

**CHRIST COLLEGE (AUTONOMOUS),  
IRINJALAKUDA**

**IRINJALAKUDA, THRISSUR - PIN 680 125**



**DEGREE OF  
MASTER OF SCIENCE  
(CHOICE BASED CREDIT AND SEMESTER SYSTEM)**

**UNDER THE**

**FACULTY OF SCIENCE**

**SYLLABUS**

**(FOR THE STUDENTS ADMITTED FROM THE ACADEMIC YEAR 2018 ONWARDS)**

**BOARD OF STUDIES IN BOTANY(PG)**

**IRINJALAKUDA, THRISSUR**

**PIN 680 125 KERALA**

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**DEPARTMENT OF BOTANY**  
**CHRIST COLLEGE (AUTONOMOUS), IRINJALAKUDA**  
**BOARD OF STUDIES IN B O T A N Y**

Sl. No.	Name of the Member	Address	Contact Details: Mobile No & Email ID
1.	Dr. Tessy Paul P. (Chairperson)	Head & Associate Professor, Department of Botany, Christ College (Autonomous), Irinjalakuda – 680125	9446233104 tessyjohnt@gmail.com
2	Dr. Asma V.M (University Nominee)	Associate Professor, Department of Botany M.E.S. Asmabi College, P. Vemballur, Kodungallur	9495223306 Asmanazar86@yahoo.in
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**CHRIST COLLEGE (AUTONOMOUS), IRINJALAKUDA, M.Sc. BOTANY PROGRAMME (CSS)**

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**DURATION OF THE COURSE:**

Four semesters (2 years)

**NUMBER OF COURSES AND CREDITS REQUIRED:**

1<sup>st</sup>, 2<sup>nd</sup> and 3<sup>rd</sup> semesters have 4 core courses each (3 theory and 1 practical, each with 4 credits – Total 16 credits per semester) and the 4<sup>th</sup> semester has 4 elective courses (2 theory and 2 practical, each with 4 credits), One dissertation with 4 credits, and one comprehensive viva voce with 4 credits Total of 24 credits in the 4<sup>th</sup> semester). Total credits required for the completion of the programme is  $(16 \times 3) + (1 \times 24) = 72$ .

**EVALUATION:**

Evaluation is to be carried out both by internal continuous evaluation and external terminal evaluation. Out of the total weightage for each course, 25% is to be given for continuous internal evaluation and 75% for external terminal evaluation.

**1. INTERNAL CONTINUOUS EVALUATION (ICE):**

Internal continuous evaluation should have five components of equal weightage as shown below. Internal evaluation will be carried out by the teacher / teachers offering the course. The marks should be displayed on the notice board of the department and the students shall be given a chance to redress grievances if any.

**a. THEORY COURSES:**

Attendance	Assignment	Seminar	Test paper (1)	Test paper (2)
90%: Full weightage	A: Full weightage	A: Full weightage	A: Full weightage	A: Full weightage
80%: $\frac{3}{4}$ weightage	B: $\frac{3}{4}$ weightage	B: $\frac{3}{4}$ weightage	B: $\frac{3}{4}$ weightage	B: $\frac{3}{4}$ weightage
75%: $\frac{1}{2}$ weightage	C: $\frac{1}{2}$ weightage	C: $\frac{1}{2}$ weightage	C: $\frac{1}{2}$ weightage	C: $\frac{1}{2}$ weightage
Below 75%: No weightage	D: No weightage	D: No weightage	D: No weightage	D: No weightage

**b. PRACTICAL COURSES:**

Attendance	Practical skill	Drawing skill and regularity	Test paper (1)	Test paper (2)
90%: Full weightage	A: Full weightage	A: Full weightage	A: Full weightage	A: Full weightage
80%: $\frac{3}{4}$ weightage	B: $\frac{3}{4}$ weightage	B: $\frac{3}{4}$ weightage	B: $\frac{3}{4}$ weightage	B: $\frac{3}{4}$ weightage
75%: $\frac{1}{2}$ weightage	C: $\frac{1}{2}$ weightage	C: $\frac{1}{2}$ weightage	C: $\frac{1}{2}$ weightage	C: $\frac{1}{2}$ weightage
Below 75%: No weightage	D: No weightage	D: No weightage	D: No weightage	D: No weightage

**c. DISSERTATION:**

Regularity	Involvement / level of Knowledge	Literature collection	Presentation (1)	Presentation (2) (Model)
90%: Full weightage	A: Full weightage	A: Full weightage	A: Full weightage	A: Full weightage
80%: $\frac{3}{4}$ weightage	B: $\frac{3}{4}$ weightage	B: $\frac{3}{4}$ weightage	B: $\frac{3}{4}$ weightage	B: $\frac{3}{4}$ weightage
75%: $\frac{1}{2}$ weightage	C: $\frac{1}{2}$ weightage	C: $\frac{1}{2}$ weightage	C: $\frac{1}{2}$ weightage	C: $\frac{1}{2}$ weightage
Below 75%: No weightage	D: No weightage	D: No weightage	D: No weightage	D: No weightage

**DISTRIBUTION OF WEIGHTAGE OF MARKS:**

1. **Theory:** Essay questions: 25%; Paragraph questions: 40%; Short answer questions: 35%
2. **Practicals:** Practical work: 85%; Practical records: 10%; Submissions and tour report: 5%
3. **Dissertation:** Written account: 80%; Presentation: 10%; Discussion: 10%
4. **Viva voce:** Viva voce at the end of the 4<sup>th</sup> semester based on the entire syllabus with 100% external evaluation.

**DISTRIBUTION OF WORK BASED ON CREDITS:**

1 credit = 1.5 hours of teaching per week.

**(1<sup>st</sup> semester to 3<sup>rd</sup> semester:** 16 credits = 24 teaching hours per week  
1 hour per week for seminar

**4<sup>th</sup> semester:** 16 credits for elective courses = 24 teaching hours per week  
1 hour for CE of Dissertation).

The credits of Dissertation (4) are to be acquired by the candidate through a project work and that for Viva voce (4) are to be acquired by appearing for a comprehensive viva at the end of the course.

**END SEMESTER EXTERNAL EVALUATION (EE)****THEORY EXAMINATIONS**

At the end of each semester, there will be external evaluation for each course. The theory examination will be of 3-hour duration and will have a total of 36 weightage. There will be two evaluations for the theory papers - one by an internal examiner and the other by an external examiner.

**THEORY EXAMINATIONS – PATTERN OF QUESTION PAPER:**

Duration – 3 hours

Maximum weightage - 36

**Part A** – Answer all questions - 14 questions (14 x 1 = 14 weightage) - Short questions

**Part B** – Answer any 7 out of 10 questions (7 x 2 = 14 weightage) each answers approximately in not more than 100 words

**Part C** – Answer any 2 out of 4 questions (2 x 4 = 8 weightage)

Essay types - Answer in 300 words

### **PRACTICAL EXAMINATIONS**

The structure of the course envisages a practical examination at the end of even semester. The 1<sup>st</sup> and 2<sup>nd</sup> semester examinations are conducted at the end of the 2<sup>nd</sup> semester. Similarly, 3<sup>rd</sup> and 4<sup>th</sup> semester examinations are conducted at the end of the 4<sup>th</sup> semester. Each practical examination will be of 6-hour duration with a break in between. The practical question paper is therefore to be set with two sections. The practical examinations are to be conducted by two examiners preferably one examiner from an outside institution and one internal examiner. The institution shall select the external examiner. It is the duty of the external examiner to provide the specimens for the examination.

The students will have to submit their tour reports and practical records on the day of the practical examinations. Every student has to submit a bound certified laboratory record of practical for evaluation. All the experiments of each practical course should be recorded properly with the experiment results. A candidate submitting a certified practical record alone is eligible for appearing the Practical Examination.

### **PRACTICALS**

Total - 36 weightage

Practical: 30 weightage

Practical records: 4 weightage

Submissions and Tour Report: 2 weightage

### **PRACTICAL EXAMINATIONS – PATTERN OF QUESTION PAPERS:**

Duration – 6 hours

Maximum weightage - 36

### **SELECTION OF SUBJECT FOR DISSERTATION:**

A subject is to be selected by each student for dissertation based on the facilities available and the specializations of the supervising teachers.

### **DISSERTATION EVALUATION**

Each student has to undertake a project work in consultation with the supervising teacher. The project report shall be submitted to the board of examiners during the practical examinations of the IV semester. The student has to present the salient features of his/her work and dissertation by way of power point (PPT) presentations to the team of examiners and will have to appear for a viva voce.

### **COMPREHENSIVE VIVA VOCE**

At the end of the 4<sup>th</sup> semester practical examinations the candidate has to appear for a comprehensive viva voce of 4 credits based on the entire programme content. There is no internal assessment for viva voce.

**CHRIST COLLEGE (AUTONOMOUS), IRINJALAKUDA  
M.Sc. PROGRAMME IN BOTANY (CSS)**

<b>Structure of Courses and distribution of Credits</b>				
<b>Course Code</b>	<b>Title</b>	<b>Internal</b>	<b>External</b>	<b>Credits</b>
<b>SEMESTER 1</b>				
<b>BO01 CT01</b>	Phycology, Bryology, Pteridology and Gymnosperms	25%	75%	4
<b>BO01 CT02</b>	Mycology and Lichenology, Microbiology and Plant Pathology	25%	75%	4
<b>BO01 CT03</b>	Angiosperm Anatomy, Embryology, Palynology and Lab Techniques	25%	75%	4
<b>BO01 CP04</b>	Practicals of Phycology, Bryology, Pteridology, Gymnosperms, Mycology, Lichenology, Microbiology, Plant Pathology, Angiosperm Anatomy, Embryology, Palynology and Lab Techniques	25%	75%	4
<b>SEMESTER 2</b>				
<b>BO02 CT05</b>	Cell Biology, Molecular Biology and Biophysics	25%	75%	4
<b>BO02 CT06</b>	Cytogenetics, Genetics, Biostatistics, Plant Breeding and Evolution	25%	75%	4
<b>BO02 CT07</b>	Plant Ecology, Conservation Biology, Phytogeography and Forest Botany	25%	75%	4
<b>BO02 CP08</b>	Practicals of Cell Biology, Molecular Biology, Biophysics, Cytogenetics, Genetics, Biostatistics, Plant Breeding, Plant Ecology, Conservation Biology, Phytogeography and Forest Botany	25%	75%	4
<b>SEMESTER 3</b>				
<b>BO03 CT09</b>	Plant Physiology, Metabolism and Biochemistry	25%	75%	4
<b>BO03 CT10</b>	Angiosperm Morphology, Taxonomy and Plant Resources	25%	75%	4
<b>BO03 CT11</b>	Biotechnology and Bioinformatics	25%	75%	4
<b>BO03 CP12</b>	Practicals of Plant Physiology, Metabolism, Biochemistry, Angiosperm Morphology, Taxonomy, Plant Resources, Biotechnology and Bioinformatics	25%	75%	4
<b>SEMESTER 4</b>				
<b>BO04 ET13</b>	Elective 1 – Environmental Biology and Biodiversity Conservation	25%	75%	4
<b>BO04 ET14</b>	Elective 2 – Genetic Engineering	25%	75%	4
<b>BO04 EP15</b>	Elective 3 – Tissue Culture	25%	75%	4
<b>BO04 EP16</b>	Practicals of Electives	25%	75%	4
<b>BO04 DN17</b>	Dissertation	25%	75%	4
<b>BO04 VV18</b>	Viva voce	0%	100%	4
<b>Total Credits</b>				<b>72</b>

*SEMESTER I*

Course Code	Title	Teaching Hours / week	Duration of examination	Weightage		Credits	Page Nos:
				EE	ICE		
<b>BO01 CT01</b>	Phycology, Bryology, Pteridology and Gymnosperms	1½+1+2+1½ = 6	3 hrs	36	20	4	8-10
<b>BO01 CT02</b>	Mycology and Lichenology, Microbiology and Plant Pathology	2½+2½+1 = 6	3 hrs	36	20	4	12-14
<b>BO01 CT03</b>	Angiosperm Anatomy, Embryology, Palynology and Lab Techniques	2+2+1+1 = 6	3 hrs	36	20	4	16-18
<b>BO01 CP04</b>	Practicals of Phycology, Bryology, Pteridology, Gymnosperms, Mycology, Lichenology, Microbiology, Plant Pathology, Angiosperm Anatomy, Embryology, Palynology and Lab Techniques	(½ x 10 + 1 for Lab Techniques) = 6	6 hrs	36	20	4	20-22

EE – External evaluation

ICE – Internal continuous evaluation

Model question papers:

BO01 CT01 – Page

no: 11 BO01 CT02 –

Page no: 15 BO01

CT03 – Page no: 19

BO01 CP04 – Page

no: 23

## **BO01CT01. PHYCOLOGY, BRYOLOGY, PTERIDOLOGY AND GYMNOSPERMS**

(1½+1+2+1½ = 6 hours per week)

### **PHYCOLOGY** [1½ hour per week]

1. **Classification of Algae** - Comparative Survey of important systems - Fritsch-Smith-Round. Criteria for algal classification - Phylogenetic considerations.
2. Ecological significance and biological importance of phytoplankton
3. **Algal cytology** - Basic ideas of cell features-Electron microscopic studies of algal cell, cell wall, flagella, chloroplast, Pyrenoids, eyespot- their importance in classification
4. **Reproduction** - Different types of life cycles in algae.
5. General account of energy sources and pigments in algae
6. **Economic importance** of algae – Role of algae in soil fertility, water blooms, algae in industry -
7. General account of thallus structure, cell ultra-structure, reproduction, relationships and evolutionary trends in the following groups: Chlorophyta, Xanthophyta, Bacillariophyta, Phaeophyta and Rhodophyta.

### **Reference Books:**

1. Lee R.E. 2008. *Phycology*. 4<sup>th</sup> edn. Cambridge University Press.
2. Round, F.E, 1965. *The Biology of Algae*.
3. Smith, G.M. 1950. *Manual of Phycology*.
4. Fritsch, F.E. 1945. *The structure and reproduction of the algae*. Vol I. & II Cambridge University press, Cambridge.
5. Smith, G.M. 1950. *Fresh water algae of United States*. 2<sup>nd</sup> edition. Mc Graw – Hill Book Co. Inc. New York.
6. Bold, H.C. and Wynne, M.J. (1985). *Introduction to the algae: structure and reproduction*. Prentice-Hall.
7. Gilbert M Smith (1971). *Cryptogamic Botany (Vol. 1): Algae and Fungi*. Tata McGraw Hill Edition.

### **BRYOLOGY** [1 hour per week]

1. **General characters** and systems of classifications of Bryophytes
2. **General account** of the anatomy, reproduction, life history and phylogeny of Sphaerocarpaceae, Marchantiales, Jungermanniales, Calobryales, Anthocerotales, Sphagnales, Andreales, Funariales and Polytrichales
3. **Origin and evolution of Bryophytes** - Gametophytic and sporophytic.
4. **Fossil Bryophytes**: A general account of fossil Bryophytes and their affinities.
5. **Economic importance** of Bryophytes.

### **Reference Books:**

1. Cavers F. The interrelationship of Bryophytes. *New Phytologist*.
2. Kashyap S.R. 1932. *The Liverworts of Western Himalaya and the Punjab Plains*, Vol. I & II. *Chronica Botanica*
3. Chopra R N, P K Kumar. 1988. *Biology of Bryophytes*. Wiley Eastern Ltd.

4. Goffinet B. and Shaw, A.J. (2009). *Bryophytic Biology (II Edn)*. Cambridge University Press.
5. Gufran, K.M., Gatew Shitie and Bekele Bedilu (2012). *Practical Manual for Bryophytes and Pteridophytes*. LAP Lambert Academic Publishing
6. Manju C. Nair, K.P. Rajesh and Madhusoodanan P.V. *Bryophytes of Wayanad in Western Ghats*. Malabar Natural History Society, Kozhikode.
7. Parihar N.S. *An introduction of Embryophyta: Bryophyta*. General Book House, Allahabad.
8. Rashid, A. (1981). *An Introduction to Bryophyta*. Vikas publishing house Pvt. Ltd.
9. Rejila, S, M. Manikandan & Vijayakumar, N. (2012). *Bryophytes*. LAP Lambert
10. Shaw, J. and Goffinet, B. 2000. *Bryophyte Biology*. Cambridge University Press.
11. Smith G.M. *Cryptogamic Botany*. McGraw Hill Book Co., N.Y.
12. Srivastava S N (1992). *Bryophyta*. Pradeep Publications.
13. Vashishta B.R., Sinha, A.K. and Kumar, A. (2003). *Bryophyta*. S Chand & Co. Ltd.
14. Verdoon, F.M. *Manual of Bryology*. Ashor & Co., Amsterdam.
15. Watson E.V. *The structure and life of Bryophytes*. Hutchinson Univ. Press, London.

**PTERIDOLOGY** [2 hours per week]

1. General characters and life history of Pteridophytes.
2. Cytology of Pteridophytes- Chromosome number and polyploidy.
3. Structure and evolution of stele in Pteridophytes.
4. Origin and evolution of Sporangium.
5. Heterospory and seed habit.
6. Development and evolutionary trends in the Gametophytes of Pteridophytes.
7. Apogamy, Apospory and Parthenogenesis.
8. Classification of Pteridophytes: Holttum, Pichi-Sermolli.
9. Comparative morphology, ecology and phylogeny of the following:
  - a) Psilopsida: Rhyniales; Psilophytales; and Psilotales;
  - b) Lycopsidea: Lycopodiales; and Isoetales;
  - c) Sphenopsida: Hyeniales, Pseudoborniales, Sphenophyllales, Calamitales, and Equisetales,
  - d) Filicopsida: General account: Primofilicales, Ophioglossales, Marattiales; Osmundales, Schizaeales, Cyatheales, Gleicheniales, Marsileales and Salviniiales.
10. Economic importance of Pteridophytes - Medicinal, Horticulture, Biofertilizer, weeds.
11. General account of the contribution of Indian Pteridologists.

**Reference Books:**

1. Abdul Hameed C., Rajesh K.P. and Madhusoodanan P.V. *Filmy ferns of South India*. Penta Book Publishers & Distributors, Calicut.
2. Azeez K., Venugopalakrishna Kurup V. and Madhusoodanan P.V. *Spleenworts (Aspleniaceae) of South India*, Malabar Natural History Society, Calicut.
3. Bierhost, D.W. 1971. *Morphology of Vascular Plants*. Mac Millen Co., New York.
4. Chandra, S. and Srivastava, M. (2003). *Pteridology in the New Millennium*, Kluwer Acad.
5. Dyer, A.C. 1979. *The Experimental Biology of Ferns*. Academic Press, London.

