.
19. G.J. Tortora, B.R. Funke, C.L. Case. 2004. Microbiology An Introduction. Pearson Education (Singapore) Pte. Ltd., Indian Branch, New Delhi.
20. Buchanan and Buchanan. 1951. Bacteriology. Oxford. 1951.
21. Tortora, Case and Funke. 2000. Microbiology. Benjamin-Cummings Pub. Co.
22. Alcamo. 2000. Fundamental of Microbiology, Jones and Barlett. Pub.

# **BRYOPHYTES, PTERIDOPHYTES, GYMNOSPERMS AND PALEOBOTANY**

## **SEMESTER I**

### **Paper-II**

**Theory: 5 Hrs**

**Practicals: 4 Hrs**

**Credits: 4**

#### **Unit I:**

**Bryophytes:** Rothmaler (1951) Classification, Structural organization and evolution of Gametophytes. Origin and evolution of Sporophytes.

Structure, Reproduction and Life cycle of *Reboulia*, *Porella*, *Funaria*

#### **Unit II:**

**Pteridophytes:** General characters and classification of Reimer 1954. Apospory, Apogamy and Stelar evolution.

#### **Unit III:**

Structure, Reproduction and Life cycle of the following genera: *Selaginella*, *Angiopteris*, *Osmunda*, *Pteris*.

#### **Unit IV:**

General characteristics and classification by K.R Sporne 1965. Economic importance of Gymnosperms. Structure, Reproduction and life cycle of *Araucaria*, *Cupressus*, *Podocarpus*, *Ephedra*, .

#### **Unit V:**

Gondwana Flora of India. Contribution of Birbal Sahni to Paleobotany. Study of fossils in understanding evolution. Study of organ genera: *Sphenophyllum*, *Cordaites*.

## **PRACTICALS**

### **Bryophytes:**

Morphological study and anatomical study of genera mentioned in the theory.

### **Pteridophytes and Gymnosperms:**

Morphological, Anatomical and Reproductive study of genera mentioned in the theory.

## **SUGGESTED REFERENCES**

1. Parihar, N.S. The Biology and Morphology of Pteridophytes, Central Book Depot, Allahabad.
2. Rashid, A 1979 An Introduction to Pteridophyta. Vikas.
3. Sporne, K,R 1965 The morphology of Gymnosperms, Hutchinson, London.
4. Surange, K.R 1966 Indian Fossil Pteridophytes. CSIR, New Delhi.
5. Vasishta, B.R. 1987 Pteridophyta. Chand, New Delhi.
6. Vasishta, B.R. 1987 Gymnosperms. Chand, New Delhi.
7. Arnold, C.A. 1947. An Introduction to Paleobotany, Mc Graw Hill.
8. Stewart, W.N. 1983. Paleobotany and the Evolution of Plants. CUP, Cambridge.
9. Surange, K.R. 1966. Indian Fossile Pteridophytes. CSIR, New Delhi.
10. Andrews, H.N. 1961. Studies in Paleobotany, Mc Graw Hill.
11. Cavers, I 1990. Interrelationships of the Bryophyta
12. Chopra, R.N. & Bhatia, S.C. 1990. Bryophyte development: Physiology and Biochemistry. CRC Press, Florida.
13. Chopra, R.N. & Kumar, P.K. 1988. Biology of Bryophyta. Wiley Eastern Ltd.
14. Clarke, G.C.S & Duckett, J. 1979. Bryophytes Systematics.
15. Puri, P. 1985. Bryophytes: A broad perspective.
16. Puri, P. 1990. Bryophytes: Morphology, Growth and Differentiation.
17. Wastron, E.V. 1971. The Structure and life of Bryophytes Hutchinson, London.



# PLANT ANATOMY, EMBRYOLOGY, PALYNOLOGY

## SEMESTER I

### Paper-III

Theory: 4 Hrs

Practicals: 4 Hrs

Credits: 4

### Unit I:

Organization & theories regarding shoot (Apical cell theory, Tunica corpus theory, Histogen theory), Root (Histogen, Korper-kape theory) and reproductive meristems (Tunica corpus, Mantle and Core).

Meristems and Differentiation: Meristems and Matured tissues. Classification of meristems, Growth patterns and differentiation in meristems.

### UNIT II:

Vascular cambium - Structure & Significance of storied & non-storied cambium. Factors affecting cambial activity.

Xylem: Differentiation, xylary elements – maceration technique-tracheids, vessels, fibre and parenchyma. Patterns of secondary wall. Tyloses; reaction wood, heart wood and sap wood, Growth rings.

Phloem: Primary and secondary elements – ontogeny – differentiation. Structural variation, characteristics of phloem components.

### UNIT III :

Nodal anatomy: Leaf traces and leaf gaps. Branch traces and branch gaps, closing of leaf gaps.

Stelar system – Types of stele.

Floral anatomy – Structure, arrangement of floral parts, vascular system, petal, sepal, stamen, pollen, carpel and ovule. Organogenesis and histogenesis.

### UNIT IV:

**Sexual Incompatibility:** Self-incompatibility; Genetic basis of self-incompatibility; Barriers to fertilization; Significance of Incompatibility; Methods to overcome incompatibility.

Microsporogenesis and megasporogenesis – structure, embryosac.

### UNIT V:

**Palynology:** Pollen architecture, Pollen transfer, Pollen – pistil interaction. Methods of pollination. Aeropalynology – pollen allergy and palynological calendars, pollen analysis of honey, pollen loads.

# **PLANT ANATOMY, EMBRYOLOGY, PALYNOLOGY**

## **PRACTICALS**

### **PLANT ANATOMY**

Techniques in making temporary microscopic preparations - free hand, peeling, clearing, maceration and wood section.

Nodal and floral anatomy

### **EMBRYOLOGY**

Preparation of dissected whole mount of embryo.

### **PALYNOLOGY**

Pollen analysis of honey

Study of pollen (acetolysis or non acetolysis).

## **SUGGESTED REFERENCES**

1. Pandey B.P(1990).Plant Anatomy
2. Esau,K(1985) Anatomy of seed plants-John Willey
3. Cutter.E.G(1989);Plant Anatomy –Part I-Addison –Wesley Publishing Co
4. Plant Anatomy:Fahn
5. Vashista.P.C (1998) A Text Book of Plant Anatomy. S Nagin&co
6. Maheswari.P (1991):An Introduction to Embryology of Angiosperms.Tata-McGraw hill Publishing Co .Ltd.
7. Swamy B.G.L and Krishnamurthy K.V (1990)from flower to fruits ,Tata – McGraw hill publishing CoLtd
8. Bhojwani S.S and Bhatnagar .S,P(1987):Embryology of Angiosperms,Vikas publishing house Pvt.Ltd.
9. Erdtman, G. 1954. An introduction to pollen analysis. Chronica Botanica, Waltham, Mass. USA.
10. Knox R.B. 1980. Pollen and Allergy. Arnold – Heinemann.
11. Nair, P.K.K. 1985. Essentials of palynology.

