GONDWANA UNIVERSITY
GADCHIROLI

SYLLABUS

BOTANY

M. Sc. Part-I and II
(Semester with credit based Pattern)
(w.e.f. session 2012-13)
**APPENDIX – 1**

Scheme of teaching under credit based semester system for M. Sc. Program in BOTANY.

**M.Sc. I**

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Semester</th>
<th>Course code / Paper</th>
<th>Course / paper</th>
<th>Title of course/ paper</th>
<th>Teaching Scheme</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Theory (Hrs.)</td>
</tr>
<tr>
<td>1</td>
<td>One</td>
<td>BOT T I</td>
<td>I</td>
<td>Microbiology Algae &amp; Fungi</td>
<td>5</td>
</tr>
<tr>
<td>2</td>
<td>One</td>
<td>BOT T II</td>
<td>II</td>
<td>Bryophytes &amp; Pteridophytes</td>
<td>5</td>
</tr>
<tr>
<td>3</td>
<td>One</td>
<td>BOT T III</td>
<td>III</td>
<td>Gymnosperms and Paleobotany</td>
<td>5</td>
</tr>
<tr>
<td>4</td>
<td>One</td>
<td>BOT T IV</td>
<td>IV</td>
<td>Cytology &amp; Genetics</td>
<td>5</td>
</tr>
<tr>
<td>5</td>
<td>One</td>
<td>PRACT. I</td>
<td></td>
<td>Algae, Fungi, Bryophytes</td>
<td>--</td>
</tr>
<tr>
<td>6</td>
<td>One</td>
<td>PRACT. II</td>
<td></td>
<td>Pterido, Gymno-Paleo, Cytology, Genetics</td>
<td>--</td>
</tr>
<tr>
<td>8</td>
<td>One</td>
<td></td>
<td></td>
<td>Seminar –I</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Two</td>
<td>BOT T V</td>
<td>I</td>
<td>Plant Physiology and Biochemistry</td>
<td>5</td>
</tr>
<tr>
<td>10</td>
<td>Two</td>
<td>BOT T VI</td>
<td>II</td>
<td>Plant Development and Reproduction</td>
<td>5</td>
</tr>
<tr>
<td>11</td>
<td>Two</td>
<td>BOT T VII</td>
<td>III</td>
<td>Cell &amp; Molecular Biology- I</td>
<td>5</td>
</tr>
<tr>
<td>12</td>
<td>Two</td>
<td>BOT T VIII</td>
<td>IV</td>
<td>Angiosperms - I</td>
<td>5</td>
</tr>
<tr>
<td>13</td>
<td>Two</td>
<td>PRACT. III</td>
<td></td>
<td>Plant Physiology, Biochemistry, and Growth &amp; Dev.</td>
<td>--</td>
</tr>
<tr>
<td>14</td>
<td>Two</td>
<td>PRACT. IV</td>
<td></td>
<td>Cell &amp; Mol. Bio. I and Angio- I</td>
<td>--</td>
</tr>
<tr>
<td></td>
<td>Two</td>
<td></td>
<td></td>
<td>Seminar –II</td>
<td></td>
</tr>
</tbody>
</table>
Scheme of teaching under credit based semester system for M. Sc. Program in BOTANY.

**M.Sc. II**

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Semester</th>
<th>Course code / Paper</th>
<th>Course / paper</th>
<th>Title of course/paper</th>
<th>Teaching Scheme</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Theory (Hrs.)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Practical (Hrs.)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>No. of Credits</td>
</tr>
<tr>
<td>15</td>
<td>Three</td>
<td>BOT T IX</td>
<td>I</td>
<td>Plant Ecology</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>16</td>
<td>Three</td>
<td>BOT T X</td>
<td>II</td>
<td>Cell and Molecular Biology - II</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>17</td>
<td>Three</td>
<td>BOT T XI</td>
<td>III</td>
<td>Plant Biotechnology</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>18</td>
<td>Three</td>
<td>BOT T XII</td>
<td>IV</td>
<td>Angiosperms - II</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>20</td>
<td>Three</td>
<td>BOT P V</td>
<td>PRACT. V</td>
<td>Ecology, Cell &amp; Mol. Biology-II</td>
<td>--</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-</td>
</tr>
<tr>
<td>21</td>
<td>Three</td>
<td>BOT P VI</td>
<td>PRACT. VI</td>
<td>Plant biotechnology &amp; Taxonomy - II</td>
<td>--</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Three</td>
<td></td>
<td></td>
<td>Seminar - III</td>
<td>1</td>
</tr>
<tr>
<td>22</td>
<td>Four</td>
<td>BOT T XIII</td>
<td>I</td>
<td>Plant Conservation, IPR &amp; Ethnobotany</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>23</td>
<td>Four</td>
<td>BOT T XIV</td>
<td>II</td>
<td>PRU, Biosafety, Bioethics, Biostat. &amp; Pl. Breed.</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>24</td>
<td>Four</td>
<td>BOT T XV</td>
<td>III</td>
<td>Special paper-I</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>25</td>
<td>Four</td>
<td>BOT T XVI</td>
<td>IV</td>
<td>Special paper-II</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>27</td>
<td>Four</td>
<td>BOT P VII</td>
<td>PRACT. VII</td>
<td>Special I &amp; II</td>
<td>--</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>--</td>
</tr>
<tr>
<td>28</td>
<td>Four</td>
<td>BOT P VIII</td>
<td>Project</td>
<td></td>
<td>--</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Seminar IV</td>
<td>1</td>
</tr>
</tbody>
</table>
1. In each semester student will have to give seminar on any topic relevant to the syllabus encompassing the recent trends and development in that field. The topic of the seminar will be decided at the beginning of each semester in consultation with supervising teachers. The students have to deliver the seminar on the hour duration which will be followed by discussion. The seminar will be open to all the teachers of the department invitees and students.