6. Gufran, K.M., Gatew Shitie and Bekele Bedilu (2012). Practical Manual for Bryophytes and Pteridophytes. LAP Lambert Academic Publishing
7. Jermy, A.C.1973. The phylogeny and Classification of Ferns.
8. Kramer, K.U. and Green, P.S. 1991. The Families and Genera of Vascular Plants. Narosa, New Delhi.
9. Nampy S. and Madhusoodanan P.V. Fern flora of South India – Taxonomic revision of Polypodioid ferns, Daya Publishing House, New Delhi.
10. Rashid, A. (1976). An introduction to Pteridophytes. Vikas Publishing House, Academic Publishing.
11. Venugopalakrishna Kurup V., Azeez K. and Madhusoodanan P.V. Primitive ferns of South India, V Publishers, Kottayam.

### GYMNOSPERMS [1½ hours per week]

1. Geological time scale and correlated predominant Gymnosperm flora
2. Classification of gymnosperms by Chamberlain (1935) and Sporne (1965).
3. Geological horizons, distribution, morphology, anatomy, reproduction and interrelationships of the following orders (Study of families and genera not required).

a. Pteridospermales	h. Cordaitales
b. Glossopteridales	i. Coniferales
c. Caytoniales	j. Taxales
d. Cycadeoidales	k. Ephedrales
e. Pentoxylales	l. Welwitschiales
f. Cycadales	m. Gnetales
g. Ginkgoales	
4. Phylogenetic relationship of Gymnosperms.
5. Economic importance of Gymnosperms.

### Reference Books:

1. Andrews, H.N. Studies in Palaeobotany. Wiley, N.Y.
2. Bhatnagar S.P. and Moitra A. (2000). *Gymnosperms*. New Age India publishers, New Delhi.
3. Biswas C. and Johri B.M. (1997). *The Gymnosperms*. Narosa Publishing House, New Delhi.
4. Chamberlain C.J. (1998). *Gymnosperms: Structure and evolution*. CBS Publishers, New Delhi.
5. Coulter J.M. and Chamberlain C.J. (1991). *Morphology of Gymnosperms*. Central Books, Allahabad.
6. Dutta S.C. 1991. An Introduction to Gymnosperms. Kalyan Publishing Company, New Delhi.
7. Foster, A.S. and E.M. Gifford. *Comparative morphology of vascular plants*. Freeman.
8. Maheshwary P. and V. Vasil. *Gnetum*. CSIR, New Delhi.
9. Sharma O.P. 2002 *Gymnosperms*. Pragathi Prakashan, New Delhi.
10. Singh V.P. (2006). *Gymnosperms*. Sarup & Sons, New Delhi.
11. Sporne K.R. (1994). *The morphology of Gymnosperms*. BI Publications Pvt. Ltd. New Delhi.
12. Vasishta P.C. (2004). *Gymnosperms*. S. Chand & Company, New Delhi.

**MODEL QUESTION PAPER – SEMESTER I M.Sc. BOTANY**

**BO 01 CT01 – PHYCOLOGY, BRYOLOGY, PTERIDOLOGY AND GYMNOSPERMS**

Time: 3 Hours

Max. Weightage: 36

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**I Answer all questions briefly:**

1. Pigment constitution of Cyanophyceae.
2. Explain Palmella stage.
3. Types of flagella in algae.
4. Cell structure of Cyanophyceae.
5. Peristome of Bryales.
6. Enumerate the salient features of Andreales.
7. Actinostele.
8. Calyptra.
9. What is gradate sorus?
10. Explain phyletic swing and phyletic slide.
11. Comment on the polyploidy in pteridophytes.
12. Distinguish between manoxylic and pycnoxylic wood.
13. Explain the significance of coralloid root.
14. Explain the female frutifications of Lyginopteris.

(14 x 1 = 14 weightage)

**II Answer any 7 questions each in not more than 100 words:**

15. Different types of life cycles in algae.
16. Economic importance of algae.
17. Chloroplast, pyrenoid and eyespot in algae.
18. Describe various energy sources of algae.
19. Write an account on sporogonium of Porella.
20. Give an account of fossil bryophytes.
21. Apogamy, Apospory and Parthenogenesis.
22. Salient features of Ophioglossales.
23. Describe the peculiarities of Pentoxylales.
24. Describe the evolutionary significance of Caytonia.

(7 x 2 = 14 weightage)

**III Answer any 2 questions in 300 words:**

25. Explain thallus organization, reproduction and economic importance of Chlorophyta.
26. Examine critically the different views on the origin and evolution of Bryophytes.
27. Describe the arrangement of sporangia in ferns.
28. Make comparison between Welwitschiales and Gnetales.

(2 x 4 = 8 weightage)

## BO01CT02. MYCOLOGY & LICHENOLOGY, MICROBIOLOGY AND PLANT PATHOLOGY

(2½+2½+1 = 6 hours per week)

### MYCOLOGY & LICHENOLOGY [2½ hours per week]

1. **General characters of Fungi:** cell - ultra structure, unicellular and multicellular organization, hyphal growth, cell wall composition, nutrition (saprobic, biotrophic, symbiotic, predacious) reproduction (vegetative, asexual, sexual), heterothallism, parasexuality.
2. **Classification of fungi** by Ainsworth & Bisby (1983), Alexopoulos *et al.* (1996) - Phylogeny of fungi - Characters used in classification.
3. **General account** of Myxomycota, Mastigomycota, Zygomycota, Ascomycota, Basidiomycota and mitosporic fungi. Different kinds of spores and their dispersal.
4. **Fungi as saprophytes:** details of the fungal decomposition of organic matter, coprophilous fungi, lignin degrading fungi, role of fungi in degradation of pesticides.
5. **Fungi as symbionts:** Mycorrhiza – ectotrophic, orchidaceous and Ericoid mycorrhiza, Vesicular Arbuscular Mycorrhiza - their distribution and significance, Endophytes.
6. **Lichenology:** General account and systematics of lichens, thallus structure, reproductive bodies, ecological significance and economic importance of lichens.

### Reference Books:

1. Ainsworth, G.C., Sparrow, K.F. & Susmann, A.S. (Eds.) (1973). The Fungi - An Advanced Treatise. Vol 1-4. Academic Press.
2. Alexopoulos C.J., Mims, C.W. & Blackwell, M. (1996). Introductory Mycology. 4<sup>th</sup> edition. John Wiley & Sons Inc. New York.
3. Burnett, J.H. (1970). Fundamentals of Mycology. Edward Arnolds.
4. Cariile, M. J. & Watkinson S.C. (1994). The Fungi. Academic Press.
5. Deacon, J.W. (1988). Introduction to Modern Mycology. Blackwell.
6. Dubey, H.C. (2009). An introduction to Fungi. 3<sup>rd</sup> Edition. Vikas Publishers, New Delhi.
7. Hale Mason, E. (1983). The Biology of Lichens. 3<sup>rd</sup> Ed. Edward Arnold, London.
8. Jennings, D.H. & Lysek, G. (1999). Fungal Biology. Bios Scientific Publishers.
9. Landecker, Elizabeth Moore. (1996). Fundamentals of Fungi. 4<sup>th</sup> Ed. Prentice Hall.
10. Mehrotra, R.S. & Aneja, K.R. (1990). An introduction to Mycology. New Age International Publishers.
11. Nair, M.C. & Balakrishnan, S. (1986). Beneficial fungi and their utilization. Scientific Publishers, Jodhpur.
12. Nash, T.H. (1996). Lichen Biology. Cambridge University Press.
13. Sharma, P. D. (2013). *The fungi*. Rastogi publications, Meerut.
14. Webster, John (1980). Introduction to Fungi. Cambridge University Press.

**MICROBIOLOGY** [2½ hours per week]

1. **Introduction:** Main groups of micro-organisms and their characteristics – Prions, Viroids, Viruses, Bacteria, Mycoplasmas and Actinomycetes
2. **Bacteria:** Classification based on Bergey's Manual, Archaeobacteria and Eubacteria, Morphology, ultrastructure, nutrition, genetics.
3. Plasmids and their characterization,
4. **Cyanobacteria:** Salient features, morphology, ultrastructure, classification and economic importance
5. **Viruses:** General account of plant and animal viruses – Classification, isolation, purification, infection, replication and transmission of plant viruses, Bacteriophages – types, classification, structure and replication, detailed study of TMV and T4 phage.
6. **Microbial ecology:** Microbiology of rhizosphere and phylloplane, Sewage disposal. Bioremediation and water purification, detection of microbes in air and water.
7. **Agricultural microbiology:** Management of agricultural soils, biofertilizers, biopesticides.
8. **Food microbiology:** Food spoilage and preservation methods, Microbiology of fermented foods - Dairy products, bread and other fermented plant products, Microorganisms as sources of food – single cell protein.
9. **Industrial microbiology:** Bioreactor, production of alcohol, vinegar, antibiotics, vitamin, steroids, vaccines, organic acids and amino acids.

**Reference Books:**

1. Adams, M.R. & Moss, M.O. (1996). Food Microbiology. New Age International Publishing Ltd., New Delhi.
2. Anand, N. 1989. *A hand book of blue green algae*. Bishen Singh Mahendrapal Singh Publishers, Dehradun.
3. Brock, T.D. (1996). Biology of Microorganisms. Prentice Hall.
4. Campbell, R. (1987). Microbiology. ELBS-Edward Arnold, London.
5. Carpenter, P.L. (1967). Microbiology. W.B. Saunders & Company, Philadelphia.
6. Desikachary, T.V. 1959. *Cyanophyta*. ICAR monograph on algae. Indian Council of Agricultural Research, New Delhi.
7. Dubey, R.C. & Maheswari, D.K. (2000). A text book of Microbiology. S. Chand.
8. Goodfellow, M. *et. al.* (1993). The Biology of Actinomycetes. Academic press.
9. Mathew, R.E.F. (1981). Plant Virology, Academic press.
10. Pelzar, M.J., Chan, E.C.S. & Krieg, N.R. (2000). Microbiology. Tata Mc Graw Hill.
11. Sharma, P.D. (1999). Microbiology & Plant Pathology. Rastogi Publishers, Meerut.
12. Stanier, R. Y., Ingraham, J. L., Wheelis, M. L., and Painter, P. R. (1987). *General microbiology* (5<sup>th</sup> ed.). MacMillan Education Ltd. University Press
13. Sharma, K. (2007). *Manual of Microbiology*. Ane Books Pvt Ltd.
14. Sullia, S. B. and S. Shantharam 1998. *General Microbiology*. Science Publishers, 573 pages
15. Christopher J. Woolverton, Linda Sherwood, Joanne Willey. 2016. *Prescott's Microbiology*. McGraw-Hill Education

**PLANT PATHOLOGY** [1 hour per week]

1. **Principles of Plant Pathology** - Causal agents of plant diseases - Biotic causes (fungi, bacteria, virus, mycoplasma, nematodes, Angiospermic parasites, Abiotic causes (nutrient and mineral deficiencies, effect of pollution), Koch's postulates, Iatrogenic diseases, Seed pathology.
2. **Symptoms:** Details of different symptoms of plant diseases.
3. **Process of infection** - Mechanical, physiological and enzymatic action, Penetration, entry and establishment of pathogens in to the host tissues.
4. **Host- parasite interaction** - Enzymes and toxins in pathogenesis. Defense mechanisms in plants (structural and biochemical).
5. **Transmission of plant diseases.** Details of different ways of spread and transmission of plant diseases – wind and water mediated, seed borne and vector borne.
6. **Plant disease management** – Exclusion, eradication and protection, Different pesticides and fungicides and their application, Biocides in plant protection, Integrated approach in plant disease management with special reference to Physical, chemical and biological control of pathogens (Brief account)
7. **Study of diseases** - Symptoms, causal organisms, disease cycle and control measures:
  - a) Bunchy top of banana
  - b) Bacterial blight of paddy
  - c) Bud rot of Coconut
  - d) Mahali of Areca nut
  - e) Powdery mildew of rubber
  - f) Abnormal leaf fall of rubber
  - g) Tikka disease of Ground nut
  - h) Blister blight of tea
  - i) Wheat rust
  - j) Coffee rust
  - k) Grey leaf spot of Coconut
  - l) *Phytophthora* foot rot of pepper
8. Angiosperm parasites - *Loranthus*, *Dendrophthoe*.

**Reference Books:**

1. Agrios, G. N. (2006). Plant pathology. 5<sup>th</sup> Ed., Elsevier Academic Press.
2. Bilgrami, K.H. & Dube, H C. *A Text Book of Modern Plant Pathology*. Vikas Publishers, New Delhi.
3. Boland, G. J. (2007). *Plant Pathology*, GN Agrios. Elsevier Academic Press, Burlington.
4. Chaube, H.S. & Ramji Singh (2001). *Introductory Plant Pathology*. International Book Distributing Co., Lucknow.
5. Gareth-Jones, D. (1983). *Plant Pathology: Principles and Practice*. Open University Press.
6. Lucas, J. A. (1998). *Plant Pathology and Plant pathogens*. Blackwell.
7. Manners, J.G. (1993) *Principles of Plant Pathology*. Cambridge Univ Press.
8. Mehrotra, R. S. (1997). *Plant Pathology* Tata Mc. Graw-Hill Publ. Co. Ltd., New Delhi.
9. Pandey, B. P. (1999). *Plant Pathology -pathogen and plant disease*. S. Chand & Co.
10. Rangaswami, G., & Mahadevan, A. (1998). *Diseases of crop plants in India*. PHI Learning Pvt. Ltd.
11. Wheeler, H. (1975). *Plant Pathogenesis*. Springer Verlag.
12. Wood, R.K.S. (1978). *Physiological Plant Pathology*. Blackwell

**MODEL QUESTION PAPER - SEMESTER I M.Sc. BOTANY**

**BO 01 CT 02 – MYCOLOGY AND LICHENOLOGY, MICROBIOLOGY AND PLANT PATHOLOGY**

Time: 3 Hours

Max. Weightage: 36

**I Answer all questions briefly:**

1. Write the control measures of Grey leaf spot of Coconut.
2. Write the etiology of Bud rot of Coconut.
3. What are the symptoms of Mahali disease of Arecanut?
4. Abiotic causes.
5. Write the structure of zygosporangium.
6. Give the salient features of Myxomycota.
7. VAM fungi
8. What is dikaryotic mycelium?
9. Soredia.
10. What are Coprophilous fungi?
11. Biofertilizers.
12. Single cell protein.
13. Xenobiotics.
14. Eubacteria.

(14 x 1 = 14 weightage)

**II Answer any 7 questions each in not more than 100 words:**

15. Mention the role of toxins in the process of infections.
16. What are the different symptoms of plant diseases?
17. Explain the symptoms, etiology and management practices of Blister Blight of Tea.
18. Enumerate the role of biocides in plant protection.
19. Explain the general characters of Basidiomycota.
20. Write a short note on Heterothallism.
21. Enumerate the role of fungi as saprophytes.
22. Describe the industrial production of antibiotics.
23. Write a note on Cyanobacteria.
24. Give an account on economic importance of Actinomycetes.

(7 x 2 = 14 weightage)

**III Answer any 2 questions in 300 words:**

25. Elucidate the defense mechanism in plants.
26. Describe the role of fungi as symbionts and their significance.
27. Write in details about food spoilage and methods of preservation.
28. Give the outline of Bergey's manual of systematic bacteriology.

(2 x 4 = 8 weightage)

## **BO01CT03. ANGIOSPERM ANATOMY, ANGIOSPERM EMBRYOLOGY, PALYNOLOGY AND LAB TECHNIQUES**

[2+2+1+1= 6 hours per week]

### **ANGIOSPERM ANATOMY [2 hours per week]**

1. **Cell wall and its development.** Chemistry of cell wall - cellulose, hemicellulose, polysaccharides, cell wall proteins, water, Organization of primary wall, Cytokinesis and growth, Plasmodesmata, Secondary wall chemical constituents - lignin, suberin, callose; organisation of secondary wall.
2. **Node - Nodal patterns:** Unilacunar, trilacunar, multilacunar and split lateral, Phylogenetic considerations, Leaf trace and branch trace - origin, departure; effect on stele and pith, Secondary growth in leaf traces.
3. **Cambium:** Development of vascular cambium and cork cambium in root and stem; cell types in vascular cambium, infected vascular cambia, seasonal variations in cambial activity; role of cambium in wound healing and grafting. Conversion of fusiform initials in to ray initials; cambium in arborescent monocotyledons (Liliflorae).
4. **Development and differentiation:** The structure of specialized cells. Vascular differentiation (procambium, residual meristem, interfascicular and intrafascicular cambia); acropetal and basipetal differentiation in leaves, stem and roots, Sieve tube differentiation, Control of phloem differentiation, Tracheary elements differentiation. Ultra structure of phloem and xylem, brief account of transfer cells, Secondary wall thickening, cytoplasmic changes and autolysis, Control of differentiation, Genetic aspects - Induction of vessel elements, Induction of secondary xylem structure in relation to function in water conduction.
5. **Anomalous secondary growth:** Concepts; modification of the common type of vascular cambium, unequal activity of the vascular cambium. Successive cambia. Anomalous placement of vascular cambium. Discontinuous, unidirectional and bidirectional activity of cambium, Anomalous secondary growth in storage roots (Beet root, Sweet potato).
6. **Seedling anatomy:** Concepts: Anatomy of cotyledons, hypocotyl, seedling root, mesocotyl differentiation.
7. **Leaf anatomy:** Unifacial, bifacial and centric leaf (onion); structure of epidermis, stomatal types, foliar scleroids, oil cells, crystal idioblasts.
8. **Anatomy in relation to taxonomy.**
9. **Wood anatomy** – General account.

### **Reference Books:**

1. Cutter, E.G. & Edward, E., 1978. Plant Anatomy: Experiment and Interpretations Part I & II.
2. Easu, K- 1983. Plant Anatomy - Wiley Eastern Limited.
3. Fahn, A. 1977. Plant Anatomy. Pergamon Press.
4. Forester, A.S. 1960. Practical Plant Anatomy. D. Van Nostrand Company Inc.
5. Mauseth, J.D. 1988. Plant Anatomy - The Benjamin Cumming Publishing Co.
6. Metcalf C R, Chalk L (1983). Anatomy of the dicotyledons: Wood structure and conclusion of the general introduction. Oxford University press.
7. Pandey, B.P. 1984. *Plant Anatomy*. S. Chand and Company, New Delhi.
8. Roberts, L.W. 1976. Cytodifferentiation in Plants - Cambridge University Press, Cambridge.
9. Vasishta P C (1994). Plant anatomy. Pradeep publications.