## **MODERN PLANT PATHOLOGY**

### **SEMESTER I Major Elective paper-I**

**Theory: 4 Hrs  
Credits: 3**

#### **Unit I**

Scope and Significance of Plant pathology – A study of principles of plant infection – inoculum potential – infection and dissemination of pathogens.

#### **Unit II**

Important diseases of crop plants in India (Bacterial blight of Rice, Wilt of cotton, Late blight of Potato, Red rot of sugar cane,). Plant disease control (physical, chemical and biological).

#### **Unit III**

Host-parasite interactions (Physiology of parasitism): Pathogenesis or Disease development, Plant-Parasite Relationship. Role of enzymes and toxins in disease development.

Defense mechanisms: Host defense – Structural defense, Biochemical defense.

#### **Unit IV**

Genetics of plant disease: Disease Resistance – Genetics of virulence and resistance, Gene-for-gene concept, Techniques in plant breeding for disease resistance. Genetics of Host-parasite interaction – mutation, heterokaryosis, parasexual recombination.

#### **Unit V**

Molecular Plant Pathology: Detection of pathogens in host tissues - ELISA - Incorporation of resistant gene methods – Electroporation - *Agrobacterium* fusion.

## **SUGGESTED REFERENCES**

1. Rangaswami, G. and A. Mahadevan. 1999. Diseases of Crop Plants in India. IV ed. Prentice Hall.
2. Mehrotra, R.S. 1980. Plant Pathology, Tata – MC Graw Hill Publishing Co. Ltd.
3. Dasgupta, M.K. 1988. Principles of Plant Pathology, Allied Publ. Pvt. Ltd.
4. Singh, R.S. 1983. Plant diseases, Oxford & IBH Publishing Co.
5. Bilgrami, K.S. and Dube, H.C. 1976. A Text book of Modern Plant Pathology. Vikas Publishing House Pvt. Ltd.
6. Walker, J.C. 1969. Plant Pathology – Tata MC Graw Hill Publishing Co. Ltd.
7. Hussain et al. Ed. 1983. Recent Advances in Plant pathology. Print House India.

# TAXONOMY OF ANGIOSPERMS AND ETHNOBOTANY

## SEMESTER II

### Paper- IV

Theory: 4 Hrs

Practicals: 3 Hrs

Credits: 4

#### Unit I:

Systems of classification – Bentham and Hooker, Hutchinson and Cronquist - Merits and demerits. Modern trends in taxonomy – Numerical taxonomy, Chemotaxonomy and Molecular taxonomy, Botanical Survey of India – Its organisation and role.

#### Unit II:

**Study the following families & Economic uses**

1. Menispermaceae
2. Portulacaceae
3. Rhamnaceae
4. Sapindaceae
5. Combretaceae

#### Unit III:

**Study the following families & Economic uses**

6. Turneraceae
7. Molluginaceae
8. Oleaceae
9. Boraginaceae
10. Bignoniaceae

#### Unit IV:

**Study the following families & Economic uses**

11. Casuarinaceae
12. Commelinaceae
13. Typhaceae
14. Amaryllidaceae
15. Cyperaceae

#### Unit V:

**Ethnobotany** – Scope of Ethnobotany and its Holistic approach to Man and Plant Relationship – Ethnoagriculture, Ethnomedicobotany, Ethnopharmacology, Ethnotoxicology and Ethnocosmetics; Sources of Data and Methods of Study – Folklore, Archeological resources, Fossils, Reports of Forest Department, Literature and travelogues, Herbaria, Museum; Collection of information from field – contact with resource persons- Information on land and People – Information on plants used by people – Proforma for ethanobotanical investigation.

# **TAXONOMY OF ANGIOSPERMS, ETHNOBOTANY AND PLANT BIODIVERSITY**

## **PRACTICALS**

1. Identification and Description of the given specimen at species level using Flora.
2. Description of species for the families mentioned in the theory.
3. Field visit for at least 5-7 days to collect specimens on the spot in and outside the state.  
Submission of not less than 20 herbarium sheets representing the families studied.

## SUGGESTED REFERENCES

1. Hutchinson, J. 1973. The Families of flowering plants. 3<sup>rd</sup> Ed. Oxford Univ Press, UK.
2. Lawrence, G.H. 1969. Introduction to Vascular Plants. Oxford IBH, Delhi.
3. Sivarajan, 1989. Introduction to principles of taxonomy, Oxford IBH.
4. Subramaniam, N.S. 1995. Modern Plant taxonomy. Vikas Pub. House, New Delhi
5. Takhtajan, A. 1969. Flowering plants - origin and dispersal, Oliver Boyd, Edinburgh.
6. Rendle, A.B. The classification of flowering plants Vol I & II. Cambridge Univ. Press.
7. Willis, J.C. A Dictionary of the flowering plants. Cambridge Univ. Press.
8. Davis, P.H. and Heywood, V.H. Principles of Angiosperm Taxonomy. Oliver and Boud.
9. Heywood, V.H. Modern methods in Plant Taxonomy. Academic.
10. Hawkes, J.G. Chemotaxonomy and Serotaxonomy.
11. Sekal and Sneath. Principles of Numerical Taxonomy. W.H. Freeman & Co.
12. Stafleu, F.A. International Code of Botanical Nomenclature (Seattle Congress). Utrecht.
13. Subramanyan, N.S. Laboratory manual of plant taxonomy. 1996.



# CYTOLOGY AND GENETICS

## SEMESTER II

### Paper-V

Theory: 4 Hrs

Practicals: 3 Hrs

Credits: 4

#### Unit I:

Molecular structure and function – Plasma membrane – Endoplasmic reticulum – Dictyosomes - Lysosomes – Glyoxysomes and Peroxisomes.

#### Unit II:

Mitochondria and Chloroplast – Ultrastructure, Chemical composition; Structure and function of Mitochondrial and chloroplast DNA.

#### Unit III:

Mendelian and Non Mendelian inheritance – Chiasma frequency – Chromosome mapping, tetrad analysis. Sex determination in plants, sex linkage – dominant and recessive sex linked genes – holandric genes. Sex linked diseases – haemophilia, colour blindness – Pedigree chart.

#### Unit IV:

Regulation of gene action in Prokaryotes with reference to Lac – Operon, Tryptophan – Operon. Regulation of gene action in eukaryotes with reference to Britten and Davidson model of gene regulation. Gene regulation and Floral morphogenesis in *Arabidopsis thaliana*.