2. The students will have to carry out the research based project work in lieu of practical in the fourth semester in the department or depending on the availability of placement; he/she will be attached to any of the national/ regional/ private research institute/ organization for the duration of the fourth semester. The student will be randomly allotted the priority number for the selection of the supervisor at the end of the third semester. The student in consultation with supervisor will finalize the topic of the project work at the third semester.

3. The regular full time teacher of the department/ contributory teacher approved by university/ scientist of government/ private research laboratory appointed by university as a contributory teacher and having M.Phil. or Ph. D. degree can supervise the project work of the student.
## SEMESTER I
### PRACTICAL I

<table>
<thead>
<tr>
<th>Question</th>
<th>Description</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q. 1</td>
<td>To identify the given Cyanobacterial material A.</td>
<td>8</td>
</tr>
<tr>
<td>Q. 2</td>
<td>To identify two algal forms B, C, from the given mixture.</td>
<td>12</td>
</tr>
<tr>
<td>Q. 3</td>
<td>To identify the given fungal culture D</td>
<td>8</td>
</tr>
<tr>
<td>Q. 4</td>
<td>To identify the given pathogen in the given material E.</td>
<td>10</td>
</tr>
<tr>
<td>Q. 5</td>
<td>To prepare a double stained micropreparation of the given Bryophytic F material and identify it.</td>
<td>10</td>
</tr>
<tr>
<td>Q. 6</td>
<td>Comment on the given spot G (Cyanobacteria/Bacteria), H (Algae), I (Fungi), J (Bryophyte)</td>
<td>12</td>
</tr>
<tr>
<td>Q. 7</td>
<td>Viva-voce</td>
<td>10</td>
</tr>
<tr>
<td>Q. 8</td>
<td>Practical Record and tour report</td>
<td>10</td>
</tr>
</tbody>
</table>

### SEMESTER I
### PRACTICAL II

<table>
<thead>
<tr>
<th>Question</th>
<th>Description</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q. 1</td>
<td>To prepare a double stained micropreparation of the given Pteridophytic A material and identify it.</td>
<td>10</td>
</tr>
<tr>
<td>Q. 2</td>
<td>Write a monograph on the given gymnospermic material B</td>
<td>13</td>
</tr>
<tr>
<td>Q. 3</td>
<td>Comment on the given fossil specimen C</td>
<td>10</td>
</tr>
<tr>
<td>Q. 4</td>
<td>One experiment from Cytology and Genetics D</td>
<td>15</td>
</tr>
<tr>
<td>Q. 5</td>
<td>Comment on the given spot E (Pteridophyte), F (Gymnosperm), G (fossils), H (Ecology)</td>
<td>12</td>
</tr>
<tr>
<td>Q. 6</td>
<td>Viva-voce</td>
<td>10</td>
</tr>
<tr>
<td>Q. 7</td>
<td>Practical Record and tour report</td>
<td>10</td>
</tr>
</tbody>
</table>
SEMESTER II

PRACTICAL III

Time : 6 Hours

Full marks : 80

Q. 1 To perform the given physiological experiment A and report The findings 15
Q. 2 To quantify the given metabolite in the given sample B 7
Q. 3 To study the cytohistological zonation in SAM of given material C 10
Q. 4 To perform the given exercise based on plant development D 10
Q. 5 Write a note on given stage of micro- or megasporogenesis E 6
Q. 6 Spotting: F (Physiology), G (Plant development), H (Reproduction) 12
Q. 7 Viva-voce 10
Q. 8 Practical Record 10