**ANGIOSPERM EMBRYOLOGY** [2 hours per week]

1. **Introduction to angiosperm embryology** - structure of ditheous and monotheous anther.
2. **Microsporogenesis**: Structure and function of wall layers, role of tapetum in pollen development
3. **Male gametophyte**: Pollen mitosis, division of generative cells, heterospory.
4. **Megasporogenesis**: Megaspore triad, dyad, coenomegaspore.
5. **Embryo sac** - Different types - ultra-structure of components - synergid and antipodal, Theories of the morphological nature of embryo sac.
6. **Pollination** - Artificial pollination - ultra-structural and dis-ultrastructural and histo-chemical nature of stigma, Significance of pollen - pistil interaction, Role of pollen wall proteins and stigma. *In vitro* pollination and fertilization.
7. **Fertilization**: Role of synergids - Filiform apparatus, heterospermy and triple fusion.
8. **Embryo**: Structure and development of typical dicot and monocot embryos - structure and function of suspensor.
9. **Endosperm**: classification and type - ruminant endosperm, mosaic endosperm, endosperm haustoria, physiology and cytology of endosperm.
10. **Polyembryony** – Classification – Practical value.
11. **Apomixis** – General account, Genetics of Apomixis
12. **Parthenocarpy** – Seedless fruits, induction of parthenocarpy.
13. **Experimental embryology** – Embryo culture, anther culture, ovule culture
13. **Embryology in relation to taxonomy**

**Reference Books:**

1. Bhojwani, S.S. and Bhatnagar, S.P. (1999). The Embryology of Angiosperms (4<sup>th</sup> Edn). Vikas Publishing House Pvt Ltd.
2. Bouman F. Ovule initiation, ovule development, and seed coat development in Angiosperms, Today and Tomorrow Publishers, New Delhi
3. Davis C.L. Systematic embryology of Angiosperms. John Wiley.
4. Eames A.J. Morphology of Angiosperms. Mc Graw Hill.
5. Johanson D. Plant Embryology. Waltham, Massachusetts.
6. John B.D. (Ed.) Embryology of Angiosperms. Springer Verlag.
7. Maheswari P. 1950. An Introduction to the Embryology of Angiosperms. Mc Graw Hill.

**PALYNOLOGY** (1 hour per week)

1. **Introduction**: Contributions of Erdtman and P.K.K. Nair.
2. **Pollen wall**: Development and structure of pollen wall, pollen morphology and its application, pollen evolution.
3. **Aeropalynology**: Methods of aerospore survey and analysis.
4. **Melittopalynology**: Nutritional and medicinal value of honey, Unifloral and multifloral honey.
5. **Recent advances in Palynological studies**: Forensic, Pollen allergy, oil exploration, paleopalynology.
6. **Palynology in relation to Taxonomy**: Eurypalynous and Stenopalynous taxa.

**Reference Books:**

1. Bhattacharya, K., Majumdar, M.R. and Bhattacharya, S.G. (2006) A Textbook of Palynology. New Central Book Agency (P) Ltd. New Delhi.
2. Nair, P.K.K. (1970) Pollen Morphology of Angiosperms. Vikas Publications, New Delhi.
3. Nair, P.K.K. (1985) Essentials of Palynology. Today & Tomorrow Printers and Publishers, New Delhi.
4. Shivanna, K.R. and Rangaswamy, N.S. (1992) Pollen Biology –A Laboratory Manual. Narosa Publishing House, New Delhi.

**LAB TECHNIQUES** [1hour per week]

1. **Study of the following instruments** - Their uses and principles:
  - a. Microscope: Microscopic measurements - Camera lucida, micrometry.
  - b. Microtomes: Sledge, Rocking, Rotary.
2. **Killing, fixing and staining of plant tissues:**
  - a. Important reagents and chemicals used in the preparation of fixatives and their properties.
  - b. Fixatives - FAA, Carnoy's fluid, Chrome acetic, Nawaschins fluid, Craff, Flemings - composition, preparation and specific uses.
  - c. Dehydrating agents, clearing agents, mounting media - Examples and brief description.
  - d. Stains - classification, composition and specific uses - Safranin, Crystal violet, Cotton blue, Fast green, Orange - G, Hematoxylin, Carmine.
  - e. Brief account of vital staining.
  - f. Staining techniques - Double staining.
    - i. Safranin - Fast green; ii. Crystal violet – Orange G
3. **Methods of embedding plant materials in paraffin wax** - TBA method; embedding for Electron microscopy.
4. **Sectioning of embedded paraffin wax materials** using Rotary Microtome.
5. **Double staining of microtome serial sections embedding in paraffin wax** - Safranin - Fast green; Crystal violet - Orange G / Erythrosin.
6. **Whole mounts** - general account
7. Maceration and smears
8. **Histochemical tests** –
  - (a) PAS Test - insoluble polysaccharides; (b) Sudan black –lipids; (c) Fuelgen reaction - Nucleic Acids.

**Reference Books:**

1. Gray, P. (1964). Handbook of Basic Microtechnique. McGraw Hill Company.
2. Johansen, D.A. 1940. Plant Microtechnique, McGraw-Hill Book Company, Inc. New York.
3. John E. Sass. 1967. Botanical Microtechnique, Oxford & IBH Publishing Co.
4. John R. Baker. Principles of Biological Microtechnique – Univ. press.
5. Krishnamurthy, K.V. (1987). Methods in Plant Histochemistry. S. Viswanathan printers, Anand book depot, Madras.
6. Prasad, M.K. and Krishna Prasad, M. (1983). Outlines of Microtechnique. Emkay Publications.
7. Toji Thomas. (2005). Essentials of botanical microtechnique (II Edn). Apex infotech publishing company.

**MODEL QUESTION PAPER - SEMESTER I M.Sc. BOTANY**

**BO 01 CT 03 – ANATOMY, EMBRYOLOGY, PALYNOLOGY & LAB TECHNIQUES**

Time: 3 Hours

Max. Weightage: 36

**I Answer all questions briefly:**

1. Explain trilacunar node.
2. What is residual meristem?
3. Differentiate compression wood from tension wood.
4. Enumerate the cell types in vascular cambium.
5. Comment on double fertilization.
6. What is mosaic endosperm?
7. Filiform apparatus.
8. Explain parthenocarpy.
9. Distinguish between unifloral and multifloral honey.
10. Paleopalynology.
11. What is vital staining?
12. Differentiate killing from fixing of plant tissues.
13. What is maceration?
14. What is camera lucida?

(14 x 1 = 14 weightage)

**II Answer any 7 questions each in not more than 100 words:**

15. With the help of diagrams describe different stomatal types.
16. Briefly describe the anomalous secondary growth in storage roots.
17. Describe the different nodal patterns with diagrams.
18. Write a note on embryological characters in relation to taxonomy.
19. Give an account on Polyembryony.
20. Explain the role of tapetum in pollen development.
21. Explain the NPC system of pollen aperture.
22. Give an account on the contribution of PKK Nair.
23. Write a note on Fuelgen reaction.
24. What is double staining? Mention one method.

(7 x 2 = 14 weightage)

**III Answer any 2 questions in 300 words:**

25. Give a detailed account on types of endosperm. Add a note on its cytology.
26. Write an essay on aeropalynology and pollen allergy.
27. Describe the different types of abnormal cambial activity in stem with suitable examples.
28. Write an account of classification, composition and specific use of stains.

(2 x 4 = 8 weightage)

**BO01CP04. PRACTICALS OF PHYCOLOGY, BRYOLOGY,  
PTERIDOLOGY, GYMNOSPERMS, MYCOLOGY,  
LICHENOLOGY, MICROBIOLOGY, PLANT PATHOLOGY,  
ANGIOSPERM ANATOMY, ANGIOSPERM EMBRYOLOGY,  
PALYNOLOGY AND LAB TECHNIQUES**

(½ x 10 + 1 for Lab Techniques = 6 hours per week)

**PHYCOLOGY** [½ hour per week]

1. Collection, preservation and preparation of algal herbarium (5 numbers).
2. Collection and study of the types mentioned below and their identification up to generic level using algal monographs:

**Chlorophyta:** *Pediastrum, Scenedesmus, Hydrodictyon, Ulva, Cladophora, Pithophora, Bulbochaete, Cephaleuros, Draparnaldiopsis, Bryopsis, Codium, Caulerpa, Halimeda, Desmids (Closterium, Cosmarium), Nitella.*

**Xanthophyta:** *Botrydium.*

**Bacillariophyta:** *Biddulphia, Coscinodiscus, Cymbella.*

**Phaeophyta:** *Ectocarpus, Dictyota, Padina, Turbinaria.*

**Rhodophyta:** *Batrachospermum, Gracilaria, Champia.*

**BRYOLOGY** [½ hour per week]

Morphological and structural study of representative members of the following types using whole mount preparations, dissections and transactions:

- |                      |                        |                    |
|----------------------|------------------------|--------------------|
| 1) <i>Asterella</i>  | 5) <i>Pallavicinia</i> | 9) <i>Sphagnum</i> |
| 2) <i>Targionia</i>  | 6) <i>Dumortiera</i>   | 10) <i>Bryum.</i>  |
| 3) <i>Cyathodium</i> | 7) <i>Porella</i>      |                    |
| 4) <i>Lunularia</i>  | 8) <i>Anthoceros</i>   |                    |

**PTERIDOLOGY** [½ hour per week]

1. Study of vegetative and reproductive features of:

1) <i>Lycopodium</i>	6) <i>Ceratopteris</i>	11) <i>Gleichenia</i>
2) <i>Ophioglossum</i>	7) <i>Pteris</i>	12) <i>Trichomanes</i>
3) <i>Angiopteris</i>	8) <i>Asplenium</i>	13) <i>Salvinia</i>
4) <i>Osmunda</i>	9) <i>Blechnum</i>	14) <i>Azolla.</i>
5) <i>Lygodium</i>	10) <i>Cyathea</i>	
2. Study of the following fossils: *Rhynia, Lepidodendron, Sphenophyllum, Calamites, Calamostachys, Zygopteris* and *Anachoropteris.*
3. Spore germination and development of prothallus in Knop's Agar medium.
4. A study of Pteridophytes in their natural habitats.

**GYMNOSPERMS** [½ hour per week]

1. Identification of petrifications, compressions and impressions: *Lyginopteris*, *Heterangium*, *Medullosa*, *Trignocarpus*, *Glossopteris*, *Caytonia*, *Pentoxylon*, and *Cordaites*.
2. Study of vegetative and reproductive structures of:
  - 1) *Zamia*
  - 2) *Ginkgo*
  - 3) *Pinus*
  - 4) *Cryptomeria*
  - 5) *Cupressus*
  - 6) *Araucaria*
  - 7) *Agathis*
  - 8) *Podocarpus*
  - 9) *Cephalotaxus*
  - 10) *Ephedra*
  - 11) *Gnetum*.

**MYCOLOGY & LICHENOLOGY** [½ hour per week]

Critical study of the following types with the help of fresh/preserved materials by making suitable micro-preparations giving emphasis on systematic position, details of vegetative and reproductive structures:

- 1) *Stemonitis*
- 2) *Saprolegnia*
- 3) *Phytophthora*
- 4) *Albugo*
- 5) *Mucor*
- 6) *Pilobolus*
- 7) *Saccharomyces*
- 8) *Xylaria*
- 9) *Chaetomium*
- 10) *Peziza*
- 11) *Puccinia*
- 12) *Auricularia*
- 13) *Polyporus*
- 14) *Ganoderma*
- 15) *Lycoperdon*
- 16) *Dictyophora*
- 17) *Geastrum*
- 18) *Cyathus*
- 19) *Aspergillus*
- 20) *Curvularia*
- 21) *Alternaria*
- 22) *Fusarium*
- 23) *Colletotrichum*
- 24) *Parmelia*
- 25) *Usnea*.

**MICROBIOLOGY** [½ hour per week]

1. Test for the presence of coliform bacteria in contaminated water.
2. Isolation of Eubacteria and Cyanobacteria from soil by dilution plate method.
3. Isolation of pure bacterial culture by streak plate method.
4. Staining of bacteria (negative staining, Gram staining and spore staining).
5. Demonstration of bacterial motility by hanging drop method.
6. Morphological studies on *Scytonema*, *Aphanocapsa*, *Spirulina*, *Oscillatoria*, *Anabaena*.

**PLANT PATHOLOGY** [½ hour per week]

1. Detailed lab study of the following diseases:
  - a) Bunchy top of Banana
  - b) Bacterial blight of Paddy
  - c) Bud rot of Coconut
  - d) Mahali of Areca nut
  - e) Powdery mildew of Rubber
  - f) Abnormal leaf fall of Rubber
  - g) Tikka disease of Ground nut
  - h) Blister blight of Tea
  - i) Wheat rust,
  - j) Coffee rust
  - k) Grey leaf spot of Coconut
  - l) *Phytophthora* foot rot of Pepper
2. Angiospermic parasites - *Loranthus* and *Dendrophthoe*.
3. Technique of isolation and pure culture of pathogens.

**ANGIOSPERM ANATOMY** [½ hour per week]

1. Study of anomalous secondary growth in stems of *Aristolochia*, *Strychnos*, *Amaranthus*, *Bougainvillea*, *Bignonia* and *Agave*.
2. Nodal anatomy of different types.
3. Leaf anatomy: Epidermal peels and T.S. of lamina.

**EMBRYOLOGY** [½ hours per week]

1. Study of anther development of *Datura*.
2. Preparation of dissected whole mounts of microsporangium.
3. Study of megaspore mother cell, megaspore and embryo sac.
4. Study of the receptivity of stigma and *in situ* germination of pollen.
5. Dissection of stages in the development of embryo and endosperm.
6. Pollen germination using hanging drop technique.
7. Demonstration of intra ovarian pollination.

**PALYNOLOGY** [½ hours per week]

1. Analysis of honey for microscopic examination of pollen.
2. Calculation of percentage of pollen viability using T Z test.
3. Study of pollen wall by acetolysis

**LAB TECHNIQUES** [1 hour per week]

1. Measurement of microscopic objects - Micrometry.
2. Camera Lucida drawing - calculation of magnification
3. Double stained permanent sections - free hand section, Microtome serial sections.
4. Preparation of whole mounts, macerations and smears.
5. Submission of 10 permanent slides - which should include microtome serial sections, free hand sections, macerations, whole mounts and smears.

**PRACTICAL RECORDS**

Submission of certified record of practicals at the time of terminal evaluation.

**FIELD WORK AND OTHER SUBMISSION**

3 days of Field work for the *in situ* study of the types of the above areas of study and submission of a field report.

**MODEL QUESTION PAPER**  
**SEMESTER I M.Sc. BOTANY PRACTICAL EXAMINATION**

**BO 01 P04 - PHYCOLOGY, BRYOLOGY, PTERIDOLOGY, GYMNOSPERMS,  
MYCOLOGY AND LICHENOLOGY, MICROBIOLOGY, PLANT PATHOLOGY,  
ANGIOSPERM ANATOMY, EMBRYOLOGY, PALYNOLOGY AND  
LABORATORY TECHNIQUES**

**TIME: 6 HOURS**

**TOTAL WEIGHTAGE: 36**

**PART A (9.30am – 12.30 pm)**

1. Make suitable micro preparations of materials **A**, **B** and **C**. Identify the materials up to the level of genus giving reasons, draw labelled diagrams and leave the preparation for valuation. (Preparation- 1; Diagram, Reason, and Identification- 2) [3 x 3 = 9 Weightage]
2. Demonstrate Gram / Negative staining of bacterial culture **D** and identify the type / morphology of bacteria (Preparation -1; Identification- 1) [2 Weightage]
3. Dissect, Display and Identify any one stage of embryo with the help of a diagram from the given material **E**. (Preparation- 1; Diagram and Identification- 1) [2 Weightage]
4. Identify the disease, Causative organism and symptoms of the materials **F** and **G**. [1 x 2 = 2 Weightage]

**PART B (1 pm – 4 pm)**

5. Make a suitable double stained permanent slide of material **H**. Describe salient anatomical features with the help of a suitable labelled diagram and leave the preparation for valuation. (Preparation- 3; Diagram and anatomical features- 2) [5 Weightage]
6. Make a suitable micro-preparation of material **I** and identify the type of stomata / nodal pattern with the help of a diagram. (Preparation- 1; Diagram and Identification- 1) [2 Weightage]
7. Make a micro preparation of the material **J** by acetolysis method. Comment on pollen morphology and leave the preparation for valuation. (Preparation- 1; Pollen morphology- 1) [2 Weightage]
8. Spot at sight **K**, **L**, **M**, **N**, **O** and **P** [1 x 6 = 6 Weightage]

**Record- 4 Weightage**

**Submissions- 2 Weightage**

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**Total – 36 Weightage**

**SEMESTER II**

Course Code	Title	Teaching Hours / week	Duration of examination	Weightage		Credits	Page Nos:
				EE	ICE		
<b>BO02 CT05</b>	Cell Biology, Molecular Biology and Biophysics	$2\frac{1}{2}+2\frac{1}{2}+1$ = 6	3 hrs	36	20	4	25-27
<b>BO02 CT06</b>	Cytogenetics, Genetics, Biostatistics, Plant Breeding and Evolution	$1+1\frac{1}{2}+1\frac{1}{2}+1+1$ = 6	3 hrs	36	20	4	29-33
<b>BO02 CT07</b>	Plant Ecology, Conservation Biology, Phytogeography and Forest Botany	$[2\frac{1}{2}+1\frac{1}{2}+1+1]$ = 6	3 hrs	36	20	4	35-36
<b>BO02 CP08</b>	Practicals of Cell Biology, Molecular Biology, Biophysics, Cytogenetics, Genetics, Biostatistics, Plant Breeding, Plant Ecology, Conservation Biology, Phytogeography and Forest Botany	$[1\frac{1}{2}+1\frac{1}{2}+1\frac{1}{2}+1\frac{1}{2}+1+1+1\frac{1}{2}+1\frac{1}{2}+1\frac{1}{2}]$ $+1\frac{1}{4}+1\frac{1}{4}$ = 6	6 hrs	36	20	4	38-39

EE – External evaluation

ICE – Internal continuous evaluation

Model question papers:

BO01 CT05 – Page no: 28

BO01 CT06 – Page no: 34

BO01 CT07 – Page no: 37

BO01 CP08 – Page no: 40

*SEMESTER II*

**BO02CT05. CELL BIOLOGY, MOLECULAR BIOLOGY AND BIOPHYSICS**

[2½+2½+1 = 6 hours per week]

**CELL BIOLOGY** [2½ hours per week]

1. **The nucleus:** Interphase nucleus, chromatin organization, nucleosomes, scaffold. Organization of eukaryotic chromosome, Heterochromatin – constitutive, facultative and condensed Euchromatin, Satellite DNA, Chromosome banding and its significance.
2. **Cell reproduction:** Cell cycle, Specific events – G<sub>1</sub>, S, G<sub>2</sub> and M phases, significance of G<sub>0</sub>, Control of cell cycle, significance, Gene expression during cell cycle, Mitotic inducers.
3. **Meiosis:** Types, Synaptonemal complex, Significance of meiosis, Genetic control and consequences of meiosis, Restriction points and check points, Cell cycle regulation of meiotic events, behavior of sex chromosomes in meiosis, Suppression of DNA replication between Meiosis I and II, Meiotic defects and human diseases.
4. **Programmed cell death:** Necessity, classes, signals, Genetic analysis of cell death, Proteins regulating apoptosis, Pathways leading to cell death – significance, Aging – Cellular and extra cellular, Cell signaling.
5. **Cell interactions:** Communication, recognition and adhesion, Application.
6. Cellular differentiation and specialization, General characteristics, intrinsic interactions, Nucleo-cytoplasmic, Extrinsic interactions, Molecular mechanisms of cellular differentiations.
7. **Cancer:** Carcinogenic agents, Phenotype of the transformed cells, Genetic basis of malignant transformation, Oncogenes, Tumour suppressor genes, Cancer and cell cycle, Metastasis, Interaction of cancer cells with normal cells.