#### Unit V:

Mutation, classification, detection, characterization. Mutagens – chemical and physical agents – clastogens, carcinogens. Chromosomal aberration. Genetic concept – fine structure – split gene – exons and introns. Gene function – Protein synthesis.

# **CYTOLOGY AND GENETICS**

## **PRACTICALS**

1. Study of dividing cells – squash and smears techniques (Mitosis and Meiosis).
2. Study of induced chromosomal aberrations in onion root tips by chemicals
3. Induction of mutation using Ultra-Violet Radiation
4. Genetic problems.

## SUGGESTED REFERENCES

1. CHERAYIL, J.D.1971. Gene and the genetic code. Tata McGraw - Hill Pub. Co.
2. DE ROBERTIS AND DE ROBERTIS. 1988. Cell and Molecular Biology. 8th edition. Narosa Pub. House.
3. FRIEDELDER,D. 1937. Microbial genetics. Jones and Barlett Publishers.
4. FRIEDEDLER,D. 1990. Molecular Biology. Second Edition. Narosa Pub. House.
5. FROSTROM,J.W. and M.T.CLEGG. 1980. Principles of genetics. Second Edition. WH Freeman and Co.
6. GOODENOUGH.V and R.P. LEVINE. 1974. Genetics. Holt, Rinehart and Winston.
7. LEWIN, B. 1994. Genes V. Oxford University Press.
8. SOBTI R.C. and GOBE. 1991. Eukaryotic chromosomes. Narosa Publishing House.
9. SMITH-KEARY,P. 1991. Molecular Genetics. Macmillan Pub. Co. Ltd. London.
10. STEWARD M.W. 1984. Antibodies: Their structure and function. Chapman and Hall Ltd.
11. STRICKBERGER,M.W.1990. Genetics. Third Edition. Macmillan Publishing Company.
12. SUZUKI,D.T. *et al.* 1986. An introduction to genetic analysis. Third Edition. W.H. Freeman & Co.
13. WATSON,J.D. *et al.* 1987. Molecular Biology of the Gene. Fourth Edition. The Benjamin Cummings Pub. Co.
14. GOMEZ, K.A., AND A. GOMEZ. 1976. Statistical Procedures for Agricultural Research with Emphasis on Rice. IRRI. Philippines.
15. PALANICHAMY, S., AND M. MANOHARAN. 1990. Statistical Methods for Biologists. Palani Paramount Publisher. Palani. Tamil Nadu.
16. PANSE, V.G., AND P.V. SUKHATME. 1985. Statistical Methods for Agricultural Workers. ICAR.
17. PRASAD, S. 1992. Fundamentals of Biostatistics (Biometry). Emkay Pub. Delhi New Delhi.
18. SPEIGELS, M.R. 1972. Theory and Problems of Statistics. Shaum's Outline Series. McGraw Hill Book Co. Singapore.

# INDUSTRIAL BIOTECHNOLOGY

## SEMESTER II

### Paper-VI

Theory: 4 Hrs

Practicals: 3 Hrs

Credits: 4

### Unit – I

**Fermentation Technology:** Media (Substrates) for Industrial Fermentation – Synthetic media, Crude media, Media from Carbon and Nitrogen sources. Bioreactors/Fermenter, Types of Bioreactors – Continuous stirred tank bioreactors, Bubble column bioreactors, Airlift bioreactors, Fluidized bed bioreactors, Packed bed bioreactors and Photobioreactors.

### Unit – II

**Microbial Metabolic Products:** Low molecular weight compounds – Primary metabolites – Vitamins, Amino acids – Secondary metabolites – Antibiotics, Alkaloids, Gibberellins and Pigments; Biotransformation of Steroids. High molecular weight compounds – Diabetes mellitus – Insulin – Techniques for recombinant insulin production, Interferons – Mechanisms of action, production of recombinant interferons, therapeutic applications of interferons.

### Unit – III

**Enzyme Technology:** Commercial production of enzymes – production process, isolation and purification of enzymes. Immobilisation of enzymes – Methods of immobilization, Microencapsulation, biosensors and types of biosensors. Industrial enzymes and therapeutic uses of enzymes.

### Unit – IV

**Microbial production:** Organic solvents: Ethanol and Acetone; Antibiotics: Penicillin and Streptomycin; Amino acids: Lysine and Glutamic acid; Organic acids: Citric acid and Lactic acid.

### UNIT – V

**Microbial Production of Food:** Fermented Foods, Advantages – Production process of Cheese, Bread and Yoghurt. Alcoholic beverages – Production process of Beer and Wine.

# **INDUSTRIAL BIOTECHNOLOGY**

## **PRACTICALS**

1. Production and estimation of citric acid from *Aspergillus niger*.
2. Production and estimation of Aminoacid (L – Glutamic Acid) produced by *Aspergillus oryzae*/ *Aspergillus* sp.
3. Production of Cheese from Milk.
4. Visit to a Biotechnology lab, breweries.

### **Suggested Readings**

1. M.J. Pelczar, Roger D. Reid and E.C.S. Chan. 1977. Microbiology, TATA McGraw-Hill Publishing Company Ltd., New Delhi.
2. A. Mani, A.M. Selvaraj, L.M. Narayanan and N. Arumugam. 1985. Microbiology, SARAS Publications, Nagarcovil.
3. Alcamo. 2000. Fundamental of Microbiology, Jones and Barlett. Pub.
4. H.D. KUMAR and L.C. RAI. Microbes and Microbial Processes . Published by East-West Press Private Limited.
5. WILLIAM C.FRAZIER, DENNIS C. WESTHOFF. 2006. Food microbiology. 4<sup>th</sup> edition. Tata Mc Graw-Hill publications. New Delhi.
6. GERARD J.TORTORA, BERDELL R.FUNKE, CHRISTINE L.CASE 2005. Microbiology - - An introduction. 8<sup>th</sup> Edition.Published by Pearson Education (Singapore) Pte. Ltd.
7. PRAVE, P., *et al.* 1987. Fundamentals of Biotechnology. FDR.
8. PUROHIT, S.S., AND S.K. MATHUR. 1993. Fundamentals of Biotechnology. Agrobotanical Publishers. India.
9. TREVAN, M.D., S. BOFFEY, K.J. GOULDING, AND P. STANBURG. 1977. Biotechnology: The Biological Principles. Tata McGraw Hill Publishing Company Limited. New Delhi.

# GENETIC ENGINEERING AND MOLECULAR BIOLOGY

## SEMESTER II

### Major Elective Paper-II

Theory: 4 Hrs

Credits: 3

#### Unit I:

Scope of molecular biology – Nucleic Acids – Base pairing and variations in base composition – Types of DNA, Chargaff's rule – DNA size – fragility – hydrophobic interactions – denaturation, Circular and superhelical DNA – Topoisomerase – special base sequence – Repeated sequence – Single stranded DNA – DNA methylation, structure of RNA.