SEMESTER II

PRACTICAL IV

Time : 6 Hours

Full marks : 80

Q. 1 One experiment from paper VII A 14
Q. 2 One experiment from paper VII B 10
Q. 3 One experiment from paper VIII C 14
Q. 4 One experiment from paper VIII D 10
Q. 5 Spotting: E (Paper VII), F (Paper VII), G (Paper VII), H (Paper VII) 12
Q. 6 Viva-voce 10
Q. 7 Practical Record and field diary 10
### SEMESTER III

#### PRACTICAL V

<table>
<thead>
<tr>
<th>Q.</th>
<th>Question</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>To perform the given Ecological exercise</td>
<td>14</td>
</tr>
<tr>
<td>2</td>
<td>Soil analysis/Ecological adaptation</td>
<td>10</td>
</tr>
<tr>
<td>3</td>
<td>One experiment from paper X</td>
<td>14</td>
</tr>
<tr>
<td>4</td>
<td>One experiment from paper X</td>
<td>10</td>
</tr>
<tr>
<td>5</td>
<td>Spotting: E (Paper IX), F (Paper IX), G (Paper X), H (Paper X)</td>
<td>12</td>
</tr>
<tr>
<td>6</td>
<td>Viva-voce</td>
<td>10</td>
</tr>
<tr>
<td>7</td>
<td>Practical Record</td>
<td>10</td>
</tr>
</tbody>
</table>

#### SEMESTER III

#### PRACTICAL VI

<table>
<thead>
<tr>
<th>Q.</th>
<th>Question</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>One experiment from paper XI A</td>
<td>13</td>
</tr>
<tr>
<td>2</td>
<td>One experiment from paper XI B</td>
<td>10</td>
</tr>
<tr>
<td>3</td>
<td>To describe the given plant in technical language with floral formula</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>and floral diagram</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>To prepare the generic/family key</td>
<td>10</td>
</tr>
<tr>
<td>5</td>
<td>To identify the species of the given plant using the standard flora</td>
<td>5</td>
</tr>
<tr>
<td>6</td>
<td>Spotting: E (Plant biotechnology), F (Plant biotechnology), G (Angiosperms)</td>
<td>09</td>
</tr>
<tr>
<td>7</td>
<td>Viva-voce</td>
<td>10</td>
</tr>
<tr>
<td>8</td>
<td>Practical Record and tour report</td>
<td>10</td>
</tr>
<tr>
<td>Q.</td>
<td>Question</td>
<td>Marks</td>
</tr>
<tr>
<td>----</td>
<td>--------------------------------------------------------------------------</td>
<td>-------</td>
</tr>
<tr>
<td>1</td>
<td>One experiment from paper XIII A</td>
<td>10</td>
</tr>
<tr>
<td>2</td>
<td>One experiment from paper XIV B</td>
<td>10</td>
</tr>
<tr>
<td>3</td>
<td>One experiment from paper XV C</td>
<td>10</td>
</tr>
<tr>
<td>4</td>
<td>One experiment from paper XVI D</td>
<td>10</td>
</tr>
<tr>
<td>5</td>
<td>Spotting: E (paper XIII), F (paper XIV), G (paper XV), H (paper XVI)</td>
<td>12</td>
</tr>
<tr>
<td>6</td>
<td>Viva-voce</td>
<td>14</td>
</tr>
<tr>
<td>7</td>
<td>Practical Record</td>
<td>14</td>
</tr>
</tbody>
</table>
M. Sc. Botany Syllabus
Semester I
Course code/name: PAPER –I: Microbiology, Algae and Fungi

MODULE-I:
General Microbiology :
Bacteria – Structure, morphology, reproduction.
Viruses – General account; Morphology and ultrastructure of TMV, Bacteriophage;
Introduction to viroids, prions and interferon.
Archaebacteria and eubacteria: General account; ultrastructure, nutrition and reproduction, biology and economic importance; Cyanobacteria: Microcystis, Lyngbya, Nostoc, Scytomena, Gloeotrichia and Stigonema.

MODULE-II
Phycology:
Criteria for classification of algae: Chlorophyta, Charophyta, Xanthophyta, Bacillariophyta, Pheophyta and Rhodophyta; pigments, reserved food, flagella
Algae in diversified habitats (terrestrial, freshwater, marine ), thallus organization; cell ultrastructure; reproduction (vegetative, asexual, sexual ); algal blooms, algal biofertilizers; algae as a food, feed and uses in industry.