**Reference Books:**

1. Alberts, B., Bray, D., Hopkin, K., Johnson, A., Lewis, J., Raff, M. & Walter, P. (2013). Essential cell biology. Garland Science.
2. Berk, A., and Zipursky, S. L. (2000). Molecular cell biology (Vol. 4). New York: WH Freeman.
3. Cooper, G.M. and Robert E Hausman (2009). The Cell: A molecular approach (5<sup>th</sup> Edn). Sinauer.
4. De Robertis and De Robertis. Cell and Molecular Biology Holt Rinehart & Winston
5. Karp, G. (2008). Cell and Molecular biology: Concepts and experiments (5<sup>th</sup> Edn). John Wiley & Sons.
6. Lewis R. Human Genetics, Concepts and applications, WCB McGraw Hill.
7. Pollard T.D. and Earn Shaw, W.C. Cell Biology Saunders.

8. Tropp, B. E. 2008. *Molecular Biology, Genes to Proteins*, 3rd ed. Jones & Bartlett Publishers.
9. Twyman, R. M. (1998). *Advanced molecular biology: a concise reference*. Westview Press.

**MOLECULAR BIOLOGY** [2½ hours per week]

1. **Molecular Biology of Gene:** Structure of DNA, Repetitive DNA, *c*-value paradox
2. **Replication of DNA:** Enzymology of replication, Replication in prokaryotes and eukaryotes, Primosomes and replisomes, Telomerase and its function.
3. **Gene Expression:** Regulation of gene expression, Operon Concept, Gene regulation in prokaryotes and eukaryotes, Enhancers and silencers.
4. **Protein synthesis:** Transcription, post transcriptional events, Introns and their significance, Translation, Post translation events, Role of chaperons.
5. **Mutation:** Spontaneous and induced, Physical and chemical mutagens, Molecular mechanism of mutation, Mutation and cancer, Mutator and antimutator genes, DNA repairing mechanisms.
6. **Molecular evolution:** The origin of genomes, Evolution of new genes, Origin of eukaryotic genomes, Phylogenetics, Application of molecular phylogenetics.

**Reference Books:**

1. Benjamin Lewin (2000). *Genes*. Oxford university press.
2. Brown, T.A. *Genomes*, John Wiley and sons
3. Gardner E.J., Simmons M.J., Snustad D.P. (1991). *Principles of Genetics* (3<sup>rd</sup> Edn). John Wiley and Sons Inc.
4. Hawkins, J.D. *Gene structure and Expression*, Cambridge University Press.
5. Snustad, D.P. and Simmons, M.J. (2010). *Principles of genetics* (5<sup>th</sup> Edn). John Wiley and Sons.
6. Tropp, B. E. 2008. *Molecular Biology, Genes to Proteins*, 3rd ed. Jones & Bartlett Publishers
7. Weaver and Hendrick. *Genetics*. Wm. C. Brown Publishers.
8. Weaver. R.F. (2002). *Molecular biology* (II Edn). McGraw Hill.

**BIOPHYSICS** [1 hour per week]

1. **pH and Buffer Solutions:** Hydrogen ion concentration and pH, Dissociation of acids and bases, Measurement of pH using organic indicator molecule and potentiometric method, Functions of Buffers in a biological system, Use of buffers in biological and biochemical research, pH and life, Henderson and Hasselbalch equation.
2. **Chromatography:** Principles of chromatography, Types of chromatography (Brief account).
3. **Electrophoresis:** Electrophoretic mobility, Principles, PAGE, Agarose gel electrophoresis,

Separation and detection of macromolecules by electrophoresis, Electrophoretic apparatus, technique and procedure.

4. **Centrifugation:** Theory of centrifugation, Centrifuge – Types, Methodology of centrifugation, Application.
5. **Colorimetry and Spectrophotometry:** Beer-Lambert's Law, Measurement of extinction, Colorimeters and spectrophotometers, Techniques and applications in biological and biochemical research, Comparison between colorimetry and spectrophotometry.
6. **Radiobiology:** Autoradiography, Principles, Types, Methods and application in biological research.
7. **Immunochemistry:** Immune response, Antigens, Antibodies, Histo-incompatibility antigens, Structure of IgG, Immunochemical assays - RIA & ELISA.
8. **Cryobiology:** Freeze drying (Lyophilization) - Applications.

### References

1. Asokan P (2002). Analytical Biochemistry. Chinna Publications, Tamil Nadu.
2. Cooper T. G. (2011). The tools of Biochemistry. Star Educational Book Distributors, New Delhi
3. Hoppe, W. (Ed.) Biophysics. Springer Verlag.
4. Keith Wilson and John Walker (1994) Practical Biochemistry. Foundation Books, New Delhi.
5. Plummer D.T. (1990). An introduction to practical biochemistry. Tata McGraw - Hill Publishing Company, New Delhi.
6. Rogers, A.W. Techniques of Autoradiography. Elsevier.
7. Roy, R.N. A Text Book of Biophysics. New Central Book agency Pvt. Ltd., Calcutta.
8. Sasidharan, A. Selected topics of Biophysics. Frontier Area Publishers.
9. Slayter, E.M. Optical methods in Biology. Wiley Intersciences.
10. Veerakumari L. (2007) Bioinstrumentation. MPJ Publishers, Chennai.
11. Wong, C.H. Radiation Tracer Methodology in Biophysical Sciences, Prentice Hall.

**MODEL QUESTION PAPER - II SEMESTER M.Sc. BOTANY**  
**BO 02 CT 05 – CELL BIOLOGY, MOLECULAR BIOLOGY AND BIOPHYSICS**

Time: 3 Hours

Max. Weightage: 36

**I Answer all questions briefly:**

1. Comment on S- phase.
2. Satellite DNA.
3. Define apoptosis.
4. Differentiate between Euchromatin and Heterochromatin.
5. Explain tumour suppressor genes.
6. What is charging of tRNA?
7. Distinguish enhancers and silencers.
8. Tautomerization.
9. Distinguish between repetitive DNA and unique DNA.
10. Define anti-mutator gene.
11. What is Density gradient centrifugation?
12. Gel filtration chromatography.
13. RIA.
14. PAGE.

(14 x 1 = 14 weightage)

**II Answer any 7 questions each in not more than 100 words:**

15. Write an account on Chromatin organization in eukaryotes.
16. Discuss the genetic analysis of cell death.
17. Briefly explain the phenotype of transformed cells.
18. Describe the molecular mechanism of cellular differentiation.
19. Discuss the post- transcriptional changes in protein synthesis.
20. Explain the chemical and physical mutagens.
21. Enumerate and explain the properties of genetic code.
22. Write a short note on comparative account of colorimetry and spectrophotometry.
23. Enumerate the applications of chromatography.
24. Write a short note on immune responses.

(7 x 2 = 14 weightage)

**III Answer any 2 questions in 300 words:**

25. Describe different phases of cell cycle.
27. What is molecular evolution? Explain briefly the origin of eukaryotic genomes.
26. Describe the mechanism of DNA replication in detail. Add a note on enzymes involved in it.
28. Explain the theory, types and applications of centrifugation.

(2 x 4 = 8 weightage)

**BO02CT06. CYTOGENETICS, GENETICS, BIOSTATICS,  
PLANT BREEDING AND EVOLUTION**

[1+1½+1½+1+1= 6 hours per week]

**CYTOGENETICS** [1 hour per week]

1. **Cytogenetics of aneuploids, euploids and structural heterozygotes:** Effect of aneuploidy on phenotype, Transmission of monosomics and Trisomics and their uses, Breeding behavior and genetics of structural heterozygotes; translocation heterozygotes; Robertsonian translocation; B-A translocation, Karyotype – concepts and its importance, Structural chromosome aberrations - types and significance in evolution, Heteroploidy, aneuploidy, monosomy, trisomy (primary, secondary, tertiary and compensating), Nullisomy, Uses of aneuploidy in cytogenetics, Euploidy - autopolloidy, allopolloidy and segmental allopolyploidic diploidization, Role of aneuploidy and euploidy in evolution. Karyotype - Concepts and its importance, Karyotype evolution.
2. **Molecular cytogenetics:** Multigenic families and their evolution; *in-situ* hybridization - concept, Computer assisted chromosome analysis, chromosome micro-dissection and micro-cloning, flow cytometry.
3. **Polytene and lampbrush chromosome:** Cytogenetic importance
4. **Supernumerary chromosomes:** B- chromosomes.

**Reference Books:**

1. Alberts B. D., Bray, J., Lewis, K. Roberts and J. D. Watson. Molecular Biology of the Cell, Gartand Publishing Inc. New York.
2. Atherly A. G., J. R. Girton and J. F. McDonald. The Science of Genetics. Saunders College Publishing, Fort Worth, USA.
3. Burnharm C. R. Discussions in Cytogenetics. Burgess Publishing Co., Minnesota
4. De Robertis E.D.P. and De Roberties E.M.F. Cell and Molecular Biology, ISBN, Hong Kong.
5. Dupraw E.J. DNA and Chromosomes. Holt, Reinhart and Winston Inc. New York.
6. Hart D.L. and E.W. Jones. Genetics: Principles and Analysis. Jones & Barlett publishers, Massachusetts, USA.
7. Hillis, D.M., Mortiz, C., Mable, B.K. 1996. *Molecular Systematics*. Sinauer Associates Inc. Publishers, Sunderland, Massachusetts, U.S.A.
8. Karp G. Cell and Molecular Biology: Concepts and Experiments. John Wiley & Sons, Inc. USA.
9. Khush, G.S. Cytogenetics of Aneuploids. Academic Press.
10. Lewin, B. Gene. Oxford University Press, New York, USA.
11. Lewis R. Human Genetics: Concepts and application. WCB Mc Graw Hill, USA.
12. Malacinski G. M. and D. Freidfelder. Essentials of Molecular Biology. Jones and Bastlet Publishers Inc., London.

13. Rieger R., A. Michaelis and M.M. Green Glossary of Genetics and Cytogenetics- Classical and Molecular. Springer-Verlag, New York.
14. Swanson, C.P., Merz T., Young, W.J. 1978. *Cytogenetics – The Chromosome in Division, Inheritance and Evolution*. Prentice Hall of India Pvt. Ltd., New Delhi.

### GENETICS [1½ hours per week]

1. **Relevance of Mendelism in modern genetics:** A critical evaluation of Mendelism on the basis of modern concept of genes.
2. **Linkage and gene mapping:** Three point test cross, linkage map, interference, Tetrad analysis and centromere mapping, Linkage in Humans, Pedigree analysis, Genetic recombination and mapping of genes in bacteria and bacteriophages.
3. **Mobile genetic elements:** Transposable elements in bacteria – IS elements, Tn elements, composite transposons, Copia and P elements in *Drosophila*, Ac, Ds and Mu elements in maize, Retrotransposons, Molecular characteristics and significance in development and evolution.
4. **Extranuclear inheritance:** Analysis of mitochondrial and chloroplast genomes and their utility, Cytoplasmic male sterility.
5. **Quantitative genetics:** polygenic inheritance, heritability and its measurements, QTL mapping.
6. **Population genetics:** Systems of mating. The Hardy-Weinberg principle. Estimation of gene frequencies, Factors affecting genetic equilibrium – natural selection, mutation, migration and genetic drift.
7. **Human genetics:** Human pedigree analysis, Lod score for linkage testing, Karyotype, genetic disorders.

### Reference Books:

1. Burnet L. Essential Genetics. Cambridge University Press.
2. Friefelder. Microbial genetics. Narosa Publishing House.
3. Gardner E.J., Simmons M.J., Snustad D.P. (1991). *Principles of Genetics* (3<sup>rd</sup> Edn). John Wiley and Sons Inc. New York, USA.
4. Goodenough U. Genetics Sanders, College, Publishers.
5. Robert, J. Brooker. (2009). Genetics: Analysis and principles (III Edn). McGraw Hill, New York.
6. Singh B.D. Fundamental of Genetics. Kalyani Publishers, New Delhi.
7. Snustad, D.P. and Simmons, M.J. (2010). *Principles of genetics* (5<sup>th</sup> Edn). John Wiley and Sons.
8. Stansfield W. Theory and Problems of Genetics, McGraw Hills
9. Strickberger (2005). Genetics (III Edn). Prentice Hall of India Pvt. Ltd, New Delhi.
10. Weaver and Hendrick. Genetics, Wm C. brown Publishers.

### BIOSTATISTICS [1½ hour per week]

1. **The science of Statistics** and its application in biological research.
2. **Types and collection of data** - Census, sampling – concept and methods- simple random sampling, systematic random sampling, stratified random sampling.
3. **Tabulation and presentation of data** –diagrammatic and graphic presentation.
4. **Analysis of data** – central tendencies - Mean, Median, Mode - numerical problems.
5. **Measures of dispersion** – range, quartile deviation, mean deviation, standard deviation and standard error – relative measures of dispersion – coefficient of variation.
6. **Tests of significance** – formulation and testing of hypothesis, testing the probability of committing type 1 and type 2 errors.  $z$  test,  $t$  test, and chi-square test.
7. **Analysis of variance** – One-Way classification and two-way classifications.
8. **Correlation and regression analysis** - Coefficient of correlation- significance testing, rank correlation, lines of regression, coefficient of regression.
9. **Experimental designs**: designing an experiment, - CRD, RBD, LSD, factorial experiment.
10. **Probability**: Basic concepts and definition, Laws of probability (multiplication law, conditional law, additional theorem – Statement only), Binomial, Multinomial, Normal and Poisson distributions – Applications.
11. **Statistical software** – SPSS, SPAR.

### Reference Books:

1. Chandal, S.R.S. A handbook of Agricultural statistics. Achal Prakashan Mandir, Kanpur, India.
2. Daniel, W.W. 2013. *Biostatistics – Basic concepts and methodology for Health Science*. Wiley Publications.
3. Das M.N. and N.C. Giri. Designs and Analysis of Experiments. Wiley Eastern Ltd.
4. Elhance and Elhance. Fundamentals of Mathematical Statistics. Kithab Mahal, New Delhi, India.
5. Gupta S.P. 2014. Statistical methods. Sultan Chand and sons educational publishers, New Delhi.
6. Gupta, C.B. An introduction to Statistical Methods. Vikas Publishing Pvt. House Ltd.
7. Gupta, S.K. and Kapoor V.K. Fundamentals of Mathematical Statistics. S.chand & sons, New Delhi
8. Jasra P.K. and Gurdeep Raj 2000. Biostatistics. Krishna Prahkashan media private limited, Meerut.
9. Kempthorne, O. An introduction to Genetic Statistics. John Wiley and Sons Inc, New York.
10. Mather, K. And Links, J.L. Biometrical Genetics. Chapman and Hall, London.
11. Norman T. J. and Bailey 2008. Statistical Methods in Biology, University press, Cambridge.
12. Panse, V.G. and Sukatme, P. Statistical Methods for Agricultural Workers. ICAR, New Delhi.
13. Prasad S. Elements of Biostatitics. 2003. Rastogi Publications, Meerut.
14. Rao C.A. Advanced statistical methods in Biometrical Research. Wiley and Sons, New York.

15. Singh R.K. and Chaudhary, B.D. Biometrical Methods in Quantitative Genetic Analysis. Kalyani Publishers, New Delhi.
16. Singh, P. and Narayanan, S.S. Biometrical Methods in Plant Breeding. Kalyani Publishers, New Delhi.

**PLANT BREEDING** [1 hour per week]

1. **Plant Breeding:** Introduction and objectives
2. Organizations involved in Plant Breeding.
3. **Breeding systems in sexually propagated plants:** Floral Biology and its significance in Plant Breeding, Sterility and incompatibility systems.
4. **Genetic Resources:** Centers of Crop Genetic diversity, *in situ* and *ex situ* conservation, Cryopreservation of germplasm.
5. **Conventional Methods of Plant Breeding:**
  - a) Domestication of wild plants: Changes under domestication.
  - b) Plant introduction: History, Types - Primary and secondary plant introduction, Principles, Plant introduction agencies in India - Rules and Regulations, Major achievements.
  - c) Selection: Selection methods in sexually and vegetatively propagated species, Selection in segregating populations, Major achievements.
  - d) Hybridization: History, Objectives, Techniques, consequences and major achievements.
  - e) Heterosis Breeding: Genetic basis of heterosis and inbreeding depression.
6. **Modern methods of Plant Breeding:**
  - a) Mutation Breeding - History, Methodology, Applications, Merits, demerits and achievements.
  - b) Polyploidy Breeding - Methodology, Applications, Merits, demerits and achievements.
  - c) Biotechnological approaches in Plant Breeding - Molecular Markers and their uses, Transgenic plants – Critical evaluation.
7. **Breeding for special purposes:**
  - a) Resistance breeding: A brief account of disease resistance
  - b) Breeding for pest resistance: Mechanism of pest resistance
  - c) Stress resistance: Achievements
  - d) Quality Breeding: Objectives and achievements.
8. **Biometrical Techniques in Plant Breeding:** Analysis of variability, heritability, genetic advance and combining ability
9. **IPR:** Protection of plant variety and farmer's right Act.

**Reference Books:**

1. Allard, R. W. (1995). Principles of Plant Breeding. John Wiley and Sons, New York.
2. Chahal G.S. and Gosal S.S. (2002) Principles and procedure of Plant breeding. Narosa Publishing House, New Delhi.
3. Chopra V.L. Breeding Field Crops. Oxford IBH publishing company, New Delhi.

4. Daniel, L. Hartl. and Elizabeth, W. Jones. (2009). Genetics: Analysis of genes and genomes (7<sup>th</sup> Edn). Jones and Bartlett publishers, Burlington, USA.
5. Ghahal, G.S. and Gosal, S.S. (2002). Principles and procedures of Plant Breeding, Narosa Publishing House, New Delhi.
6. Gupta S.K. (1998) Plant Breeding – Theory and Techniques. Agrobios (India), Jodhpur.
7. Hayward, M. D., Bosemark, N. O., and Romagosa, I. (1993). Plant Breeding: Principles and prospects. Chapman and Hall Ltd, UK.
8. Jain H.K. and Kharkwal, M.C. Plant Breeding – Mendelism to Molecular Approaches. Narosa Publishing House, New Delhi.
9. Khan M.A. Plant Breeding. Biotech Books, New Delhi.
10. Mohanan K.V. Essentials of Plant Breeding. PHI Ltd., New Delhi.
11. Mohanan K.V. Essentials of Plantation Science. Penta Book Publishers, Calicut, Kerala.
12. Roy D (2000) Plant Breeding – Analysis and exploitation of variation. Narosa Publishing House, New Delhi.
13. Sharma, J.R. (1994). Principles and practices of Plant Breeding. Tata McGraw-Hill Publishers Company Ltd, New York.
14. Singh, B.D. (2005) Plant Breeding. Kalyani Publishers, Ludhiyana.
15. Stoskopf N.C. Plant Breeding – Theory and Practice. Scientific Publishers (India), Jodhpur.
16. Hill, J., Becker, H. C., Tigerstedt, P. M., & Pooni, H. S. (1998). Quantitative and ecological aspects of plant breeding, Chapman & Hall, London.