#### Unit II:

DNA replication – DNA Polymerase, Ligase Helicase – Termination of DNA replication – Mismatch repair – Transcription – RNA polymerase – classes of RNA molecules – Transcription in ProEukaryotes – splicing mechanisms – Reverse transcriptions. Translation, overlapping genes.

#### Unit III:

**Vectors:** Plasmid biology, PBR322 and its derivatives – gene markers, phage vectors, cosmid and plasmid vectors, artificial chromosome vectors, shuttle vectors and expression vectors. Selection of vectors for copy number, cloning promoters and terminators.

#### Unit IV:

**Cloning strategies:** Restriction enzymes for cloning, restriction mapping, construction of chimeric DNA. Construction of genomic and cDNA libraries.

#### Unit V:

Southern, Northern and Western Blotting, Dot and Slot blots; Antisense RNA technology, DNA finger printing and DNA foot printing, Basic PCR, RT PCR, anchored PCR, Sequencing methods, Chromosome walking.

## SUGGESTED REFERENCES

1. CHERAYIL, J.D. 1971. Gene and the genetic code. Tata McGraw - Hill Pub. Co.
2. DE ROBERTIS AND DE ROBERTIS. 1988. Cell and Molecular Biology. 8th edition. Narosa Pub. House.
3. FRIEDELDER, D. 1937. Microbial genetics. Jones and Barlett Publishers.
4. FRIEDEDLER, D. 1990. Molecular Biology. Second Edition. Narosa Pub. House.
5. FROSTROM, J.W. and M.T. CLEGG. 1980. Principles of genetics. Second Edition. WH Freeman and Co.
6. GOODENOUGH, V. and R.P. LEVINE. 1974. Genetics. Holt, Rinehart and Winston.
7. LEWIN, B. 1994. Genes V. Oxford University Press.
8. SOBTI R.C. and GOBE. 1991. Eukaryotic chromosomes. Narosa Publishing House.
9. SMITH-KEARY, P. 1991. Molecular Genetics. Macmillan Pub. Co. Ltd. London.
10. STEWARD M.W. 1984. Antibodies: Their structure and function. Chapman and Hall Ltd.
11. STRICKBERGER, M.W. 1990. Genetics. Third Edition. Macmillan Publishing Company.
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13. WATSON, J.D. *et al.* 1987. Molecular Biology of the Gene. Fourth Edition. The Benjamin Cummings Pub. Co.
14. Brown, T.A. 2001. Gene Cloning and DNA Analysis, 4<sup>th</sup> edition, Black Well Science.
15. Cibelli, J.R.P., Lanza, K.H.S., Campbell and M.D. West. 2002. Principles of Cloning, Academic Press.
16. Date, J.W. and M.V. Schantz, 2002. From genes and genomes. John Wiley and Sons Ltd.
17. Old, R.W. and Primrose, S.B. 1998. An introduction to genetic engineering, Principles of gene manipulation, Blackwell Science, Germany.
18. Primrose, S., R. Twyman and B. Old. 2001. Principles of gene manipulation, Blackwell Science Ltd., USA.
19. Watson, J.D., M. Gilman, J. Witkowski and M. Zoller., 2001. Recombinant DNA, Scientific American Books, USA.



# **BIOINFORMATICS**

**SEMESTER II**  
**Non Major Elective Paper-I**

**Theory: 4 Hrs**  
**Credits: 3**

## **Unit I:**

Bioinformatics: Introduction; History and Scope of Bioinformatics.

## **Unit II:**

Introduction to Databases – Protein and Nucleotide Databases; Biological Databases.

## **Unit III:**

Similarity Searching Tools – FASTA and BLAST Algorithm; Human Genome Project (HGP).

## **Unit IV:**

Proteomics – Introduction, Methods and Applications; Genomics – Introduction, Methods and Applications.

## **Unit V:**

Introduction of Molecular Modeling: Drug – Receptor Interaction, finding new drug targets to treat diseases – new targets for anticancer drugs, drugs that rescue mutant p53's.

## **SUGGESTED REFERENCES**

1. Brown, T.A. 2001. Gene Cloning and DNA Analysis, 4<sup>th</sup> edition, Black Well Science.
2. Cibelli, J.R.P., Lanza, K.H.S., Campbell and M.D. West. 2002. Principles of Cloning, Academic Press.
3. Date, J.W. and M.V. Schantz, 2002. From genes and genomes. John Wiley and Sons Ltd.
4. Old, R.W. and Primrose, S.B. 1998. An introduction to genetic engineering, Principles of gene manipulation, Blackwell Science, Germany.
5. Primrose, S., R. Twyman and B. Old. 2001. Principles of gene manipulation, Blackwell Science Ltd., USA.
6. Watson, J.D., M. Gilman, J. Witkowski and M. Zoller., 2001. Recombinant DNA, Scientific American Books, USA.
7. Baxevanis, 1998. Bioinformatics
8. Higgins and Taylor, OUP. 2000. Bioinformatics
9. Brown, T.A. 2001. Gene Cloning and DNA Analysis, 4<sup>th</sup> edition, Black Well Science.
10. S.C. Rastogi, N. Mendiratta, P. Rastogi 2007. Bioinformatics Methods and Applications, Second Edition, Prentice Hall of India Private Ltd., New Delhi.

# RESEARCH METHODOLOGY AND INSTRUMENTATION

## SEMESTER III

### Paper-VII

Theory: 4 Hrs

Practicals: 3 Hrs

Credits: 4

#### Unit I:

**Extraction and separation procedure:** Solvent extraction, pH meter, Purification by centrifugation, dialysis and Electrophoresis - SDS.

#### UNIT - II

**Chromatographic techniques:** Paper chromatography, Thin Layer Chromatography (TLC), High Performance Thin Layer Chromatography (HPTLC), High Performance Liquid Chromatography (HPLC), Column chromatography and Gas Chromatography.

#### Unit III

**Spectroscopic techniques:** Colorimetry, UV-Visible Absorption Spectrophotometry, Infra Red Spectrophotometry, Mass Spectrophotometry, NMR Spectrophotometry and X-Ray Diffraction analysis.

#### Unit IV

**Microscopy:** Light Microscopy, Dark-field, Phase contrast, Polarized light, Interference contrast (Nomarski) and Fluorescence Microscopy. Scanning and Transmission Electron Microscopy. Photography – Micro and Macrography.

#### UNIT – V

**Microtomy and slide preparation:** Fixatives, microtomy and staining technique. Preparation of whole mounts. Bright-field stains and fluorochromes. Metachromatic staining reaction. Histochemical dyes for the localization of starch, proteins, nucleic acid and lipids.