MODULE-III
General account: Classification of Fungi (recent trends and criteria used in classification);
Physiology of Fungi (with reference to biotrophs, hemibiotrophs, symbionts); Fungal Cytology : Heterothallism, heterokaryosis, parasexual cycle.
Comparative study, classification and evolutionary trends in the following: Myxomycota: Protist characters and general account with special reference to Physarium and Plasmodiophora
Eumycota: i. Oomycetes : Saprolegnia, Synchytrium, Phytophthora, Peronospora, ii. Zygomycetes : Mucor, Rhizopus, Syncephalastrum, Cunninghamella

MODULE- IV:
Plant Pathology : Symptomology, histopathology, etiology and identification of diseases with reference to following fungal, bacterial and viral diseases (Paddy blast, wheat rust, bunt of wheat, smut of jowar, black arm of cotton, red rot of sugarcane, citrus canker, gummosis, leaf curl of papaya, potato blight.)
PRACTICAL
Classification and type study of the following classes

Prochlorophyta : Prochloron
Phaeophyta : Spacelaria, Padina, Turbinaria.
Rhodophyta : Nemalion, Gelidium, Gracilaria, Corallina, Polysiphonia.
Euglenophyta : Euglena, Phacus.
Bacillariophyta : Cyclotella, Synedra, Cymbella, Navicula, Gomphonema.

Morphological Studies of Fungi (any 15 of the following)
Stemonities, Perenospora, Phytophora, Albugo, Mucor, Rhizopus, Yeast, Aspergillus, Penicillium, Chaetomium, Taphrina, Peziza, Erisyphe, Phyllactenia, Ucinula, Melamosora, Uromyces, Drechslera, Ravenalia, Ustilago, Polyporus, Morchella, Cyathus, Alternaria, Helminthosporium, Curvularia, Colletotrichum, Phoma, Plasmodiophora, Cercospora, Fusarium, Claviceps.

Symptomology of some diseased plants (any 7 of the following).
White rust of Crucifers, Downy mildew, powdery mildew, Rusts, Smuts, Ergot, Groundnut leaf spot (Tikka disease), False smut of paddy, red rot of Sugarcane, Wilt disease, Citrus canker, Angular leaf spot of cotton, Potato blight, Leaf mosaic of bhindi/papaya, Leaf curl of tomato/Potato/Papaya, Little leaf of brinjal.

Identification of Fungal cultures (Any 5)
Rhizopus, Mucor, Aspergillus, Penicillum, Drechslera, Curvularia, Phoma, Colletotrichum, Alternaria, Helminthosporium.

Field study: For collection and studying fungal flora

Suggested Readings:
26. On line Journals available on UGC -VSAT
Module I:
General characters, distribution, classification, ecology of Bryophytes, Bryophytes as ecological indicators, morphogenesis in bryophytes, fossil history of bryophytes, cytology of bryophytes, regeneration in bryophytes, modern trends in taxonomy.

Module II:
General account in-
Hepaticopsida: Sphaerocarpels, Takakiales
Anthocerotopsida: Anthocerotales,
Bryopsida: Sphagnales, Polytrichales..

Module III:
General characters, distribution, classification, evolution of stele, heterospory and seed habit, apospory and apogamy; Important contributions of Indian Pteridologists, General account of Ryniopsida, Psilopsida, Lycopsida [protlepidodendrales, Lycopodiales, Selaginales, Isoetales].

Module IV:
General account of Sphenopsida [Hyeniales, Equisetales], Filicopsida [Ophioglossales, Filicales, Selvinales, Marsileales], Tracheophyta [Progymnospermida].

BRYOPHYTES:
Practicals:-
Study of morphological and reproductive characters of representative members mentioned in the syllabus using cleared whole mount preparations, dissections and sections. Preparation of permanent slides is necessary. Study of bryophytes in their natural habitats. Botanical excursion outside the state is compulsory to study the bryophytes in their natural conditions.

PTERIDOPHYTES:
Practicals: Pteridophytes-
Study of fossil forms (specimens and permanent micropreparations). Study of living forms: Morphological, anatomical and reproductive characters of the forms mentioned in the syllabus. Anatomical characters to be studied either by taking free hand sections (t.s./ l.s.) and by observing the permanent micropreparations. Preparations of permanent slides are essential.

Suggested Readings
Module I – Paleobotany
Introduction: Plant fossils – Preservation, preparation, age determination, geological time scale; Fossil record – systematic, reconstruction and nomenclature; Applied aspects of paleobotany.

Module II – Gymnosperms
General account, distribution (living, Fossil), origin, systems of classification, economic importance.