### EVOLUTION [1 hour per week]

1. **The concept of evolution:** Geological Time Scale and Evolution
2. **Origin of life:** theories and experimental evidences, chemical evolution and biological evolution.
3. Evidences of Evolution,
4. **Theories of evolution:** Pre - Darwinian, Darwinian and Post – Darwinian theories, Modern synthetic theory of Evolution.
5. **Reproductive isolation** and origin of species.
6. **Evolution at the molecular Level.**

### Reference Books:

1. Crick F., 1981. Life itself: Its origin and Nature. Simon and Schuster, New York.
2. Dobzhansky, T. 1970. Genetics of the Evolutionary Process. Columbia University press.
3. Stebbins, L. 1971. The Process of Organic Evolution, prentice Hall.
4. Dott R.H., Batten, 1981. Evolution of the earth 3<sup>rd</sup> ed. McGraw Hill New York.
5. Fox S.W. and K. Dose, 1972. Molecular Evolution and the Origin of Life. W.H. Freeman & Co., San Francisco.
6. Strickberger, 1990. Evolution, Jones and Bartlett Publishers International, England.

**MODEL QUESTION PAPER - SEMESTER II M.Sc. BOTANY**

**BO 02 CT 06 – CYTOGENETICS, GENETICS, BIOSTATISTICS, PLANT BREEDING AND EVOLUTION**

Time: 3 Hours

Max. Weightage: 36

**I Answer all questions briefly:**

1. FISH.
2. Differentiate between euploidy and aneuploidy.
3. B-A translocation.
4. Retrotransposons
5. QTL mapping
6. IS elements.
7. Define Quartile deviation.
8. RBD.
9. How mean, median and mode are linked?
10. Heritability.
11. What is Resistance breeding?
12. IARI
13. Reproductive isolation.
14. Compare Homology and Analogy

(14 x 1 = 14 weightage)

**II Answer any 7 questions each in not more than 100 words:**

15. Describe flow cytometry.
16. Elucidate Karyotype concept and its significance.
17. Describe genetic recombination in bacteria.
18. Give an account on tetrad analysis.
19. Write a note on Ac-Ds and Mu elements in maize.
20. Differentiate between Correlation and Regression.
21. Explain the various methods of collection of data.
22. Give an account on IPR.
23. Describe floral biology and its significance in plant breeding.
24. Write a note on Lamarkism.

(7 x 2 = 14 weightage)

**III Answer any 2 questions in 300 words:**

25. What is population genetics? Explain the factors affecting equilibrium.
26. Explain various methods of tabulation and presentation of data.
27. What is polyploidy breeding? Explain briefly on the methodology and achievements of polyploidy breeding.
28. Explain briefly the various theories of evolution.

(2 x 4 = 8 weightage)

## **BO02CT07. PLANT ECOLOGY, CONSERVATION BIOLOGY, PHYTOGEOGRAPHY AND FOREST BOTANY**

[2½+1½+1+1 = 6 hours per week]

### **PLANT ECOLOGY** [2½ hours per week]

1. **Habitat Ecology:** Salient features of terrestrial (Biomes), freshwater (Limnology), wetland, and marine habitats.
2. **Productivity and energy flow:** Concepts, limits and processes of primary production. Methods of productivity measurements. Global trends in primary productivity. Energy flow models.
3. **Population characteristics:** Density, natality, mortality, distribution, biotic potential, carrying capacity. Aggregation and dispersal. Ecotone and edge effect.
4. **The environment and its pollution:** Land, air and water pollution. Effect of pollution on living organisms. Control of pollution with emphasis on biological methods. Environmental hazards.
5. **Threats to the global environment:** Greenhouse effect, ozone depletion, El-Nino and La Nina effects.
6. **Environmental impact assessment (EIA)** and assessment of environmental hazards. Remote sensing.

### **Reference Books:**

1. Ahluvalia V.K. Malhotra S. 2009. Environmental Science. Ane Books – New Delhi.
2. Cunningham W. P. and M. A. Cunningham 2003. Principles of Environmental Science: Inquiry and Applications. Tata McGraw Hill Pub. N.D.
3. Khitoliya, R.K. 2007. Environmental Pollution – Management and Control for Sustainable development S. Chand and Company Ltd., New Delhi.
4. Krebs, C.J. 1985. Ecology 3<sup>rd</sup> ed. Harper & Row New York.
5. Michael, S. 1996. Ecology. Oxford University Press, London.
6. Mishra, D.D. 2008. Fundamental Concepts in Environmental studies. S. Chand & Co., New Delhi.
7. Mishra, S.P. & S.N. Pandey 2008. Essential Environmental Studies. Ane Books Pvt. Ltd. Thiruvananthapuram.
8. Odum E. P. (1991). Fundamentals of ecology. Saunders and Com.
9. Odum, E.P. 1983, Basics principles of Ecology. Saunders International UN Edition.
10. Sharma P. D. (1999). Ecology and Environment. Rastogy Pub.
11. Shukla, R.S. & Chandel. P.S. 2005. A Text Book of Plant Ecology S. Chand & Co. Ltd. New Delhi.
12. Trivedi R K. Practical methods in Ecology and Environmental sciences. Env. pub.
13. Varma P S, Agarwal V K. Principles of Ecology. S Chand and Co.

### **CONSERVATION BIOLOGY** [1½ hours per week]

1. **Problems of conservation:** Causes of threat to environment, human interference, deforestation, habitat destruction and overexploitation of resources.

2. **Identification of threatened plants:** Red List categories – extinct, endangered, vulnerable, rare and out of danger. Extinction process. Hot spots, keystone species and flagship species.
3. **Strategies for conservation:** *in situ* and *ex situ* conservation. Biosphere reserve, national parks, wildlife sanctuaries, gene banks, cryopreservation, seed banks.
4. **Afforestation:** social forestry and agroforestry. International Biological Programme (IBP), Man and Biosphere Programme (MAB), IUCN, World Environment Day, Wildlife (Protection) Act (1972), Indian Forest Conservation Act (1980) and United Nations Environment Programme (UNEP), Environment (Protection) Act (1986) and amendments.
5. **Environment awareness** – Role of Government and NGOs, Gaia hypothesis.
6. **Biodiversity:** Significance at local, national and global levels. Deep ecology. Paradigm shift from anthropocentric ecology to ecocentric ecology, Ecotourism impacts, National heritages

### Reference Books:

1. Bharucha E. 2005. Text Book of Environmental Studies for UG courses. University Press (India) Private Limited Hyderabad.
2. Sharma, P.D. 2009. Ecology and Environment. Rastogi Publication.
3. Wilson Edward O. (1993), Diversity of Life, Harvard University Press, Cambridge, MA
4. Klee G. A. (1991), Conservation of natural resources, Prentice Hall
5. Gurdip Singh (2005), Environmental Law in India, Macmillan India Ltd, New Delhi
6. Trivedi RK, Handbook of Environmental Laws, Rules Guidelines, Compliances and Standards (Vol I and II), Enviro Media.

### PHYTOGEOGRAPHY [1 hour per week]

1. Patterns of plant distribution – Continuous distribution, Circumpolar, Circumboreal, Circum austral, Pan tropical.
2. Discontinuous distribution: Theory of land bridges, Theory of continental drift, Theory of glaciation.
3. Endemic distribution (Neoendemic, Paleoendemic), Age and Area hypothesis.
4. Phytochoria of world and India.

### Reference Books:

1. Bharucha, F.R. A Textbook of Plant Geography of India. Oxford University Press.
2. Brown, J.H. and Linolino, M.V Biogeography, Sinauer Associates.
3. Hugget. R. J. Fundamentals of Biogeography, Routledge, London.
4. Ronald Good. The Geography of Flowering Plants, Longman Publishers
5. Puri, G.S. Indian Forest Ecology, Vol I & II, Oxford & IBH.

### FOREST BOTANY [1 hour per week]

1. **Forest:** Definitions. Study of various types of forests in India and the World.
2. **Forest Products:** Major and minor forest products with reference to Kerala
3. **Influence of forests on environment:** Consequences of deforestation and industrialization – Sustainable utilization of bioresources.

### Reference Books:

1. Agarwal, A. P. Forests in India, Oxford and IBH
2. Gregorv, G.R. Forest Products, Production, Trade, Consumption, quantity and value of raw material requirements, Ford foundation, New Delhi.
3. Puri, G. S. Indian Forest Ecology I and II, Oxford IBH, New Delhi
4. Champion G.H. and Seth S.K.A. A revised survey of the forest types of India.

**MODEL QUESTION PAPER - SEMESTER II M.Sc. BOTANY**

**BO 02 CT 07 – PLANT ECOLOGY & CONSERVATION BIOLOGY, PHYTOGEOGRAPHY  
AND FOREST BOTANY**

Time: 3 Hours

Max. Weightage: 36

**I Answer all questions briefly:**

1. Carrying capacity.
2. What is biotic potential?
3. Enumerate the methods of Primary productivity measurement.
4. Write a short note on Freshwater ecology.
5. What is Flagship species? Give an example.
6. El- Nino.
7. Kaziranga National Park.
8. Pantropical distribution.
9. Write a note on paper industry.
10. What is Seed bank?
11. IUCN.
12. What is Paradigm shift?
13. Minor forest products.
14. Evergreen forests.

**(14 x 1 = 14 weightage)**

**II Answer any 7 questions each in not more than 100 words:**

15. Indian Forest Act (1980).
16. Write a note on Cryopreservation.
17. Evaluate the causes and effects of water pollution.
18. Evaluate the threats to the global environment.
19. Give an account on EIA.
20. Enumerate the important population characteristics.
21. Write a note on influence of forests on environment.
22. Age and area hypothesis.
23. Bring out the consequences of Deforestation.
24. Explain Littoral and Swamp forests.

**(7 x 2 = 14 weightage)**

**III Answer any 2 questions in 300 words:**

25. Write an account on causes of threat to environment and problems of conservation.
26. Explain the role of Government and NGO's in creating environmental awareness.
27. Explain various patterns of plant distribution.
28. Give a detailed account on environment and its pollution.

(2 x 4 = 8 weightage)

**BO02CP08 PRACTICALS OF CELL BIOLOGY, MOLECULAR BIOLOGY, BIOPHYSICS, CYTOGENETICS, GENETICS, BIOSTATISTICS, PLANT BREEDING, PLANT ECOLOGY, CONSERVATION BIOLOGY, PHYTOGEOGRAPHY AND FOREST BOTANY**

$[\frac{1}{2}+\frac{1}{2}+\frac{1}{2}+\frac{1}{2}+1+1+\frac{1}{2}+\frac{1}{2}+\frac{1}{2}+\frac{1}{2}+\frac{1}{4}+\frac{1}{4}= 6 \text{ hours per week}]$

**CELL BIOLOGY** [ $\frac{1}{2}$  hour per week]

1. Study of mitosis in root tip cells.
2. Pre-treatment of root tips with Colchicine / Hydroxyquinone / Paradichlorobenzene and study of Chromosomes in Chlorophytum / Zea mays / Crotalaria / Cyanotis.
3. Isolation of plastids and mitochondria
4. Chromosome banding

**MOLECULAR BIOLOGY** [ $\frac{1}{2}$  hours per week]

1. Working out problems from molecular genetics.
2. Isolation of nucleic acid and identification of histones by SDS-PAGE
3. Isolation of plant DNA and its quantification by spectrophotometric / Colorimetric method.
4. Immunological techniques: ELISA and Western Blot.

**BIOPHYSICS** [ $\frac{1}{2}$  hour per week]

1. Preparation of buffers (acetate and phosphate) and measurement of pH using pH meter.
2. Determination of isoelectric pH.
3. Paper chromatography: Separation of sugars.
4. Thin Layer Chromatography: Separation of amino acid mixtures.
5. Colorimetric / Spectrophotometric estimation of proteins by Biuret / Lowry's method.
6. Estimation of amino acids by ninhydrin method (Colorimetric).

**CYTOGENETICS** [ $\frac{1}{2}$  hour per week]

1. Induction of polyploidy using colchicine; Different methods of the application of colchicine.
2. Effect of induced and spontaneous polyploidy on plant phenotype, meiosis, pollen and seed

- fertility and fruit set.
3. Preparation of karyotype and idiogram of plant meristematic cells.
  4. Cytological studies in callus tissues.
  5. Study of meiosis in translocation heterozygotes (*Rhoeo discolor*).
  6. Study of polytene chromosomes.

**GENETICS** [1 hour per week]

Problems from linkage, tetrad analysis, quantitative genetics and population genetics.

**BIOSTATISTICS** [1 hour per week]

Problems from Mean, Standard deviation, Coefficient of variation, Tests of significance, Correlation analysis and computer aided statistical analysis.

**PLANT BREEDING** [½ hour per week]

1. Study of floral morphology and flower structure in crop plants - Rice, Cashew, Pulses, *Solanum*, *Capsicum*.
2. Practice of hybridization technique in self- and cross-pollinated plants mentioned in (1).
3. Biometrical techniques in Plant Breeding – Analysis of variability.
4. Submission of certified report of visit to one Plant Breeding station in India.

**ENVIRONMENTAL BIOLOGY** [½ hour per week]

1. Determination of food chain and food web in aquatic systems
2. Determination of the minimum size of the quadrat suitable for an area using species area curve method.
3. Determination of the Importance Value Index (IVI) of plant species in a community by quadrat method.
4. Comparative study of polluted and non-polluted aquatic systems
5. Visit to a meteorological station, sewage treatment facility, national park, or wild life sanctuary and the report shall be submitted at the time of practical examinations.
6. Estimation of dissolved oxygen content in the water sample by Winkler's method
7. Determination of primary production in aquatic systems by dark and light bottle method
8. Determination of dissolved carbon dioxide content in water samples.
9. Determination of frequency of plant species of an area and heterogeneity of vegetation using transect method.

**PHYTOGEOGRAPHY** [¼ hours per week]

Identification of the various floristic and vegetational regions of the world and India in maps.

**FOREST BOTANY** [¼ hours per week]

Study of the major and minor forest products of Kerala and their uses.

**MODEL QUESTION PAPER**  
**SEMESTER II M.Sc. BOTANY PRACTICAL EXAMINATION**

**BO02P08 - CELL BIOLOGY, MOLECULAR BIOLOGY, BIOPHYSICS,  
CYTOGENETICS, GENETICS, BIostatISTICS, PLANT BREEDING,  
PLANT ECOLOGY, CONSERVATION BIOLOGY, PHYTOGEOGRAPHY  
AND FOREST BOTANY**

**TIME: 6 HOURS**

**TOTAL WEIGHTAGE: 36**

**PART A (9.30am – 12.30 pm)**

1. Make a smear of material **A**. Submit any one stage for valuation. Identify and draw diagram.  
(Preparation- 2; Identification and Diagram- 1) [3 Weightage]
2. Determine the pH of the solution **B** prepared by mixing ..... ml of ..... molar solution  
with ..... ml of ..... molar solution. You are supplied with 1molar solution of both.  
(Preparation- 2; Calculation- 1) [3 Weightage]
3. From the given data **C**
  - a) Construct Idiogram
  - b) Find out Centromeric index
  - c) Relative chromosome length
  - d) Designation of chromosomes[3 Weightage]
4. Work out the problem **D** [3 Weightage]
5. In the given map **E**, mark ..... & .....  
phytogeographic zones. [1 Weightage]
6. Write the botanical name, family and economic importance of **F** and **G**.  
[1 + 1 = 2 Weightage]

**PART B (1pm – 4pm)**

7. Estimate the Dissolved oxygen in the given water sample **H** [3 Weightage]
8. Demonstrate hybridization between **I** and **J** [2 Weightage]
9. Work out the problem **K**. [5 Weightage]
10. Work out the problem **L**. [3 Weightage]
11. Comment on the Ecological/ Environmental/ Conservational significance of **M** and **N**  
[1 + 1 = 2 Weightage]

**Record – 4 Weightage**  
**Submissions – 2 Weightage**

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**Total – 36 Weightage**

**SEMESTER III**

Course Code	Title	Teaching Hours / week	Duration of examination	Weightage		Credits	Page Nos:
				EE	ICE		
<b>BO03 CT09</b>	Plant Physiology, Metabolism and Biochemistry	2+2+2 =6	3 hrs	36	20	4	42-44
<b>BO03 CT10</b>	Angiosperm Morphology, Taxonomy and Plant Resources	1+4+1 = 6	3 hrs	36	20	4	46-48
<b>BO03 CT11</b>	Biotechnology and Bioinformatics	3+3 = 6	3 hrs	36	20	4	50-52
<b>BO03 CP12</b>	Practicals of Plant Physiology, Metabolism, Biochemistry, Angiosperm Morphology, Taxonomy, Plant Resources, Biotechnology and Bioinformatics	1+1+1+ ½+1+½ +½+½ =6	6 hrs	36	20	4	54-56

EE – External evaluation

ICE – Internal continuous evaluation

Model question papers:

BO01 CT09 – Page no: 45

BO01 CT10 – Page no: 49

BO01 CT11 – Page no: 53

BO01 CP12 – Page no: 57

## **BO03CT09 PLANT PHYSIOLOGY, METABOLISM AND BIOCHEMISTRY**

[2+2+2=6 hours]

### **PLANT PHYSIOLOGY** [2 hours per week]

1. **Water and plant cells:** Properties of water, hydrogen bonding, polarity, cohesion and adhesion. The concept of water potential. Water movement in cells and tissues. Soil – plant –atmosphere continuum. Transpiration, stomatal movement, modern theories of stomatal mechanism. The ascent of xylem water and the uptake of water by the roots. Absorption of mineral ions – absorption of solutes.
2. **Plants and nitrogen:** The nitrogen cycle, biological nitrogen fixation, symbiotic nitrogen fixation in leguminous plants. Biochemistry of nitrogen fixation. Export of fixed nitrogen from nodules. Genetics of nitrogen fixation. Nitrogen assimilation. Assimilation of nitrate. Nitrogen nutrition – agricultural and ecological aspects. Biosynthesis of amino acids - reductive amination and transamination. GDH and GS / GOGAT pathway.
3. **Photosynthesis:** Absorption and fate of light energy, Absorption spectra and action spectra. Photoreceptors – chlorophylls, carotenoids, phycobilins. Bioenergetics and the light dependent reactions of photosynthesis. Photosynthetic electron transport and photophosphorylation. The two pigment systems. Z scheme, Water oxidizing clock. The photosynthetic carbon reduction cycle, C<sub>3</sub>, C<sub>2</sub>, C<sub>4</sub> and CAM metabolism and ecological significance.
4. **Translocation and distribution of photoassimilates:** Phloem transport, Sources and sinks, Mechanism of translocation, Phloem loading and unloading, Distribution of assimilates, Translocation of xenobiotic chemicals.
5. **Patterns in plant development:** Growth, differentiation and development, Genetic control and hormonal regulation of development, Seed germination - Physiology of hormones in plant development – Auxins, Gibberellins, Cytokinins, Abscisic acid and Ethylene, Role of vitamins and nutrients in development.
6. **Photomorphogenesis:** Phytochrome – chemistry and physiological effects, Mechanism of phytochrome and gene action, Cryptochromes and blue light effect.
7. **Stress Physiology:** Types of stress – Water, temperature, salt, stresses caused by pests, pathogens and pollutants

### **Reference Books:**

1. Frank B. Salisbury and Cleon W. Ross 2002. Plant physiology 3<sup>rd</sup> edition CBS publishers and distributors.

2. Goodwin Y.W. and Mercer E.I. 2003. Introduction to Plant Biochemistry, 2<sup>nd</sup> edition. CBS Publishers and distributors.
3. Jain V. K. 1996. Fundamentals of Plant Physiology. S Chand and Company, Delhi.
4. Lincoln Taiz and Eduardo Zeiger 2012. Plant Physiology 5<sup>th</sup> edition, Sinauer Associates, Inc. Publishers Sunderland, Massachusetts.
5. Noggle G.R. and Fritz G. J. 1986. Introductory Plant Physiology Prentice Hall.
6. Salisbury F.B. and Ross C.W. 1985. Plant Physiology, CBS Publishers and Distributers, Delhi.
7. Srivastava H.S. 2005. Plant Physiology. Rastogi Publications, Meerut.
8. William G. Hopkins and Norman P. Huner, 2008. Introduction to Plant Physiology, 4<sup>th</sup> edition, Wiley Inc.