## **RESEARCH METHODOLOGY AND INSTRUMENTATION PRACTICALS**

1. Microtechnique requirements: Microtome, Coupling jar, Safranin, Fast green, Toluidine Blue, Wax block, Ribbon, Knife, Strap, Stone and Stub.
2. Localization of starch, proteins, nucleic acids and lipids using Histochemical dyes.
3. Demonstration of the following:
  - a) pH meter
  - b) Colorimeter
  - c) Spectrophotometer
  - d) Centrifuge
  - e) Chromatography (TLC)
  - f) Electrophoresis.
4. Submission of permanent slides (10 Nos.).

## **SUGGESTED REFERENCES**

1. BERLYN, G.P. AND J.K.MIKSCHE. 1976. Botanical Microtechnique and cytochemistry. Iowa State University Press. Iowa. USA.
2. CONN,H.J. 1991. Biological stains. Ninth Edition. Sigma Chemical Company, St. Louis. USA.
3. CLARK, G. 1981. Staining Procedures. Fourth Edition. Williams & Wilkins Co. MD. U.S.A.
4. DELLY,J. 1988. Photography through the microscope. Ninth edition. Eastman Kodak Co. New York.
5. GAHAN, P.B. 1984. Plant Histochemistry and Cytochemistry - An Introduction. Academic Press. U.K.
6. HOROBIN, R.W. 1982. Histochemistry: An Explanatory Outline of Histochemistry and Biophysical Staining. Gustav Fischer Verlag. Stuttgart. Germany.
7. HOROBIN, R.W. 1988. Understanding Histochemistry: Selection, Evaluation and Design of Biological Stains. Ellis Horwood Ltd. U.K.
8. JENSEN, W.A. 1962. Botanical Histochemistry. W.H. Freeman and Company. San Francisco.
9. KIERNAN,J.A. 1990. Histological and Histochemical Methods. Theory and Practice. Pergamon Press. U.K.
10. KRISHNAMURTHY, K.V. 1988. Methods in Plant Histochemistry. S. Viswanathan (Printers & Publishers) Pvt. Ltd. Madras.
11. LACEY,A.J. 1989. Light microscopy in biology - a practical approach. IRL Press. Oxford University Press. U.K.
12. PEARCE, A.G.E. 1980. Histochemistry : Theoretical and Applied. Vol. I and II. Fourth Edition. Churchill Livingston. London.
13. REID, P.D., AND R.F. PONT-LEZICA (Eds.). 1992. Tissue Printing: tools for the study of anatomy, histochemistry, and gene expression. Academic Press. New York.
14. ROBINSON, P.C. 1992. Qualitative polarized light microscopy. Royal Microscopical Society. Oxford University Press. U.K.

## PLANT TISSUE CULTURE

### SEMESTER III

#### Paper-VIII

Theory: 4 Hrs

Practicals: 3 Hrs

Credits: 4

#### Unit – I:

**Tissue culture:** Early attempts in tissue culture of plants. Concept of totipotency. Sterilization Procedures – Fumigation, wet and dry sterilization, ultraviolet sterilization, ultra filtration and surface sterilization Design of laboratory and commercial tissue culture facility.

#### UNIT – II

**Tissue culture:** Media for *in vitro* culture; Types of media – Solid, liquid and commercial prepacked media; Media composition – Macronutrients, Micronutrients and growth regulators; Preparation of media; Selection of suitable media.

#### UNIT - III.

**Explants for Tissue Culture:** Shoot tip, axillary buds, leaf discs, cotyledons, inflorescence and floral organs. Callus culture - initiation and maintenance of callus. Micropropagation - direct and indirect morphogenesis, somatic embryogenesis and synthetic seed production.

#### UNIT – IV

**Suspension Culture** - Culture systems, Isolation of single and aggregate of cells and regeneration of plants; Immobilization of cells and use of bioreactors.

**Protoplast Culture** - Isolation of protoplast, culture of protoplast, regeneration and sub-protoplast; Somatic cell hybridization, selecting desired hybrids and their regeneration into plants.

#### UNIT - V

**Impact of gene cloning and bioethics:** Intellectual Property Rights (IPR) and patents, biosafety – physiological and ecological aspects containment facilities for genetic engineering experiments. Regulations on field experiments and release of Genetically Modified Organisms (GMO), labeling of Genetically Modified (GM) foods.

# **PLANT TISSUE CULTURE**

## **PRACTICAL**

### 1. Laboratory Techniques –

Cleaning and sterilization of Glasswares

Surface Sterilization

Inoculation (Laminar Air flow Chamber)

### 2. Preparation of solid and liquid media (Murashige-Skoog).

### 3. Culture of excised leaves and shoot tips.

## **SUGGESTED REFERENCES**

1. AMMIRATO, P.V., D.A EVANS, W.R. SHARP., and Y.P.S. BAJAJ 1990. Hand Book of Plant Cell Culture. Vol 5. Ornamental Species. McGraw Hill Publishing Company. New York.
2. BENCOCHEA, T., AND J.H. DODDS. 1986. Plant Protoplasts. A Biotechnological Tool for Plant Improvement. Chapman and Hall. London.
3. BUTCHER, D.N., and D.S. INGRAM. 1982. Plant Tissue Culture. Oxford. IBH Publishig Company. Delhi.
4. BUTENKO, R.G. 1985. Plant Cell Culture. MIR Publishers. Moscow.
5. DEBERG, P.C., AND R.H. ZIMMERMANN. 1981. Micropropagation-Technology and Application. Kluwer Academic Publishers. London.
6. DIXON, R.A. 1985. Plant Cell Culture. A Practical Approach. IRL, Press. Oxford. London.
7. DODDS, J.H., AND L.W. ROBERTS. 1985. Experiments in Plant Tissue Culture. Cambridge University Press. London.
8. LINDSEY, K. 1992. Plant Tissue Culture Manual. Kluwer Academic Publishers.
9. NARAYANASWAMY, S. 1994. Plant Cell and Tissue Culture. Tata Mc Graw - Hill Publishing Company Limited. New Delhi.
10. REINERT, J., AND Y.P.S. BAJAJ. 1977. Applied and Fundamental Aspects of Plant Cell, Tissue and Organ Culture. Springer-Verlag. Berlin.
11. REINERT, J., AND YEOMAN. 1988. Plant Cell and Tissue Culture - A Laboratory manual.
12. REINHARD, B.E., AND M.H. ZENK. 1977. Plant Tissue Culture and its Biotechnological Application.
13. TREVAN, M.D., S. BOFFEY, K.J. GOULDING, AND P. STANBURG. 1977. Biotechnology: The Biological Principles. Tata McGraw Hill Publishing Company Limited. New Delhi.