Comparative morphology and evolutionary tendencies of
1. Pteridospermales – Lyginoptridaceae (*Calymotheca hoeninghausii*, *Hetarngium*, *Spheroistoma*) Medullosaceae (*Medullosa*, *Trignocarpus*)
2. Cycadales – Cycadaceae; Fossil history (*Baenia*, *Nilssonia*, *Androstrobus*)
3. Cycadeoidales – Williamoniaceae, Cycadoeidaceae

Module III
4. Cordaitales (General account and relationships)
5. Caytoniales (General account and relationships)
6. Glossopteridales (General account and relationships)
7. Pentoxylales (General account and relationships)
8. Gnetales (General account and relationships)

Module IV
9. Ginkgoales – *Ginkgo*, *Baiera*, *Trichopitys*
10. Coniferales – (Morphology, reproductive organs, gametophytes, embryo)
11. Taxales – *Taxus*

Laboratory Exercise
Comparative Study of vegetative and reproductive parts of – *Cycas*, *Zamia*, *Cedrus*, *Abies*, *Pinus*, *Cupressus*, *Cryptomeria*, *Taxodium*, *Podocarpus*, *Agathis*, *Thuja*, *Gnetum*, *Ephedra*, *Juniperus*, *Cephalotaxus*, *Taxus*
Permanent micropreparatious to be submitted by the students.

Ginkgo: Morphology to be studied from Museum specimens & anatomy from permanent slides only.
Study of important fossil gymnosperms from material and permanent slides.
Visit to palaeobotanical Institutes, localities and collection of specimens.
Field visits to ecologically different localities to study living gymnosperms.

Suggested Readings:
5. Kubitzki K. (1990), The families and genera of vascular plants Pteridophytes and Gymnosperms, Springer Verlag, New York
18. Chamberlain C.J. (1986); Gymnosperms, structure and Evolution, CBS publishers and distributors, New Delhi. On line Journals available on UGC -VSAT
M.Sc. Botany Syllabus
Semester I
Course code/name: Paper- IV Cytology and Genetics

Module I
Mendel’s laws of inheritance; chromosome theory of inheritance; deviations from Mendel’s findings; Penetrance and expressivity; Modifiers, suppressors and pleiotropic genes; multiple alleles and isoalleles (example Corn, Drosophila and Nicotiana); multigene families (globin and immunoglobin genes); sex determination and dosage compensation in plants, Drosophila, C. elegans.

Module II
Chromatin organization: Chromosome structure and packaging of DNA; molecular organization of centromere and telomere, rRNA genes, euchromatin and heterochromatin; Karyotype analysis and evolution, banding patterns; specialized types of chromosomes: polytene, lambrush, B-chromosome, sex chromosome; molecular basis of chromosome pairing, C- value paradox, Cot curve and its significance.

Module III
Structural and numerical changes in chromosomes; origin, breeding behavior of duplications, deficiency, inversion and translocation heterozygotes; effect of aneuploidy on plants; transmission of trisomics and monosomics and their use in chromosome mapping; complex translocation heterozygotes, translocation tester sets; Robertsonian translocation.

Module IV
Mutations: Spontaneous and induced; physical and chemical mutagens; molecular basis; transposable genetic elements; site directed mutagenesis; role of mutations in crop improvement; induction of polyploidy
Epigenetics: Introduction; paramutations in maize; Callipygh sheep; role of histones; DNA methylation; Epigenetics and Lamarckism; Epigenome and epigenomics.

Practicals
1. To study the effect of mutagen treatment on germination, seedling height and cell division.
2. To study the spontaneous and induced chromosomal aberrations in pollen mother cells.
3. To study the effect of mutagen treatment on pollen fertility.
4. To study the karyotype of given organism.
5. To study the chiasma frequency in the given material.
6. To study linear differentiation of chromosomes by chromosome banding.
7. To perform the site directed mutagenesis in the given system.

Suggested Reading
Module-I:-
1) **The Scope of plant physiology**
2) **Photosynthesis:** Evolution of photosynthetic apparatus, pigments, Light, light harvesting complex, Mechanism of electron transport, Photo protective mechanism, CO$_2$ fixation, C$_3$, C$_4$ and CAM pathway, Photorespiration, photosynthesis Physiological and ecological consideration (photosynthetic responses to light by the intact leaf, photosynthetic responses to carbon dioxide and temperature) coupled reaction and ATP Synthesis, the chemiosmotic-coupling hypothesis, ATP Synthesis in chloroplast and in mitochondria

Module-II
**Respiration:**- introduction, the respiratory substrate, fermentation, anaerobic and aerobic respiration, mechanism of respiration, Glycolysis, Citric acid cycle, oxidative pentose phosphate pathway, Plant mitochondrial electron transport, alternative pathway of electron transport chain, cyanide resistant chain, metabolic pool, respiratory ratio, measurement of R.Q., Regulation of respiration, respiratory enzymes, the non oxidative enzymes, the oxidative enzymes, factor affecting the rate of respiration