**METABOLISM** [2 hours per week]

1. **Enzymes:** General aspect – International classification, Michaelis-Menton equation and its significance, Mechanism of enzyme action, cofactors, co-enzymes, inhibition, regulation, allosteric enzymes, covalently modulated enzymes, Kinetics of enzyme catalysis. Isoenzymes.
2. **Intermediary metabolism:** Anabolism, Catabolism, amphibolic pathways and anapleurotic reactions. Link between primary metabolism and secondary metabolism. Bioenergetics and thermodynamics.
3. **Catabolism of hexoses:** Glycolysis – two phases, overall balance sheet, regulation; fate of pyruvate under aerobic and anaerobic conditions. Pentose phosphate pathway-multifunctional pathway (significance). Tricarboxylic acid cycle. Formation of acetate, reacton of citric acid cycle, anapleurotic reactions of citric acid cycle. Regulation of citric acid cycle. Glyoxylate cycle, Amphibolic nature of TCA cycle.
4. **Oxidation of fatty acids:** Activation and entry of fatty acids, Beta oxidation of saturated and unsaturated fatty acids. Regulation.
5. **Oxidation of amino acids** and entry to TCA cycle.
6. **Oxidative phosphorylation:** Electron transfer reactions in mitochondria. Electron carriers, Electron carriers function as multienzyme complexes, ATP synthesis. Regulation of oxidative phosphorylation. Shuttle systems- Alternate pathways - Thermogenesis.
7. **Carbohydrate biosynthesis:** Gluconeogenesis, biosynthesis of starch, glucose and other carbohydrates. Involvement of NDP sugars - Regulation.
8. **Lipid biosynthesis:** Biosynthesis of fatty acids, synthesis of Triacylglycerols, phospholipids and isoprenoids, Regulation.
9. **Biosynthesis of nucleotides:** PRPP and its significance. Purine and pyrimidine biosynthesis. Precursors and regulation. Conversion of NMP to NTP. Biosynthesis of deoxyribonucleotides.
10. **Secondary metabolism:** Main pathways and their relation to primary metabolism.

**Reference Books:**

1. Lehninger. Principles of Biochemistry, Mcmillan, U.K.
2. Geoffrey Zubay, Biochemistry, Mcmillan Publishing Company, New York.
3. Trevor Palmer, Enzymes – Biochemistry, Biotechnology and Clinical Chemistry, Norwood Publishing.

**BIOCHEMISTRY** [2 hours per week]

1. The molecular logic of life.
2. The chemical unity of diverse living organisms.
3. Weak interactions in aqueous systems and the fitness of aqueous environment for living organisms.
4. **Biomolecules:** a) Carbohydrates- Structure and function of simple sugars and compound carbohydrates. Sugar derivatives of biological importance. b) Lipids. Classification – storage and structural lipids; lipids in membrane; the supramolecular architecture of membranes. c) Amino acids, peptides and proteins. Amino acids: classification based on polarity; properties. Covalent structure of proteins. Three-dimensional structure of proteins. Protein- tertiary and quaternary structures. Denaturation and renaturation. Functions of proteins. d) Nucleotides and nucleic acids. Chemistry- structure of nucleotide- Other functions of nucleotides.
5. **Secondary metabolites:** Secondary metabolites, their physiological roles. Significance - ecological and phylogenetic importance.

**Reference Books:**

1. Lehninger. Principles of Biochemistry, Mcmillan, U.K.
2. Geoffrey Zubay, Biochemistry, Mcmillan Publishing Company, Newyork.
3. Sadasivam and Manickam, Biochemical methods, New Age International Publishers. New Delhi.
4. David T. Plummer. An Introduction to Practical Biochemistry. Tata McGraw Hill.
5. Voet, D. and Voet J.G. 2010. *Biochemistry*. John Wiley & Sons. Inc.

**MODEL QUESTION PAPER - SEMESTER III M.Sc. BOTANY**  
**BO 03 CT 09 – PLANT PHYSIOLOGY, METABOLISM AND BIOCHEMISTRY**

Time: 3 Hours

Max. Weightage: 36

**I Answer all the 14 questions very briefly:**

1. Describe root pressure theory.
2. What is an action spectrum?
3. List out the functions of nucleotides.
4. Explain hydrogen bonding in water.
5. Write the constituents of cane sugar.
6. Give a broad outline of classification of lipids.
7. Differentiate denaturation and renaturation of protein.
8. What is meant by saponification of lipids?
9. Differentiate between saturated and unsaturated fatty acids.
10. What is gluconeogenesis?
11. List out the differences between nucleotide and nucleoside.
12. Give an outline of classification of carbohydrates.
13. What are amino acids? Which group of amino acids takes part in the formation of peptide bonds?
14. Explain the properties of Zwitter ion. **(14 x 1 = 14 weightage)**

**II Answer any 7 questions each in not more than 100 words:**

15. Write the schematic representation of cyclic and non-cyclic photophosphorylation.
16. Describe briefly the stress physiology in plants caused by water and salt.
17. Discuss the water relations of a plant cell.
18. Explain transamination of amino acids.
19. Classify lipids based on structural and storage.
20. Describe the biosynthesis of pyrimidines.
21. What are the mechanisms by which mineral ions are absorbed by roots?
22. Enumerate the functions of carbohydrates.
23. Describe the primary and secondary structure of proteins.
24. Elucidate the structure of nucleotides. **(7 x 2 = 14 weightage)**

**III Answer any 2 questions in 300 words:**

25. Discuss the three-dimensional structure of protein. Add a note on its biological importance.
26. Explain the different types of stresses in plants.
27. Describe the mechanism of translocation in plants.
28. What are lipids? How are they biosynthesized? Discuss mechanism of their biosynthesis. **(2 x 4 = 8 weightage)**

## **BO03CT10 ANGIOSPERM MORPHOLOGY, TAXONOMY AND PLANT RESOURCES**

[1+4+1 = 6 hours per week]

### **ANGIOSPERM MORPHOLOGY** [1 hour per week]

1. A critical study of the current ideas on the origin of Angiosperms with special reference to their ancestral stock, time and place or origin.
2. The concept of primitive angiosperm flower. Origin and evolution of flower, co-evolution of flowers and their pollinators.
3. Origin and evolution of structure and morphology of stamens, nectaries and nectar.
4. Origin and evolution of carpels, different types - concept of foliar origin of carpels, types of ovary; evolution of placental types, inferior ovary, foliar and axial concepts.
5. Role of floral anatomy in interpreting the origin and evolution of flower and floral parts.

#### **Reference Books:**

1. Eames, E. J. Morphology of Angiosperms, McGraw Hill Book Co. New York
2. Bamard, C. 1961. The interpretation of Angiosperm flower. Aust. J. Sci. 24: 64-72.
3. Manilal K.S. Vascularization of corolla in Compositae. J. Indian Bot. Soc., 59: 189-196.
4. Meeuse, A.D.J. 1974. Some Fundamental Principles of Interpretive floral Morphology, International Science Publishers.
5. Melville, R. 1960. New theory of Angiosperm flower. Nature, 188: 14-18.
6. Puri, V. 1952. Inferior ovary. Phytomorphology, 2: 122.
7. Sporne, K.R. 1974. The Morphology of Angiosperms, Hutchinson's University Press.

### **TAXONOMY** [4 hours per week]

1. **Principles of Taxonomy:** Scope and importance of Taxonomy. Systems of classification. – Artificial, natural and phylogenetic systems, Phenetic versus phylogenetic systems, Cladistics in taxonomy.
2. **Conceptual basis of classification:** Essentialism, nominalism, empiricism, phenetics and cladistics, phylogenetic and alternative.
3. **Taxonomic hierarchy:** Concept of taxa – species, genus and family – interpecific categories.
4. **Definition and terms:** Primitive and advanced; homology and analogy; parallelism and convergence; monophyly and polyphyly.
5. **Plant nomenclature:** History of nomenclature, polynomial and binomial systems; detailed study of salient features and major provisions of the International Code of Botanical Nomenclature, Effective and valid publications, Rank of taxa, Rule of priority and its limitations, Typification, Author citation, Rejection of names and names of hybrids, A brief account of International code of Nomenclature of Cultivated Plants.

6. **Concepts of character:** Definition, classification of characters – analytic and synthetic; qualitative and quantitative; unit and multiple; good and bad, Correlation of characters, Character weighting.
7. **Modern trends in Taxonomy:** Cytotaxonomy, chemotaxonomy, biosystematics and numerical taxonomy, Molecular taxonomy, DNA bar-coding in plants.
8. **History and development of Taxonomy in India.** Classification of taxonomic literature – general indices, floras, icons, monographs, reviews and journals; Herbarium – Definition, steps involved in the development of herbarium, utility of herbarium and its maintenance, General account of regional and national herbaria with special reference to Central National Herbarium, Calcutta (CAL) and Madras Herbarium (MH).
9. **Botanical Survey of India:** Organization and functions.
10. **Botanical Gardens:** Types of Gardens and importance of gardens in taxonomic studies, Important National and International Botanical Gardens. – Royal Botanical Garden, Kew; Indian Botanical Garden, Calcutta; National Botanical Garden, Lucknow and Jawaharlal Nehru Tropical Botanic Garden & Research Institute, Trivandrum.

**Reference Books:**

1. Cronquist, A. An integrated system of classification of flowering plants. New York.
2. Cronquist, A. Evolution and Classification of Flowering Plants, Thomas and Nelson Co.
3. Graf, A.B. Tropica, Roehers Publ. NJ, USA.
4. Harbone, J.B. and Turner B.L. Plant Chemosystematics. A.P. London.
5. Haywood, W.H. & Moore, D.M. Current concepts in Plant Taxonomy.
6. Lawrence, G.H.M. Taxonomy of Vascular Plants, Oxford and IBH.
7. Rendle, A.E. Classification of flowering plants.
8. Simpson, M.G. Plant Systematics, Elsevier.
9. Sivarajan V.V. Introduction to Principles of Plant Taxonomy, Oxford IBH.
10. Smith P.M. The Chemotaxonomy of plants. Edward Arnold, London.
11. Spone K.R. The Morphology of Angiosperms. Hutchinson University Press, London.
12. Stace, C.A. Plant Taxonomy and Biosystematics, Edward Arnold, London.
13. Stebbins, G. L. Flowering Plants, - Evolution above Species Level, Edward Arnold.
14. Takhtajan, A.L. Diversity and Classification of Flowering Plants, Columbia University Press.
15. Woodland, D.W. Contemporary Plant Systematics. Prentice Hall, New Jersey.

**PLANT RESOURCES [1 hour per week]**

1. A study of history, occurrence and morphology of useful part and overall chemical composition of the following.
  - a. Cereals and Millets: Rice, Wheat, Maize, Sorghum, Finger millet, Pearl millet
  - b. Pulses: Bengal gram, Cluster bean, Common bean, Horse gram, Cow pea
  - c. Sugar yielding plants: Sugar cane, Beet root
  - d. Starch yielding tubers: Potato, Tapioca, Arrow root, Taro

- e. Fats and oils: Ground nut, Coconut, Castor, Gingelly, Mustard, Oil palm.
  - f. Beverages: Tea, Coffee, Cocoa
  - g. Spice and condiments: Pepper, Ginger, Turmeric, Coriander, Cumin, Fennel, Fenugreek, Cardamom, Nutmeg, Cloves, Cinnamon.
  - h. Fiber yielding plants: Cotton, Jute, Coir
  - i. Rubber yielding plants: Para rubber
  - j. Timber yielding plants: Teak, Rose wood, *Artocarpus*, *Ailanthus*, *Xylia*
2. A study of the following medicinal plants with reference to the chemical and pharmacognostic properties: *Azadirachta indica*, *Curcuma longa*, *Adhathoda vasica*, *Rauwolfia serpentina*, *Catharanthus roseus*, *Bacopa monnieri*, *Strychnos nux-vomica*, *Acorus calamus*, *Saraca asoka*, *Linonia acidissima*, *Terminalia chebula*, *Terminalia bellerica*, *Glyarrhiza glabra*,

**Reference Books:**

1. Arora R.K. & Nayar, E.K. Wild relatives of crop plants in India. NBPGR Sci. Monograph No. 7.
2. Bole, P.V. & Vaghani, Y. Field guide to common Indian trees. Oxford Uni. Press.
3. Chandel, K.P.S., Shukla, G and Sharma, N. Biodiversity in medicinal and aromatic plants in India. – Conservation and utilization in India. NBPGR, New Delhi
4. Chripeels, M.J. and Sadava, D. Plants, Food and People. W. Freeman and Co. San Francisco.
5. Cotton, C.M. Ethnobotany- Principles and Applications. Wiley and Sons.
6. Jain. S.K. A Manual of Ethnobotany. Scientific Publishers, Jodhpur.
7. Jain. S.K. Glimpses of Indian Economic Botany. Oxford
8. Kochar, S.L. Economic Botany of the Tropics. McMillan India.
9. Pandora R.S. and Arora R.K. Plant Genetic Resources and Management. IPGRI Publication, South Asia office, NBPGR, Pusa Campus, New Delhi.
10. Sahni, K.C. The book of Indian Trees. Oxford Uni. Press, Mumbai.
11. Sambamurthy AVSS and Subramanyan N S 2000 Economic Botany of Crop Plants Asiotech publishers.
12. Sharma O.P. Hill's Economic Botany. Tata Mc Graw Hill Co. New Delhi.
13. Swaminathan, M.S. & Kochar, S.L. (eds.). Plants and Society. Macmillan Pulication, London.
14. Thakur, R.S., Puri, H.S. & Husain, A. Major medicinal plants of India. Central Institute of Medicinal and Aromatic Plants. CSIR, Lucknow.

**MODEL QUESTION PAPER - SEMESTER III M.Sc. BOTANY**

**BO 03 CT 10 – ANGIOSPERM MORPHOLOGY, TAXONOMY AND PLANT RESOURCES**

Time: 3 Hours

Max. Weightage: 36

**I Answer all the 14 questions very briefly:**

1. Briefly explain the theories regarding origin of perianth.
2. Gonophyll.
3. What are nectaries?
4. Define parallelism.
5. Distinguish homology from analogy.
6. Floras.
7. Differentiate paratype from lectotype.
8. CALI.
9. 1<sup>st</sup> May 1753.
10. What is ICNCP?
11. Pharmacognostic properties of *Bacopa*
12. Jute.
13. Indian Myrobalans.
14. Fennel.

(14 x 1 = 14 weightage)

**II Answer any 7 questions each in not more than 100 words:**

15. Write the binomial, family and morphology of useful parts of starch yielding plants.
16. Enumerate the economic importance of fibre-yielding plants.
17. Elucidate the chemical and pharmacognostic properties of *Rauwolfia* and wood apple.
18. Explain the Caytonialean theory of primitive flowers.
19. Petals are modified stamens. Justify.
20. Give a detailed account on effective and valid publication.
21. Explain the concept of typification and its significance.
22. Elucidate the classification of taxonomic literature.
23. Explain the scope and principles of taxonomy.
24. Evaluate botanical gardens and their importance in taxonomic studies.

(7 x 2 = 14 weightage)

**III Answer any 2 questions in 300 words:**

25. Give an account on co-evolution of flowers vis-à-vis pollinators.
26. Elucidate the utility, maintenance and significance of herbarium.
27. Give a detailed account on plant nomenclature.
28. Evaluate the economic importance of cereals and millets.

(2 x 4 = 8 weightage)

## BO03CT11. BIOTECHNOLOGY AND BIOINFORMATICS

[3+3 = 6 hours per week]

### BIOTECHNOLOGY [3 hours per week]

#### A. PLANT TISSUE CULTURE

1. **Basic concepts and** history
2. **General account of** laboratory facilities and management
3. **Media** for *in vitro* culture, composition and their preparation.
4. **Callus culture**, Selection of explants and medium, Types of callus – Growth profile of callus.
5. **Cell culture**: Isolation of single cells – Mechanical and Enzymatic methods, Measurement of growth of cells in suspension culture, Viability tests.
6. Large scale cultivation of cells using bioreactors for secondary metabolite production.
7. **Organogenesis**: direct and indirect, Factors affecting organogenesis.
8. **Organ culture**: Apical or axillary meristems, embryo, ovary, ovule, endosperm, anther, pollen and root cultures.
9. **Applications of plant tissue culture**: Clonal propagation, Somaclones, somatic hybrids, synthetic seeds, secondary metabolites, germplasm conservation - cryopreservation.

### GENETIC ENGINEERING

1. **Molecular analysis of gene and gene products**: Southern, Northern and Western blots – restriction maps - RAPD and RFLP, Chromosome walking and jumping, PCR and its applications, DNA finger printing. DNA chips.
2. **DNA sequencing**: Enzymatic method, Gilbert and Maxam method, Messing's shot gun method, Fluorescent detection and automation, The Human genome Project.
3. **Recombinant DNA Technology**: Enzymes, vectors, gene – cloning strategies, construction and screening of genes and *c* DNA Libraries, Expression of cloned genes in bacteria and mammalian cells, Prospects and achievements.
4. **Transgenic plants**: Gene Cloning strategies in plants, Vector dependent and vector independent methods, Identification and selection of transformed plants, the reporter enzyme technology, Objectives and achievements – Engineering for secondary metabolites, Resistance against herbicides, pests, pathogens and stress, Improved nutritional and status changes in plants, Plants as bioreactors; Phytopolymers and biodegradable plastics; Antisense RNA technology; Transgene inactivation, Terminator and traitor technologies.
5. **Cloning**: Objectives, Creation of transgenic animals - other developments in cloning, Human cloning, Ethics of cloning.
6. Patenting of Genes and GMOs, Gene piracy, Ethics and biosafety aspects, recDNA safety, IPR, Biosafety protocols.