# ECOLOGY AND PHYTOGEOGRAPHY

## SEMESTER III

### Paper-IX

Theory: 4 Hrs

Practicals: 3 Hrs

Credits: 4

## UNIT I

**Ecosystem Ecology :** Concept of Ecosystem; Kinds of ecosystem – Natural and Artificial; Structure of ecosystem – Biotic and Abiotic; Types of ecosystem – Pond, Lake, Ocean, Grassland, Forest and Desert Ecosystem; Basics of population Ecology.

## UNIT II

**Energy Flow:** Energy flow in an ecosystem; Types of energy flow models; Study of Nutrient cycles (Biogeochemical Cycles) – Atmospheric cycle (Hydrological and carbon cycle) and Edaphic Nutrient cycle ( Nitrogen and Phosphorus cycle).

## UNIT III

**Global Warming:** Green House Effects – Causes and consequences – Carbon dioxide and carbon monoxide as pollutants – Depletion of Ozone Layer – Threats to ozone protector – Global efforts to save ozone layer ; Biological Monitoring Programmes.

## UNIT IV

**Community Ecology:** Definition; Characteristics of a Community - Composition, structure, origin and development of a community – Characters used in community structure – Methods of study of communities – Units of vegetation – Classification of community - Clementsian units of vegetation - Main concepts of communities.

## UNIT V

**Phytogeography** – Definition - Continental Drift – Major plant communities of world – Phytogeographic regions of world (Vegetation Belts) – Soils of India – Climatic regions of India – Floristic / Botanical regions of India – Vegetation of India.

# **ECOLOGY AND PHYTOGEOGRAPHY**

## **PRACTICALS**

1. Types of Ecosystem – Pond, Lake, Ocean, Forest, Desert and Grassland,
2. Types of Energy Flow Models - Hydrological cycle, Carbon cycle, Nitrogen cycle and Phosphorus cycle.
3. Green House Effect - Carbonmonoxide, Carbondioxide,. Ozone layer.
4. Determination of the qantitative characters of a plant community by Random Quadrat Method, Belt Transect Method and Line Transect Method and calculate the Abundance, Density and Frequency.
5. Mapping - Soil types in India (Alluvial soil, Black soil, Red soil, Skeletal mountain soil, Desert soil, ad laterite soil).
6. Mapping - Rainfall in India (Under 20 cm, 20 -40 cm, 40 – 80 cm; more than 80 cm).
7. Mapping – Floristic/ Botanical regions of India (Western Himalayas, Eastern Himalayas, Gangetic plains, West Indian Desert/ Indus plain, Assam, Central India, Malabar, The Deccan, Andamans).

### **SUGGESTED REFERENCES**

1. Clements, F.E. 1928. Introduction to the study of world vegetation.
2. Dash, M.C. Fundamentals of Ecology. Tata Mc Graw – Hill.
3. Daubenmire, R.F. 1973. Plant Environment. John Wiley.
4. Good, R. 1964. Geography of Flowering Plants.
5. Golley, F.B. 1977. Ecological Succession. Dowdent.
6. Kochhar, P. L. 1972. Plant Ecology. S. Nagin and Co. Delhi.
7. Kotpal, R. L. and N. P. Bali. 1975. Concepts of Ecology. R. K. Jain for Vishal Publication, Jullundur, India.
8. Mansfield, T.A. 1976. Effect of air pollutants on Plants. Cambridge University Press.
9. Misra, K.C. 1974. Manual of Plant Ecology.
10. Odum, E.P. Fundamental of Ecology.
11. Raunkier, C. 1974. The life forms if Plants and Statistical plant geography.
12. Rice, E.L. 1974. Allelopathy. Academic Press.
13. Sharma, P. D. 1993. Environmental Biology and Toxicology. Rastogi Publication, Meerut. India.
14. Sharma, P. D. 2003. Ecology and Environment. Rastogi Publication, Meerut. India.
15. Sharma, P. D. and R. Misra. 1981. Element of Ecology. Rastogi Publication, Meerut. India.
16. Shukla, R. S. and P. S. Chandel. 1989. Plant Ecology and Soil Science. S. Chand and Company limited, New Delhi.

# BIOINFORMATICS

## SEMESTER III

### Major Elective Paper-III

Theory: 4 Hrs

Credits: 3

#### Unit I:

**Scope of Bioinformatics:** Sequence analysis – Homology & Analogy – National center for biotechnology & information (NCBI). Biological data bases – primary data base – Protein sequence data base – MIPS – SWISS PROT; Secondary data base – Prosites – Finger print data base; Genomics and Proteomics.

#### Unit II:

**Sequence alignment:** Scoring matrix – PAM and BLOSSOM – Local and global alignment concepts – dynamic programming methodology – Needleman and Wunsch algorithm – multiple sequence alignment – progressive alignment – data searches for homologous sequence – FASTA and BLAST version.

#### Unit III:

**Phylogenetic analysis:** Phylogenetic trees; Methods of Phylogenetic Analysis – Distance method and Character based method – their Advantages and Disadvantages; automated tools for Phylogenetic analysis – PHYLIP.

#### Unit IV:

**Introduction to Drug Discovery:** Approaches to drug Discovery – Influence of molecular biology on drug discovery – HTS (High Throughput Screening) – Combinatorial Chemistry and HTS – Pharmacogenomics and Pharmacogenetics and its applications – Analysis of Single Nucleotide Polymorphism (SNP)

#### Unit V:

**Process of Drug discovery:** Target identification – Target Validation – Lead identification – Lead optimization – Preclinical pharmacology and Toxicology.

## **SUGGESTED REFERENCES**

11. Brown, T.A. 2001. Gene Cloning and DNA Analysis, 4<sup>th</sup> edition, Black Well Science.
12. Cibelli, J.R.P., Lanza, K.H.S., Campbell and M.D. West. 2002. Principles of Cloning, Academic Press.
13. Date, J.W. and M.V. Schantz, 2002. From genes and genomes. John Wiley and Sons Ltd.
14. Old, R.W. and Primrose, S.B. 1998. An introduction to genetic engineering, Principles of gene manipulation, Blackwell Science, Germany.
15. Primrose, S., R. Twyman and B. Old. 2001. Principles of gene manipulation, Blackwell Science Ltd., USA.
16. Watson, J.D., M. Gilman, J. Witkowski and M. Zoller., 2001. Recombinant DNA, Scientific American Books, USA.
17. Baxevanis, 1998. Bioinformatics
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19. Brown, T.A. 2001. Gene Cloning and DNA Analysis, 4<sup>th</sup> edition, Black Well Science.
20. Rastogi, S.C., N. Mendiratta, P. Rastogi. 2007. Bioinformatics Methods and Applications. Second Edition, Prentice Hall India Private Limited, New Delhi.