Module-III
1) **Carbohydrates Metabolism**
General classification and properties of carbohydrates, synthesis of starch and Sucrose, catabolism (degradation) of starch and sucrose
2) **Lipids Metabolism**
General classification and properties of lipids, fatty acid biosynthesis, synthesis of membrane lipids, synthesis of structural lipids, synthesis and catabolism of storage lipids.
3) **Metabolism of amino acids**
General classification and properties of amino acids, amino acid biosynthesis in plants, assimilation of inorganic nitrogen into n-transport amino acids, GS/GOGAT Cycle
4) **Nitrogen metabolism**
Nitrogen cycles, Biological Nitrogen fixation by free-living and symbiotic bacteria, nif genes
5) **Sulfur and Phosphate assimilation by the plants**

Module-IV
**Enzymes:** - nomenclature and classification of Enzymes, Isoenzymes, Allosteric Enzymes, Multienzymes, Ribozymes, Lysozymes, Ribozymes & Abyzymes and Coenzymes enzyme kinetics, mode and mechanism of Enzyme action (Regulation of Enzyme activity), Activators & Inhibitors, properties of Enzymes, factors affecting Enzyme activity pH, Buffer, reaction kinetics, colligative properties

**Solute transport and photo-assimilate translocation:**- Mechanism of water transport through xylem; Pathway of translocation patterns of Translocation through phloem;
Source and sink, Materials Translocated in the Phloem i.e. Sucrose, Amino acids, Hormones and some inorganic ions, Rate of Movement, Phloem loading: from chloroplast to sieve elements, Phloem Unloading: sink-to-source Transition, mechanism of translocation in the phloem

**Suggested Laboratory Exercises:**

To study the effect of time and enzyme concentration on the rate of reaction of enzyme (e.g. phosphatase, nitrate reductase).

To study the effect of substrate concentration on activity of enzyme and determination of its Km value.

Demonstration of the substrate inducibility of the enzyme nitrate reductase.

Determination of succinate dehydrogenase activity, its kinetics and sensitivity to inhibitors.

To determine the total carbohydrate content in the given sample

Estimation of Pectic Substances-gravitic method

To prove Berr-Lambert’s law using a suitable solution.

Extraction of chloroplast pigments from leaves and preparation of the absorption spectrum of chlorophyll and carotenoids.

To determine the chlorophyll a/ chlorophyll b ratio in C3 and C4 plants.

Isolation of intact chloroplasts and estimation of chloroplast proteins by spot protein assay.

Preparation of standard curve of protein (BSA) and estimation of protein content in extracts of plant material by Lowry’s or Bradford’s method.

Preparation of Leaf Protein Concentrates from green vegetables.

Determination of reducing sugars by Nelson – Somogyi Method

**Suggested Readings (for laboratory exercises):**


15 Sadasivam and Manikum: Biochemical Methos , New Age International (p) Limited Publishers 4835/24, Ansari Road, Daryaganj, New Delhi- 110002

SUGGESTED READINGS (FOR THEORY):


15 Ranjan, purohit, Prasad 2003: Plant Hormones Action and Application, Agrobios(India), agro house, behind Nasrani cinema Chopasani Road, Jodhpur -34
M. Sc. Botany Syllabus  
Semester -II  
Paper- VI: Plant Development and Reproduction

Module I:  
Plant growth  
Kinetics and pattern of growth  
Shoot Development – Organization of shoot apical meristem (SAM); cytological and molecular analysis of SAM; control of cell division and cell communication; control of tissue differentiation.  
Phytohormones: Classification, chemical nature and their role in plant development.

Module II:  
Leaf growth and differentiation – Determination; phyllotaxy; control of leaf form; differentiation of epidermis (with special reference to stomata & trichomes) and mesophyll.  
Root Development – Organization of root apical meristem (RAM); vascular tissue differentiation; lateral root hairs; root microbe interactions.  
Flower Development – Physiology of flowering, florigen concept and photoperiodism, Genetics of floral organ differentiation; homeotic mutants in Arabidopsis and Antirrhinum. Pollination mechanisms and vectors

Module III:  
Male Gametophyte – Structure of anther, microsporogenesis, tapetum; pollen development and gene expression; male sterility; sperm dimorphism; pollen germination; pollen tube growth and guidance.  
Female Gametophyte – Ovule types; megasporogenesis; organization of embryo sac; structure of embryo sac cells.  
Pollen – pistil interaction and fertilization: Structure of the pistil; pollen – stigma interactions, double fertilization; in vitro fertilization.

Module IV:  
Seed Development and fruit growth – Endosperm development; embryogenesis; ultrastructure and nuclear cytology; storage proteins of endosperm and embryo; polyembryony; apomixes; embryo.  
Germination of seed: Biochemical and hormonal control.  
Latent life – Dormancy: Importance and types of dormancy; seed dormancy; overcoming seed dormancy; bud dormancy.  
Senescence and Programmed Cell Death (PCD) – Basic concepts; types of cell death, PCD in life cycle of plants; metabolic changes associated with senescence and its regulations; influence of hormones and environmental factors on senescence.