**Reference Books:**

1. Bernard R. Glick and Jack J. Pasternack. Molecular Biotechnology – Principles and Applications of Recombinant DNA. ASM press, Washington.
2. Brown, T.A. Gene Cloning and DNA Analysis, Blackwell Science Pub.
3. Channarayappa. 2006. *Molecular Biotechnology- Principles and Practices*. Universities Press India Pvt. Ltd.
4. Das, H.K. 2004. *Textbook of Biotechnology*. Wiley Dreamtech India Pvt. Ltd.
5. Dubey R.C. 2006. A Text Book of Biotechnology. S.Chand and Company, New Delhi.
6. Gupta P.K. 2006. Biotechnology and Genomics. Rastogi Publications, Meerut.
7. Howe, C. 2007. *Gene Cloning and Manipulation*. Cambridge University Press.
8. Kalyan De Kumar 2006. Plant Tissue Culture. New Central Book Agency, Calcutta.
9. Narayana Swami S. 2005. Plant Cell & Tissue culture. Mc Graw Hill Company, New York.
10. Primrose, S.B. Molecular Biotechnology, Panima Publishing Corporation.
11. Purohit. S. S. 2004. A Laboratory Manual of Plant Biotechnology. Agro bios India.
12. Robert de la Pemere and Franck Seuret. Brave New Seeds: The threat of GM crops to farmers. Global Issues Series.
13. Smith, J.E. 2009. 5<sup>th</sup> edn. *Biotechnology*. Cambridge University Press.
14. Sobti R.C and Suparna S. Panchauri 2009. Essentials of Biotechnology, Ane Pvt. Ltd., New Delhi.
15. Timir Baran Jha and Biswajith Ghosh 2007. Plant Tissue Culture, University Press, New Delhi.

**BIOINFORMATICS [3 hours per week]**

**A. COMPUTER APPLICATIONS**

1. Computer in Science with special reference to Biology, the scope and prospects.
2. Information super highway (Internet) – Information networks: Internet, World Wide Web, Web browsers, HTTP, HTML, and URLs, Biological networks.
3. **Online Publications with special reference to Biology:** Electronic journals, books downloading and uploading, Open Archive Initiative ([www.openarchives.org](http://www.openarchives.org)), Biomedcentral, Pubmedcentral, Freedom of scientific information access, e-access debate – concepts and implications, Free Software Movement, Free Software Foundation, GNU/Linux, Online archives, databases, the Public Library of Science ([www.publiclibraryofscience.org](http://www.publiclibraryofscience.org)).

**Reference Books:**

1. Bosu, O. and Thukral, S.K. (2007). Bioinformatics: Databases tools and algorithms. Oxford University press.
2. Curran, B.G., Walker, R.J., Bhatia, S.C. 2010. *Bioinformatics*. CBS Publishers and Distributors Pvt. Ltd.
3. Ghosh, Z. and Mallik, B. (2008). Bioinformatics: principles and applications. Oxford University press.

4. Higgs, P.G. and Attwood, T.K. (2005). Bioinformatics and molecular evolution. Blackwell publishing.
5. Mount, D.W. (2001). Bioinformatics: Sequence and genome analysis. CBS publishers & distributors.
6. Norton P. Introduction to Computer, McGraw Hill
7. Rajaraman V. Fundamentals of Computers, PHI
8. [www.publiclibraryofscience.org](http://www.publiclibraryofscience.org)
9. [www.openarchive.org](http://www.openarchive.org)
10. [www.pubmedcentral.gov](http://www.pubmedcentral.gov)
11. [www.biomedcentral.com](http://www.biomedcentral.com)
12. [www.nature.com/nature/debates/e-ccess/index.html](http://www.nature.com/nature/debates/e-ccess/index.html)

## B. BIOINFORMATICS

1. **Introduction:** Importance and scope.

2. **Biological Databases**

- a. Nucleic acid databases: EMBL, GenBank – Structure of GenBank entries, Specialized genomic resources, UniGene.
- b. Protein sequence databases: PIR, SWISSPROT, TrEMBL.  
Composite protein databases: NRDB, OWL.  
Secondary Databases: PROSITE, PRINTS, BLOCKS, IDENTIFY  
Structure classification databases: SCOP, CATH

3. **Database searching:**

- a. Sequence database searching - EST searches, Different approaches to EST analysis, Merck/IMAGE, Incyte, TIGR, EST analytical tools, Sequence similarity, Sequence assembly and Sequence clustering.
- b. Pair wise alignment technique: comparison of sequences and sub-sequences, Identity and similarity, Substitution matrices, BLOSUM, DOTPLOT and BLAST.
- c. Multiple alignment technique: Objective, Manual, Simultaneous and progressive methods, Databases of multiple alignments, PSI-BLAST, CLUSTAL-W.

4. **Protein structure prediction:**

- a. Secondary structure prediction: Chou-Fasman, J Pred.
- b. Tertiary structure prediction: Comparative modeling - Modeller, Rasmol.

5. **Emerging areas of Bioinformatics:** DNA Microarrays, Functional genomics, Comparative genomics, Pharmacogenomics, Chemoinformatics, Medical Informatics.

### Reference Books:

1. Attwood, T.K and Arry-Smith, D.J. Introduction to Bioinformatics, Pearson Education.
2. Ignacimuthu. 2010. Basic Bioinformatics. Narosa Publishers, New Delhi.
3. Sundararajan, S. and Balaji, R. Introduction to Bioinformatics, Himalaya Publishing House.

**MODEL QUESTION PAPER - III SEMESTER M.Sc. BOTANY**  
**BO 03 CT 11 – BIOTECHNOLOGY AND BIOINFORMATICS**

Time: 3 Hours

Max. Weightage: 36

**I Answer all the 14 questions very briefly:**

1. SWISS - PROT
2. BLAST
3. World Wide Web.
4. Expand DOTPLOT and HTML.
5. What are GMO'S? Cite examples?
6. What is terminator technology?
7. Cybrid
8. DNA Chips.
9. IPR.
10. Structure of a bioreactor.
11. Write a note on Human genome project.
12. Explain briefly chromosome walking and jumping.
13. FISH.
14. Organogenesis.

(14 x 1 = 14 weightage)

**II Answer any 7 questions each in not more than 100 words:**

15. Give an account on nutrient medium.
16. Write a short note on Transgenic plants with examples?
17. What are synthetic seeds?
18. Explain somaclones and their applications.
19. Give a detailed account on reporter enzyme technology.
20. Write a short note on endosperm culture.
21. Explain about sequence and structure data base.
22. Write a short note on electronic journals.
23. Explain Composite protein database.
24. Write a short note on reporter enzyme technology.

(7 x 2 = 14 weightage)

**III Answer any 2 questions in 300 words:**

25. Discuss the applications of plant tissue culture.
26. Write an essay on meristem culture and its applications.
27. Describe the role of bioinformatics in developing biological data base.
28. Write a detailed account on recombinant DNA technology.

(2 x 4 = 8 weightage)

**BO03CP12. PRACTICALS OF PLANT PHYSIOLOGY,  
METABOLISM, BIOCHEMISTRY, ANGIOSPERM  
MORPHOLOGY, TAXONOMY, PLANT RESOURCES,  
BIOTECHNOLOGY AND BIOINFORMATICS**

[1+1+1+½+1+½+½+½=6 hours per week]

**PLANT PHYSIOLOGY** [1 hour per week]

1. Determination of water potential by tissue weight change method.
2. Extraction of leaf pigments and preparation of absorption spectra of chlorophylls and carotenoids.
3. Demonstration of Hill Reaction.
4. Separation of leaf pigments by paper chromatography and column chromatography.
5. Effects of light intensity on photosynthesis using Wilmot's bubbler.
6. Determination of sugars and amino acids in germinating seeds by TLC.
7. Extraction of seed proteins based on solubility.
8. Biochemical analysis of leakages from seeds during germination.
9. Analysis of proline in water stressed plants.
10. Testing of seed viability by NBT test.
11. Changes in reserve proteins during germination.

**METABOLISM** [1 hour per week]

1. Extraction of enzyme: Any enzyme.
2. Effect of substrate on enzyme and determination of its Km value.
3. pH dependent activity profile of enzymes.
4. Ammonium sulphate precipitation of enzymes.
5. Desalting of proteins by gel filtration using Sephadex G25/ dialysis.
6. Separation of isoenzymes by native PAGE.
7. Determination of enzyme / protein sub units by SDS PAGE.
8. Metabolism of germinating seeds – Changes in metabolisable carbohydrates.

**BIOCHEMISTRY** [1 hour per week]

1. Qualitative test for monosaccharides, reducing and non-reducing oligosaccharides, starch and proteins.
2. Quantitative estimation of reducing sugar and starch.
3. Qualitative test for lipids, emulsification, saponification, acrolein test, Boundouin's test.
4. Quantitative estimation of amino acids.
5. Quantitative estimation of proteins by Biuret / Bradford's / Lowry et al method.
6. Quantitative estimation of DNA / RNA (Colorimetric / Spectrophotometric).
7. Quantitative estimation of total phenolics.

**ANGIOSPERM MORPHOLOGY** [½ hour per week]

1. Preparation of cleared whole mounts of floral parts to show vasculature.
2. Examination of the following with the help of dissections and hand sections. Transmitting tissues/canals in style and stigma. Different types of ovaries. Different types of placentations. Vasculature in the androecium and gynoecium of special types of flowers.

**TAXONOMY** [1 hour per week]

1. Familiarization with local flora and construction of keys - Use of floras in identification up to species.
2. Study of diagnostic features of the families studied in the theory paper with special reference to their economic aspects. Study of the following families with special reference to morphology of modified parts, economic importance, interrelationships and evolutionary trends:

- |                    |                      |                    |
|--------------------|----------------------|--------------------|
| 1) Magnoliaceae    | 12) Melastomaceae    | 23) Nyctaginaceae  |
| 2) Ranunculaceae   | 13) Rhizophoraceae   | 24) Euphorbiaceae  |
| 3) Menispermaceae  | 14) Aizoaceae        | 25) Urticaceae     |
| 4) Nymphaeaceae    | 15) Rubiaceae        | 26) Casuarinaceae  |
| 5) Polygalaceae    | 16) Sapotaceae       | 27) Orchidaceae    |
| 6) Caryophyllaceae | 17) Gentianaceae     | 28) Zingiberaceae  |
| 7) Clusiaceae      | 18) Boraginaceae     | 29) Amaryllidaceae |
| 8) Sterculiaceae   | 19) Convolvulaceae   | 30) Commelinaceae  |
| 9) Meliaceae       | 20) Scrophulariaceae | 31) Araceae        |
| 10) Sapindaceae    | 21) Pedaliaceae      | 32) Cyperaceae     |
| 11) Rosaceae       | 22) Verbenaceae      | 33) Poaceae        |

3. Dissection of at least two members of each family, making suitable sketches, and describing them in technical terms and identifying them by constructing floral diagram and floral formula.
4. Field study of five days under the guidance and supervision of teachers at an ecologically different locality and submission of a field study report certified by the teacher concerned. The report should contain ecology of flora of the area studied. Each student shall collect plant specimens following the standard means of plant collection for preparation of herbarium. Each student shall submit a minimum of 50 such herbarium specimens along with the field book for the practical examination.
5. Problems in bar coding.

**PLANT RESOURCES** [½ hour per week]

Morphological study of the source of plants mentioned in the theory syllabus and identification of the plants and plant products - common name, botanical name, family, morphology of the useful part and the uses.

**BIOTECHNOLOGY** [½ hour per week]

**A. Tissue culture**

1. Preparation and sterilization of culture media.
2. Culturing of Carrot / Tobacco / Datura.
3. Estimation of cell growth in callus culture by fresh weight and dry weight.
4. Induction of multiple shoots using axillary and apical meristems as explants.
5. Plantlet regeneration from callus.
6. Identification of secondary metabolites in culture.

**B. Genetic Engineering**

1. Isolation of DNA.

**BIOINFORMATICS** [½ hour per week]

**A. Computer Application**

1. Acquiring basic computer operation and internet browsing skills in Windows and Linux platforms.
2. Acquiring basic word processing /data entry using popular (both commercial and open source) packages such as MS-Word, K-Word, Open word, PageMaker.
3. Acquiring graphic processing skills using popular packages such as Photoshop, Coral Draw, Chem Draw.
4. Preparation of scientific presentations using packages such as MS-PowerPoint.
5. Uses of statistical packages such as SPSS, Biostat, Origin, MS-Excel.

**B. Bioinformatics**

1. Acquisition of basic skill in Internet browsing.
2. Use of web browsers and search engines.
3. Use of biological and bioinformatics websites Agris, Agricola, BIOSI S, CABWeb.
4. Visit to Bioinformatics websites: NCBI, SWISS PROT, PIR, PDB

**MODEL QUESTION PAPER**  
**SEMESTER III M.Sc. BOTANY PRACTICAL EXAMINATION**  
**BO03 CP12 – PLANT PHYSIOLOGY, METABOLISM, BIOCHEMISTRY,**  
**ANGIOSPERM MORPHOLOGY, TAXONOMY, PLANT RESOURCE**  
**UTILIZATION, BIOTECHNOLOGY, COMPUTER APPLICATION AND**  
**BIOINFORMATICS**

**Time: 6 hrs**

**Part A (9.30am -1.30pm)**

**Max Weightage: 36**

- 1a. Separate the chloroplast pigments in the given extract **A** by unidirectional chromatography. Calculate Rf values of the pigments separated. Outline the procedure and leave the chromatogram for evaluation.  
(Preparation- 1; Procedure- 1; Calculation of Rf value- 1) [3 Weightage]
- 2a. Estimate the amount of protein present in the given sample **B** using colorimeter / spectrophotometer. You are supplied with a standard solution of protein of .....g/L  
(Procedure- 2; Calculation- 1; Result- 1) [4 Weightage]

**OR**

- 1b. Determine the percentage of seed viability of **A** by NBT / TTC method  
(Preparation- 1; Procedure- 1; Tabulation and Calculation- 1) [3 Weightage]
- 2b. Determine the pH optimum of the enzyme **B**  
(Procedure- 2; Graph- 1; Result- 1) [4 Weightage]
3. Derive the specimen **C** up to species using “The Flora of Presidency of Madras”.  
(Derivation up to family- 2; Genus- 1; species with author citation- 1) [4 Weightage]
4. Derive the specimen **D** up to family using technical terms  
(Derivation up to family- 1; Description using technical terms- 1) [2 Weightage]
5. Construct the floral diagram, floral formula and draw a labelled diagram of the V.S. of the specimen **E**. (V.S.- 1; Floral Diagram- ½ ; Floral formula- ½ ) [2 Weightage]
6. Demonstrate the inoculation of material **F** into the given culture medium for callus culture. Write down the procedure adopted.  
(Procedure- 1; Demonstration- 1) [2 Weightage]
7. Comment on **G** and **H**. [½ + ½ = 1 Weightage]

**PART B (2PM – 4 PM)**

8. Construct a taxon card and dichotomous key using the specimens **I, J, K, L** and **M**.  
(Taxon card- 2; Indented key- 1) [3 Weightage]
9. Give the binomial and family of the source plant **N** and **O**  
(Binomial- ½; Family- ½) [1 x 2 = 2 Weightage]
10. Determine the water potential of the given material **P** by tissue weight change method.  
(Preparation- 2; Procedure- 1; Graph & Calculation- 1) [4 Weightage]
11. Give the binomial and family of the herbarium specimens **Q** and **R**.  
(Binomial-1; Family- 1) [1 + 1 = 2 Weightage]
12. Prepare a line/ bar/ pie diagram or a PPT slide using the given data provided **S**.  
(Preparation- 1) [1 Weightage]

Record: 4 Weightage

Submissions- Herbarium, Field book, tour report: 2 Weightage

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Total: 36 Weightage

*SEMESTER IV*

Course Code	Title	Teaching Hours / week	Duration of examination	Weightage		Credits	Page Nos:
				EE	ICE		
<b>BO04 ET13</b>	Elective 1 – Environmental Biology and Biodiversity Conservation	6	3 hrs	36	20	4	59-60
<b>BO04 ET14</b>	Elective 2 – Genetic Engineering	6	3 hrs	36	20	4	62
<b>BO04 EP15</b>	Elective 3 – Plant Tissue Culture	6	6 hrs	36	20	4	64
<b>BO04 EP16</b>	Practicals of Electives	6	6 hrs	36	20	4	64
<b>BO04 DN17</b>	Dissertation	-	-	36	20	4	-
<b>BO04 VV18</b>	Viva voce	-	-	-	-	4	-

EE – External evaluation

ICE – Internal continuous evaluation

Model question papers:

BO01 CT13 – Page no: 61

BO01 CT14 – Page no: 63

BO01 CT15 – Page no: 65

BO01 CP16 – Page no: 66

## **BO04ET13 ELECTIVE-1. ENVIRONMENTAL BIOLOGY AND BIODIVERSITY CONSERVATION**

[6 hours per week]

1. **Population ecology:** Properties (concept of rate, intrinsic rate of natural increase, carrying capacity, population fluctuations and cyclic oscillations), density independent and density dependent mechanisms of population regulation, Pattern of dispersion, Allee' principle of aggregation and refuging, home range and territoriality, energy partitioning and optimization,  $r$  and  $k$  selection.
2. **Community ecology:** Types of interactions between two species, coevolution, evolution of cooperation, group selection, interspecific competition and coexistence, positive and negative interactions, concepts of habitat, ecological niche and guild.
3. **Human population:** Expansion and its causes, rich and poor nations, consequences, dynamics, Cairo Conference 1994.
4. **Major global environmental challenges:** Acid rain, Ozone depletion, deforestation, land degradation and desertification, freshwater degradation and shortage, marine fisheries decline, loss of biological diversity and excess nitrogen.
5. **Global initiatives:** Stockholm Conference (1972), Rio (1992), Ramsar Convention (1971), Kyoto (1997), Johannesburg (2002), Stockholm (2011).
6. **Environmental law** - International and National, The Environment Protection Act & Rules 1986; Water (Prevention & Control of Pollution) Act (1974); Biodiversity Act (2002).
7. **Thoughts on ecology:** Contributions of Mahatma Gandhi, Rachel Carson, Gro Harlem Brundtland and Vandana Siva.
8. **Biodiversity:** a) Genetic diversity, agro-biodiversity and cultivated taxa, causes of decline, value of wild species, conservation practices-Traditional (Upavana vinoda, Sacred groves, Sthalavrikshay) and modern (*in situ* and *ex situ*)  
b). Biodiversity information management and communication - Libraries, databases taxonomic database working groups for plant species, data bases on biodiversity; Distribution of biodiversity information, metadata bases, virtual libraries.
9. **Ecosystem capital - use and restoration:** Global perspective on biological systems; conservation, preservation and restoration, Biomes and ecosystems under pressure (forest biomes, ocean ecosystems).
10. **Habitat studies:** Wetlands (Ramsar sites), Mangroves and forest types of Kerala.
11. **Brief study of the following:** Environment Impact analysis (EIA), ecological foot print, sustainable development, conservation ethics, Peoples movements for biodiversity conservation – Chipko, Narmada Bachavo Andholan and Silent Valley movements, role of NGOs and educational institutions in biodiversity conservation, trade related IPR, ecotourism, Carbon sequestration and GIS in forestry.