# **BASICS OF GENETIC ENGINEERING**

## **SEMESTER III**

### **Non Major Elective Paper-II**

**Theory: 4 Hrs**

**Credits: 3**

#### **Unit I:**

**Gene Concept and Nature:** Structure of DNA - Chemical Nature of DNA – Types of DNA - Circular and Super helical DNA; Structure of RNA; Units of Gene – Cistron, Recon, Muton, Introns (Split Genes). Replication of DNA – Conservative and Semi conservative Mechanism.

#### **Unit II:**

**Tools of Genetic Engineering:** Enzymes – Exonuclease, Endonuclease, Restriction Enzyme, DNA Ligase, DNA polymerase and Alkaline Phosphatase; Vector – Plasmid, Phage DNA and Cosmid Vectors.

#### **Unit III:**

**Outlines of Recombinant DNA Technology:** Isolation of DNA – Insertion of foreign DNA into Vector – Use of Restriction Enzyme – Transfer of rDNA into Bacterial Cell – Selection of Clones.

#### **Unit IV:**

**Basic Techniques of Genetic Engineering:** Agarose gel electrophoresis (AGE) and polyacrylamide gel Electrophoresis (PAGE); Blotting Techniques – Northern, Southern and Western Blotting; Autoradiography; DNA Amplification – Polymerase Chain Reaction (PCR).

#### **Unit V:**

**Application of Genetic Engineering:** Transgenic Plants – Agrobacterium mediated Gene Transfer (Ti Plasmid); Invitro fertilization technology (IVF) – Problems related to Test tube Babies; Pollen Transformation through Particle Bombardment – Microinjection – Gene Gun.

## SUGGESTED REFERENCES

- CHERAYIL, J.D. 1971. Gene and the genetic code. Tata McGraw - Hill Pub. Co.
- DE ROBERTIS AND DE ROBERTIS. 1988. Cell and Molecular Biology. 8th edition. Narosa Pub. House.
- FRIEDELDER, D. 1937. Microbial genetics. Jones and Barlett Publishers.
- FRIEDEDLER, D. 1990. Molecular Biology. Second Edition. Narosa Pub. House.
- FROSTROM, J.W. and M.T. CLEGG. 1980. Principles of genetics. Second Edition. WH Freeman and Co.
- GOODENOUGH, V. and R.P. LEVINE. 1974. Genetics. Holt, Rinehart and Winston.
- LEWIN, B. 1994. Genes V. Oxford University Press.
- SOBTI R.C. and GOBE. 1991. Eukaryotic chromosomes. Narosa Publishing House.
- SMITH-KEARY, P. 1991. Molecular Genetics. Macmillan Pub. Co. Ltd. London.
- STEWART M.W. 1984. Antibodies: Their structure and function. Chapman and Hall Ltd.
- STRICKBERGER, M.W. 1990. Genetics. Third Edition. Macmillan Publishing Company.
- SUZUKI, D.T. *et al.* 1986. An introduction to genetic analysis. Third Edition. W.H. Freeman & Co.
- WATSON, J.D. *et al.* 1987. Molecular Biology of the Gene. Fourth Edition. The Benjamin Cummings Pub. Co.
- BROWN, T.A. 2001. Gene Cloning and DNA Analysis, 4<sup>th</sup> edition, Black Well Science.
- CIBELLI, J.R.P., LANZA, K.H.S., CAMPBELL and M.D. WEST. 2002. Principles of Cloning, Academic Press.
- DATE, J.W. and M.V. SCHANTZ, 2002. From genes and genomes. John Wiley and Sons Ltd.
- OLD, R.W. and PRIMROSE, S.B. 1998. An introduction to genetic engineering, Principles of gene manipulation, Blackwell Science, Germany.
- PRIMROSE, S., R. TWYMAN and B. OLD. 2001. Principles of gene manipulation, Blackwell Science Ltd., USA.
- WATSON, J.D., M. JILAMN, J. WITKOWSKI and M. ZOLLER., 2001. Recombinant DNA, Scientific American Books, USA.

## PLANT PHYSIOLOGY AND BIOCHEMISTRY

### SEMESTER IV

#### Paper-X

Theory: 5 Hrs

Practicals: 5 Hrs

Credits: 4

#### Unit I:

**Photosynthesis:** Plant pigment system: Absorption and action spectrum – Phosphorescence and fluorescence. Light reaction - Pathways of carbon fixation  $C_3$ ,  $C_4$  subtypes and CAM.

#### Unit II:

**Respiration:** Aerobic respiration - Glycolysis and Krebs' cycle, chemiosmotic ATP synthesis. Anaerobic respiration – Pentose phosphate pathway; Oxidation of Lipids –  $\alpha$  – oxidation,  $\beta$  – oxidation,  $\omega$  – oxidation and conversion of fats into carbohydrates (Glyoxylate cycle).

#### Unit III:

**Plant Growth Hormones:** Plant growth regulators – Bioassay and application of auxins, gibberellins, cytokinins, ethylene, ABA, Brassinolides.

**Photoperiodism** : Critical day length – Photoperiodic induction –Importance of photoperiod – Florigen – Phytochrome –  $P_R$  and  $P_{FR}$  forms.

#### UNIT – IV

**Enzymes** – Classification – Chemical nature –properties – Enzyme kinetics - Michaelis-Menten constant – Regulation of enzyme activity.

**Nitrogen metabolism:** Structure and synthesis of amino acids and protein.

#### UNIT - V

**Secondary metabolites** – Structure, Types, Sources, Biosynthesis and function of alkaloids, terpenoids and flavonoids



## **PLANT PHYSIOLOGY AND BIOCHEMISTRY PRACTICALS**

1. Separation of photosynthetic pigments by paper chromatography
2. Separation of aminoacids using TLC
3. Separation of alkaloids by paper chromatography or TLC
4. Determination of  $\alpha$ -amylase activity
5. Estimation of peroxidase activity
6. Effect of pH on Enzyme activity.
7. Identification of C<sub>3</sub> and C<sub>4</sub> plants.
8. Determination of C<sub>4</sub> photosynthetic subtypes using anatomical criteria
9. Comparative rate of respiration by titration method
10. Effect of plant growth regulators on seed germination