Suggested Readings:  
20) On line Journals available on UGC -VSAT

Suggested Laboratory / Field Exercises (Any 12):
   1. Tissue systems, meristem, vascular and cork cambium
   
   2. Internal structure of root, stem and leaf (dicot and monocot), advanced secondary growth in dicot stem and root.
   
   3. Anomalies in primary and secondary structure of stem
4. Study of living shoot apices by dissections using aquatic plants such as *Ceratophyllum* and *Hydrilla*.

5. Study of cytohistological zonation in the shoot apical meristem (SAM) in sectioned and double-stained permanent slides of a suitable plant such as *Coleus, Kalanchoe, Tobacco*. Examination of shoot apices in a monocotyledon in both T.S. and L.S. to show the origin and arrangement of leaf primordia.

6. Study of alternate and distichous, alternate and superposed, opposite and superposed; opposite and decussate leaf arrangement.

7. Examination of rosette plants (*Launaea, Mollugo, Raphanus, Hyoscyamus* etc) and induction of bolting under natural conditions as well as by GA treatment.

8. Microscopic examination of vertical sections of leaves such as *Cleome, Nerium, Maize* and *Wheat* to understand the internal structure of leaf tissues and trichomes, glands etc. Also study the C3 and C4 leaf anatomy of plant.

9. Study of epidermal peels of leaves such as *Coccinia, Gaillardia, Tradescantia, Thunbergia*, etc. to study the development and final structure of stomata and prepare stomatal index. Demonstration of the effect of ABA on stomatal closure.


11. Study of microsporogenesis and gametogenesis in sections of anthers.

12. Examination of modes of anther dehiscence and collection of pollen grains for microscopic examination (Maize, Grasses, *Crotolaria, Tradescantia, Brassica, Petunia, Solanum melongena*, etc.)


15. Role of transcription and translation inhibitors on pollen germination and pollen tube growth.

17. Study of ovules in cleared preparations; study of monosporic, bisporic and tetrasporic
types of embryo sac development through examination of permanent stained serial
sections.

18. Field study of several types of flower with different pollination mechanisms (wind
pollination, thrips pollination, bee/butterfly pollination, bird pollination).

19. Emasculation, bagging and hand pollination to study pollen germination, seed set and
fruit development using self compatible and obligate outcrossing systems. Study of
cleistogamous flowers and their adaptations.

20. Study of nuclear and cellular endosperm through dissections and staining.

21. Isolation of zygotic globular, heart-shaped, torpedo stage and mature embryos from
suitable seeds and polyembryony in citrus, jamun (Syzygium cumini) etc. by
dissections.

22. Study of seed dormancy and methods to break dormancy.
M. Sc. Botany Syllabus
Semester II
Course code/name: Paper- VII Cell and Molecular Biology

Module I:
Cell wall: Structure; function; biogenesis and growth; cell differentiation
Plasma membrane: Membrane architecture (fluid mosaic model); sites for ATPases; membrane transport - ion carriers, channels, pumps and aquaporins; receptors.
Plasmodesmata: Structure, role in movement of molecules and macromolecules; comparison with gap junction.

Module II:
Cellular organelles: Ultra-structure and function of golgi complex, lysosomes, peroxisomes, endoplasmic reticulum, mitochondria, chloroplast and plant vacuoles.
Cell shape and motility: The cytoskeleton; organization and role of microtubules and microfilaments; motor movements, implications in flagellar & other movements, cell division.

Module III:
Nucleus: Ultrastructure, nuclear pores, nucleolus, DNA structure A, B and Z forms, replication in prokaryotic and eukaryotic cells, DNA replication proteins, damage and repair.

Module IV:
Molecular biology of stress responses: Definition and classification of stress; Plant defence mechanism (passive and active); HR and SAR; modulation of plant metabolism in response to biotic stress: early and late response; production of ROS, induction of enzymes, induction of genes involved in phenylpropenoid metabolism; PR proteins and R- genes

Suggested Readings:


Practicals
- Orcein staining of the salivary gland chromosomes of Chironomus and Drosophila.
- Cell fractionation & isolation of Chloroplast and mitochondria.
- Isolation of plant DNA and its quantification by spectrophotometric method.
- To perform flagellary staining.
- Isolation of DNA and preparation of Cot-curve.
- Demonstration of vital structure and functions of cell
- To study the induction of defence genes by elicitors.

Suggested Readings (for laboratory exercises):

References: Online journals available on UGC V-SAT programme.