12. **Climate change and its impacts on biodiversity** - Climatic disruption (brief study).
13. **Disaster management** - Basic aspects.

**Reference Books:**

1. Agrawal, K.C. 2000. *Biodiversity*, Agrobios (India), Jodhpur.
2. Asthana, D.K. and Asthana, M. 2001. *Environment: Problems and solutions*. 2<sup>nd</sup> edition. S. Chand and Company Ltd. New Delhi.
3. Champion H.G. and Seth S.K. A Revised Classification of Forest Types of India. Govt. of India, New Delhi.
4. Elangovan, K. 2006. GIS: Fundamentals, Applications and Implementations. New India Publishing Agency, New Delhi.
5. Gadgil Madhav. *Ecological Journeys*. Permanent Black, Delhi.
6. Jaiswal P.C. *Soil, Plant and Water Analysis*. Kalyani Publishers, Ludhiana.
7. Krishnamurthy K.V. *An Advanced Text Book on Biodiversity Principles and Practice*. Oxford IBH.
8. Michael H. Stephenson, *Returning Carbon to Nature; coal, carbon capture and storage*. Elsevier Publications.
9. Misra R. *Ecology work book*, Oxford, IBH.
10. Nick Hanley, Cleive L Spash. *Cost – Benefit analysis and the Environment*, Edward Elgar Publications.
11. Odum E.P. and Barrett G. W. *Fundamentals of Ecology*. Thomson Books, Bangalore.
12. Palmer J.A. *Fifty Thinkers on the Environment*. Routledge, London.
13. Peter Raven, George B. Johnson, Kennath A. Mason, Jonathan B. Loses, Susan S. Singer 2013. *Biology*, 10<sup>th</sup> Edition. Boston: Mc.Graw-Hill Higher Education.
14. Puri G.S. *Indian Forest Ecology*. Oxford IBH.
15. Pushpangadan P. and Nair K.S.S. *Biodiversity and Tropical Forests- The Kerala Scenario*. STEC, Thiruvananthapuram.
16. Sarngdharacharyar. (Translated by Vishnu B.). *Vruksha Ayurvedam Janapriya* Pusthakasala, Kottayam.
17. Speth Gustave James and Haas M. Peter. *Global Environmental Governance*. Pearson Longman, New Delhi.
18. Trivedi, R.K., Goel, P.K. and Trisal, C.L. 1998. *Practical methods in Ecology and Environmental Science*. Enviromedia Publications, Karad (India).
19. Vijayalakshmi K. and Shyam Sundar K.M. *Vrkshayurveda- An Introduction Indian Plan Science*. Lok Swasthya Parampara Samardhan Samithi, Madras.
20. Wright T. Richard. *Environmental Science - Towards a Sustainable Future*. Prentice Hall Learning Pvt. Ltd., New Delhi.

**MODEL QUESTION PAPER - SEMESTER IV M.Sc. BOTANY**

**BO04ET13 ELECTIVE-1.**

**ENVIRONMENTAL BIOLOGY AND BIODIVERSITY CONSERVATION**

Time: 3 Hours

Max. Weightage: 36

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**I Answer all questions briefly:**

1. What is Mutualism?
2. Evaluate the Significance of Sthala Vrikshas.
3. Home range.
4. Evaluate the trade related IPR.
5. Explain Allee principle of aggregation and refuging.
6. What is territoriality?
7. What are Kyoto protocol (1997) resolutions?
8. List out the causes of marine fisheries decline.
9. Mangroves.
10. Explain impact of Acid rain.
11. Elucidate ecological foot print.
12. Explain patterns of Dispersions.
13. Evaluate conservation ethics.
14. Explain ecotourism.

(14 x 1 = 14 weightage)

**II Answer any 7 questions each in not more than 100 words:**

15. Write a note on concepts of Habitats.
16. Explain the properties of population ecology.
17. Write a note on Disaster management.
18. Gaia hypothesis.
19. Give an account on contributions of Rachel Carson.
20. Ramsar Convention (1971).
21. Give an account on Forest types of Kerala.
22. Evaluate the role of NGO's in Biodiversity conservation.
23. Cairo Conference (1994).
24. Write a note on ecological succession.

(7 x 2 = 14 weightage)

**III Answer any 2 questions in 300 words:**

25. Give an account on major global environmental challenges.
26. Elucidate National and International environmental protection laws.
27. Write an essay on community ecology.

28. Write in detail about Biodiversity.

(2x4=8 weightage)

## **BO04ET14. ELECTIVE - 2**

### **GENETIC ENGINEERING**

[6 hours per week]

1. **Structure of genes in Prokaryotes and eukaryotes:** Genetic code and codons, Gene expression.
2. **Recombinant DNA technology:** Tools of *r* DNA technology, Methods of creating *r* DNA molecules, restriction mapping, isolation and separation of genetic material, southern, northern, western, south western and north western blotting techniques.
3. **Gene transfer techniques in plants:** Agrobacterium mediated transfer, gene gun method, electroporation, microinjection, chemical methods.
4. **Molecular markers:** RAMPO, SSCP, RFLP, RAPD, AFLP, EST markers, Repetitive DNA, Microsatellite and Mini satellite.
5. **DNA sequencing:** Chemical and enzymatic methods, importance of DNA sequencing.
6. **Gel electrophoresis:** Techniques for visualization and reading sequences.
7. **Polymerase Chain Reaction:** History, methodology of PCR. Variations from basic PCR- reverse transcriptase PCR, nested PCR, inverse PCR- applications of PCR.
8. **DNA profiling:** History, methodology of genetic finger printing-applications.
9. **Genetic engineering for crop improvement:** transgenic plants.
10. Cloning of genes and production of vaccines, drugs, growth hormones and chemicals.
11. **Gene therapy:** Types of gene therapy. Getting transgenes in to patients-viral and non viral approaches. Success of gene therapy.
12. Abatement of pollution through genetically engineered microorganisms-an emerging approach towards environmental clean-up programmes.
13. Nanotechnology and its applications in genetic engineering.

#### **Reference Books:**

1. Avise, John C. The hope, Hype and Reality of Genetic Engineering
2. Brown, T.A. Gene cloning and DNA analysis. Blackell Science Pub.
3. Chrispeels, M.J. and Sadava D.E. Plants, Genes and Agriculture.
4. Dubey, R.C. A text book of Biotechnology. Chand Pub.
5. Hant, D.L. and Jones, E. Genetics: Analysis of genes and genome. Jones and Bartlett Publishers.
6. Khhadpekar, N.R. The age of Nanotechnology. ICFAI University Press, Hyderabad.
7. Lewin, B. Genes. Oxford University Press.
8. Mason, A.C. Principles of gene manipulation and genomics.
9. Mitra, S. 1996. *Genetic Engineering – Principles and Practice*. Macmillan India Ltd.
10. Nalwa, H.R. Encyclopedia of Nanoscience and Technology.
11. Narayana, L.M. Molecular biology and Genetic Engineering.
12. Nicholl Desmond, S.T. An introduction to Genetic engineering. Cambridge Pub.
13. Rastogi, S. and Pathak N. 2009. *Genetic Engineering*. Oxford University Press.

14. Rissler J. and Mellon M. The ecological risks of engineered crops. MIT Press, Cambridge.
15. Walker and Rapley. Molecular biology and Biotechnology. Panima pub.

**MODEL QUESTION PAPER - SEMESTER IV M.Sc. BOTANY**  
**BO04ET14 ELECTIVE - 2. GENETIC ENGINEERING**

Time: 3 Hours

Max. Weightage: 36

**I Answer ALL questions briefly:**

1. RAMPO.
2. What are the applications of Western blotting?
3. What is real- time PCR?
4. What is gene targeting?
5. Explain biolistic method of gene delivery.
6. List out the properties of Genetic code.
7. What is Sonication?
8. What is 'microsatellite'?
9. What is DNA vaccine?
10. Golden rice.
11. What are interrupted genes?
12. Superbug.
13. What is the role of Magnesium in PCR reaction?
14. What is Annealing temperature?

**(14 x 1 = 14 Weightage)**

**II Answer any SEVEN questions each in not more than 100 words:**

15. What is DNA sequencing? Give a brief account on Sanger's method of DNA sequencing.
16. Differentiate between chromosome walking and chromosome jumping.
17. Explain the non- viral approaches in gene therapy.
18. How is DNA visualized in gel electrophoresis?
19. How Flavr-Savr tomato was produced?
20. What is Shuttle vector? How does it differ from other vectors?
21. What is 'vir' gene? Give an account on different types of vir genes.
22. Explain the production of Insulin through gene cloning.
23. Explain genetic fingerprinting with a note on its application.
24. Describe how a transformed plant is identified and selected?

**(7 x 2 = 14 Weightage)**

**III Answer any TWO questions in 300 words:**

25. What are the applications of nanotechnology in genetic engineering? Explain.

26. Explain various blotting techniques employed in rDNA technology.
27. What is the role of GMOs in environmental cleanup programmes. Give suitable examples.
28. What is bioremediation? Explain the types of bioremediation.

(2 x 4 = 8 Weightage)

**ADDED THIRD ELECTIVE IN IV<sup>TH</sup> SEMESTER**

**BO04ET15. ELECTIVE3**

**PLANT TISSUE CULTURE**

[6 hours per week]

1. Tissue culture- plant tissue culture- techniques and significances of embryo, endosperm and haploid plant culture. Techniques and significances of cell and protoplast culture.
2. Tissue culture as a biotechnological tool- clonal propagation, somatic embryogenesis, synseed production and exploitation of somaclonal variations.
3. Culture media- liquid, semisolid, raft- MS, WPM, White's, Nitsch & Nitsch, SH- a comparative study. Media for special purposes- modifications, additives- antioxidants, organic supplements, adsorbants.
4. Hormones- role of hormones in phytomorphogenesis *in vitro* and *in vivo*- mode of action of hormones-synergistic action.
5. Commercial clonal propagation- requirements, management- production planning- man power-contamination- endophytes as contaminants in tissue cultures- in process quality control.
6. Hardening of TC plants- primary and secondary- green house- poly house- shade house- pots. Media for hardening- management of TC plants.
7. Bioreactor technology for plant micropropagation- photoautotrophic micropropagation.
8. Secondary metabolite production- objectives and achievements.
9. Commercial tissue culture production of trees: Eucalyptus, Teak, Bamboo; crops: Banana, Potato, Papaya; flower crops: Orchids, Anthurium, Gingers.
10. Virus indexing of tissue cultured plants- ELISA, PCR based indexing- methodology and importance.
11. Value addition in TC plants- inoculation of VAM and other endophytes.
12. Certification of TC plants.
13. Farmer's acceptance of TC plants- lab to land awareness.
14. Costing- cost benefit analysis- cost reduction measures and low cost alternatives.
15. Marketing of TC plants.
16. Major tissue culture ventures in India and abroad- success stories.

## Reference Books:

1. Bajaj Y.P.S. (Ed.). High Tech Micropropagation. Springer.
2. Biotech Consortium India Ltd. Summary Report on Market Survey on Tissue Cultured Plants.
3. DBT, Govt. of India. National Certification System for Tissue Culture Raised Plants.
4. Dutta G.S. and Ibaraki Y. (Ed.). Plant Tissue Culture Engineering. Springer.
5. George E.F., Hall M.A. and Klerk Geert –Jan De. Plant Propagation by Tissue Culture. Springer.
6. George E.F. and Sherrington P.D. Plant Propagation by Tissue Culture. Exegetics Limited.
7. IAEA. Low-cost Options for Tissue Culture Technology in Developing Countries.
8. Jain S.M. and Ishii K. (Ed.). Micropropagation of Woody Trees and Fruits. Kluwer Academic Publishers.
9. Greisen Kay S. Commercial Propagation of Orchids in Tissue Culture: Seed- Flasking Methods.
10. Dirr, Michael A. and Heuser Jr., Charles W. The Reference Manual of Woody Plant Propagation- From Seed to Tissue Culture.
11. Neumann K.H., Kumar A. and Imani J. Plant Cell and Tissue Culture- A Tool in Biotechnology: Basics and Application. Springer.
12. Razdan M.K. Plant Tissue Culture. Science Publishers Inc., U.S.A.
13. Trigiano, Robert N. and Gray Dennis J. (Eds.) Plant Tissue Culture, Development and Biotechnology. CRC Press.
14. Ziv M., 2000. Bioreactor technology for plant micropropagation. Horticultural Reviews 24: 1-30.

## MODEL QUESTION PAPER - SEMESTER IV M.Sc. BOTANY

### BO04ET15 ELECTIVE-3.

### PLANT TISSUE CULTURE

Time: 3 Hours

Max. Weightage: 36

#### **I Answer all questions briefly:**

1. What is explant?
2. List organic supplements and adsorbants used in tissue culture.
3. Name any two hormones used for phytomorphogenesis.
4. How VAM inoculation is beneficial in tissue culture.
5. What are advantages of poly house.
6. What are additives- antioxidants?
7. ELISA
8. What is embryo culture.

9. Write any two uses of anther culture.
10. What is synseed?
11. How can we make farmers confident in tissue culture plants?
12. Differentiate primary hardening from secondary hardening.
13. Define Clonal propagation
14. Comment on Production planning in Tissue culture.

(14 x 1 = 14weightage)

**II Answer any 7 questions each in not more than 100 words:**

15. Write note on techniques and significance of cell and protoplast culture.
16. Explain Bioreactor technology and secondary metabolite production?
17. What is virus indexing? What is its importance?
18. What is a green house? What are its advantages?
19. How do somaclonal variations advantageous in tissue culture?
20. Explain the significance of somatic embryogenesis in agriculture.
21. Differentiate between somatic embryos and zygotic embryos.
22. Comment on commercial tissue culturing of trees, fruit crop and flower crop.
23. Explain the major sources of contamination in tissue culture lab. Suggest remedial measures.
24. What is Androgenesis? Discuss the role of androgenesis in tissue culture.

(7 x 2 = 14 weightage)

**III Answer any 2 questions in 300 words:**

25. Explain the methods of production of haploid plants and list out its applications.
26. What is plant tissue culture, Explain techniques and significance of plant tissue culture?
27. Write an essay on methods, advantages and applications of cell immobilization.
28. Give a comparative study on media used in plant tissue culture.

(2 x 4 = 8 weightage)

## BO04EP16 PRACTICALS OF ELECTIVES

[6 hours per week]

### ENVIRONMENTAL BIOLOGY AND BIODIVERSITY CONSERVATION

1. **Studies on the following and submission of reports:** Waste water treatment plant, local environmental peculiarities (such as hillocks and forest patches), wetland ecosystem, alien invasive plants, degraded ecosystem, different forest types, effluent treatment system).
2. **Physical and chemical analysis of soil and water:**
  - a) Particle size analysis of soil

- b) Estimation of particle density using relative density or volumetric flask
  - c) Air capacity analysis of soil by field method
  - d) Soil pH analysis of soil using pH meter
  - e) Water analysis for pH using pH meter
  - f) Estimation of BOD by Winkler's method (dark and light bottles).
3. **Study of community structure:** Charting and mapping of vegetation, Raunkiaer's life forms, biological spectrum, and profile diagram (Soil).
  4. Study of ecological succession: Different types of ecological successions.

### **GENETIC ENGINEERING**

1. Working out problems in Genetic Engineering.
2. Isolation of plant DNA and its quantification by Spectrophotometer.
3. Isolation of plasmid DNA from *E. coli*.
4. Gel electrophoresis - Gel preparation. Casting, elution and staining.
5. Visualization of DNA by agarose gel electrophoresis and gel reading.
6. Construction of coding sequence of DNA using amino acid sequence.

### **PLANT TISSUE CULTURE**

1. Media preparation- culture initiation- clonal multiplication- rooting- hardening and filed transfer in the case of one plant species.
2. Callus induction and organogenesis in the case of one plant species.
3. Synseed production in the case of one plant species.
4. Suspension culture and its microscopic examination for morphological features and viability in the case of one plant species.
5. Preparation of commercial TC planting material production plan for a crop species.
6. Visit to a TC lab and submission of a report.
7. Preparation of a project report for a commercial TC unit.

**BO04EP15: PRACTICALS OF ELECTIVES**

**ENVIRONMENTAL BIOLOGY AND BIODIVERSITY CONSERVATION,  
GENETIC ENGINEERING AND PLANT TISSUE CULTURE**

**TIME: 6 HOURS**

**TOTAL WEIGHTAGE: 36**

**PART A (9. 30am –1. 30 pm)**

1. Find out the Important Value Index (IVI) of species **A & B** from the given data. Comment on their ecological significance by drawing a polygraph. (IVI Calculation-4, Polygraph construction and comments-2) **(6 Weightage)**
2. Estimate the Carbon present in the soil sample **C** (Procedure-2, Calculation-2, Result-1)

**OR**

Compare the dissolved oxygen content of the Water samples **D** and **E** and comment on the quality of Water (Calculation of dissolved oxygen-4, Comment-1)

**(5 Weightage)**

3. Prepare .....ml MS Medium **F** with following composition using stock solution applied. Show the pH value of the prepared Medium before and after adjusting the final pH. (Procedure-2, Tabulation-2, Preparation-2, Final volume and pH-2)

**OR**

Subculture the given culture **G** provided by clump multiplication method. (Procedure-2, Aseptic Procedure-2, Inoculation Procedure-2, Labelling and Sealing-2)

**(8 Weightage)**

4. Comment on **H, I, J** **(3 Weightage)**

**PART B (2pm – 4pm)**

5. Isolate DNA from the given plant material **K**  
(Demonstration- 3; Procedure- 1) **(4 Weightage)**
6. Solve the problem **L** related with derivation of restriction map  
(Derivation- 1; Map- 1) **(2 Weightage)**
7. Demonstrate the encapsulation technique using specimen **M**. Write down the procedure and submit the seed for valuation.  
(Procedure- 1, Demonstration- 3)

**OR**

Demonstrate the process of Gel casting **N** using Gel mould and comb.  
(Demonstration- 1.5; Procedure- 0.5)

**(2 Weightage)**



**Record – 4 Weightage**

**Submissions & Tour report – 2 Weightage**

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**Total – 36 Weightage**