## **SUGGESTED REFERENCES**

1. BIDWELL, R.G.S. 1974. Plant Physiology. Macmillan Pub. Co., N.Y.
2. BONNER, J. AND J.E. VARNER. 1976. Plant Biochemistry. Academic Press.
3. BROWN, W.H. AND E.P. ROGERS. 1980. General Organic and Biochemistry. Willard Grant Press.
4. BUCHANAN, B. B., W. REUISSEM AND R. L. JONES. 2000. Biochemistry and Molecular Biology of Plants. American Society of Plant Physiologist, Rockwell, Maryland, USA.
5. CONN, E.E., AND P.K. STUMPF. 1976. Outlines of Biochemistry. Academic Press.
6. CONN, E.E., P.K. STUMPF, G. BRUENING AND R.H. DOI. 1987. Outlines of Biochemistry. John Wiley and Sons. New York.
7. DAVID, F. 1982. Physical Biochemistry. W.H. Freeman and Company. New York.
8. DAVID, F. 1987. Molecular Biology. Narosa Publishing House. New Delhi.
9. DENNIS, D.T. AND D.H. TURPIN, (Eds.). 1989. Plant Physiology, Biochemistry and Molecular Biology. Longman Scientific and Technical Publishers. U.K.
10. DEVLIN, R.M. AND F.H. WITHAM. 1983. Plant Physiology. Willard Grant Press. U.S.A.
11. HALL, D.O. AND K.K. RAO. 1994. Photosynthesis. Fifth Edition. Cambridge University Press. U.K.
12. HANS-WALTER HELDT. 1997. Plant Biochemistry and Molecular Biology. Oxford University Press, New York. USA.
13. MACMILLAN, J. 1980. Hormonal Regulation of Development. I. Molecular Aspects of Plant Hormones. Springer-Verlag. Berlin.
14. MOORE, T.C. 1979. Biochemistry and Physiology of Plant Hormones. Springer-Verlag. Berlin.
15. SALISBURY, F.B. AND C. ROSS. 1991. Plant Physiology. Wadsworth Publishing Company. Belmont.
16. SCOTT, T.K. 1984. Hormonal Regulation of Development. Vol. II. The Functions of Hormone. Springer-Verlag.
17. STRYER, L. 1981. Biochemistry. W.H. Freeman and Company. New York.

## **PLANT PHARMACOGNOSY**

### **SEMESTER IV**

#### **Major Elective Paper- IV**

**Theory: 4 Hrs**

**Credits: 3**

#### **UNIT I:**

Introduction, historical background, present status and future of pharmacognosy and its relationship with other fields of study. Traditional system of medicines - Homeopathy, Siddha, Ayurvedic and Unani systems of medicine.

#### **UNIT – II**

Study of Crude Drugs – Crude drugs as pharmaceutical aids; its therapeutic uses; adulteration; Drug evaluation – organoleptic, microscopic, physical, chemical and biological evaluation; Storage of crude drugs; Marketing of drugs – dry, garbling and packing.

#### **UNIT III**

Chemical nature of natural Drugs - Classification, isolation and function of Alkaloids, Terpenoids, Glycosides, Volatile oils, Lipids, tannins, Resins and Carbohydrates.

#### **UNIT IV**

Grouping of Natural Drugs - Occurrence, distribution, organoleptic characters, chemical constituents and therapeutic uses.

1. Laxative – Isphaghula
2. Cardiotonics – Digitalis
3. Carminatives – Nutmeg
4. Drugs acting on Nervous System – Ashwaganda (*Withania somnifera*)
5. Antihypertensive – *Rauwolfia serpentina*

#### **UNIT V**

Grouping of Natural Drugs - Occurrence, distribution, organoleptic characters, chemical constituents and therapeutic uses.

6. Antispasmodic – Tulsi (*Ocimum sanctum*)
7. Antidiabetic – *Gymnema sylvestris*
8. Antimalarial – Cinchona
9. Antiseptic and Disinfectant – Turmeric (*Curcuma longa*)
10. Diuretic – *Tribulus terrestris*.

## **SUGGESTED REFERENCES**

1. Chopra. Poisonous Plants of India.
2. Chopra, R.N. 1958. Indigenous drugs of India
3. Dentson, T.C. 1945. A Text Book of Pharmacognosy.
4. Lincoff, G. and Mitchell, D.H. 1977. Toxic and Hallucinogenic mushroom poisoning.
5. Handa, S.S. and Kapoor, V.K. Pharmacognosy.
6. Hill, F. 1952. Economic Botany
7. Iyengar, M.A. Powdered Crude drugs.
8. Jain, S.K. Medicinal Plants.
9. S.B. Gokhale, C.K. Kokate and A. P. Purohit. 1993. Pharmacognosy. Nirali Prakashan, Pune.

## APPLICATION OF ALGAE

**SEMESTER IV**  
**Major elective V**

**Theory:4 Hrs**  
**Credits: 3**

### UNIT - I

Historical perspective of use of algae for human needs; Algae as Nutraceuticals; Chemical constituent of *Spirulina*, its vitamin and mineral content; chemical constituent of *Chlorella*. Biofertilizers: Nitrogen fixing algae; structure and function of heterocysts; reaction involved in nitrogen fixation. Significance of using bluegreen algal fertilizers.

### UNIT – II

Industrial uses of algae: Structure, source, extraction and uses of agar-agar, carrageenin and alginic acid. Liquid seaweed fertilizers – preparation, composition and uses.

### UNIT - III

Cultivation of macroalgae: Macroalgal cultivation in India. Rope cultivation, net cultivation and raft cultivation. Control of diseases with reference to the cultivation of *Laminaria* and *Porphyra*. National laboratories involved in marine algal cultivation.

### UNIT - IV

Mass cultivation of microalgae: Mass culture of *Spirulina* and *Chlorella*: Composition of medium, techniques involved in their culture, harvest. Indian centers cultivating microalgae.

### UNIT – V

Importance of algae in fisheries; parasitic algae; algae in medicine: Algal antibiotics and other substances of pharmaceutical importance. Aquatic pollution – causes and consequences:- algae as pollution indicators; bioremediation.

## **SUGGESTED REFERENCES**

1. DIXON, B.S. 1973. Biology of the Rhodophyta. Oliver and Boyd. Edinburgh.
2. FRITSCH, F.E. 1935. Structure and Reproduction of Algae. Vol.I. Cambridge University Press. Cambridge.
3. FRITSCH, F.E. 1945. Structure and Reproduction of Algae. Vol.II. Cambridge University Press. Cambridge.
4. GRAHAM, L.E. 1993. Origin of Land Plants. John Wiley and Sons. Inc. New York.
5. LEMBI, CAROLE,A. and J. ROBERT WAALAND . 1988. Algae and human affairs. Cambridge University Press. Cambridge.
6. LOBBAN, C.S., AND M.J. WYNNE (Eds.). 1981. The Biology of Seaweeds. Blackwell Scientific Publications. Oxford.
7. PARKER, S.P,( Ed.). 1982. Synopsis and Classification of Living Organisms. McGraw-Hill Book Company. New York.
8. SOUTH, G.R., AND A. WHITTICK. 1987. Introduction to Phycology. Blackwell Scientific Publications. Oxford.