Review Journals:
- Annual Review of Plant Physiology and Molecular Biology
- Biochemistry and Cell Biology
- Cell
- Cell Biology International
- Cell Death and Differentiation
- Cell Motility and the Cytoskeleton
- Cellular Physiology and Biochemistry
- Current Advances in Plant Sciences
- Cytokine
- European Journal of Cell Biology
- Journal of Cell Science
- Nature Reviews: Molecular and Cell Biology
- Protoplasma- An International Journal of Cell Biology
- Trends in Cell Biology
- Trends in Plant Sciences
M. Sc. Botany Syllabus
Semester II
Course code/name: Paper- VIII Angiosperms- I

Module I:
Angiosperm Morphology, structural units and floral symmetry, dicot and monocot flower; structure, diversity origin and evolution of stamen, carpels; placentation types and evolution. Floral adaptation to different pollinators

Module II:
Angiosperm Taxonomy: Scope, aims, principles of taxonomy, historical development of plant taxonomy, relative merits and demerits of major systems of classifications. Taxonomic structure: taxonomic hierarchy, concept of taxa, concept of species, concept of genus and family; Taxonomic character: HETEROBATHMY, ANALYTIC Vs. synthetic character, qualitative Vs quantitative characters.

Module III:
Taxonomic evidence: Morphology, anatomy, embryology, palynology, cytology, phytochemistry, genome analysis.
Taxonomic tools: herbarium, floras, monographs, botanical gardens, biochemical and molecular techniques, computers and GIS.

Module IV:
Plant nomenclature: Salient features of ICBN

Practicals
1. To study the floral symmetry in various taxa.
2. To study and work out the differences in dicot and monocot flower.
3. To study the variation in stamens and carpels.
4. To study placentation types in various taxa.
5. To study the floral adaptations for pollination.
6. To study anatomical features of various taxa.
7. To study embryological features of various taxa.
8. To study palynological features of various taxa.
9. To study cytological features of various taxa.
10. To prepare a cladogram on the basis of various morphological features of the species belonging to a genus.

Suggested Readings
Module I:
Vegetation organization: Concepts of community and continuum, analysis of communities (analytical and synthetic characters); interspecific associations, concept of ecological niche. Vegetation development: Temporal changes (cyclic and non-cyclic); mechanism of ecological succession (relay floristics and initial floristic composition; facilitation, tolerance and inhibition models); changes in ecosystem properties during succession, Autecology.

Module II:
**Ecosystem organization:** Structure and functions; primary production (methods of measurement, global pattern, controlling factors); energy dynamics (trophic organization, energy flow pathways, ecological efficiencies); litter fall and decomposition (mechanism, substrate quality and climatic factors); global biogeochemical cycles of C, N, P, and S; mineral cycles (pathways, processes, budgets) in terrestrial and aquatic ecosystems.

Module III:
**Air, Water and Soil pollution:** Kinds; sources; quality parameters; effects on plant and ecosystems. Climate change: Greenhouse gases (CO₂, CH₄, N₂O, CFCs; sources, trends and role); ozone layer and ozone hole; consequences of climate change (Global warming, sea level rise, UV radiation).

Module IV:
**Ecosystem stability:** Concept (resistance and resilience); Ecological perturbations (natural and anthropogenic) and their impact on plants and ecosystems; ecology of plant invasion; environmental impact assessment; ecosystem restoration. Ecological management: Concepts; sustainable development; sustainability indicators.

**Plant Ecology- Practicals:**
1) A trip to the grass land/ forest/ water body to get acquainted with their plant species.
2) Distribution pattern of different plant species determined by Quadrat/ Transat/ Point centered Quarter methods.
3) Qualitative parameters of distribution of plant species, Frequency, Density, Basal cover, dominance, Abundance and IVI.
4) Analysis of soils of two different areas i.e. Cropland and forest/ grassland for certain nutrients, CO₃, NO₃, Base defficiency.
5) Analysis of water quality for physical properties like colour BOD, COD, O₂, CO₂ contents etc.
6) Study of adaptations in plants of hydrophytic, Xerophytic and halophytic zones.

**Suggested Readings:**
4. Anderson JM Ecology for environmental sciences: biosphere ecosystems and man
22. Reynolds CS 1984 The ecology of phytoplankton, Cambridge Univ Press
M. Sc. Botany Syllabus
Semester III
Course code/name: Paper- X Cell and Molecular Biology- II

Module I:

**Ribosomes**: Structure and function

**Transcription & Translation**: Transcription in prokaryotic and eukaryotic cells, plant promoters, transcription factors, types of RNA and their function, splicing, mRNA transport, rRNA biosynthesis; translation in prokaryotic and eukaryotic cells, structural levels of proteins, post-translational modification; structure and role of tRNA.

Module II:

**Gene structure and expression**: Fine structure of gene, Cis-trans test; fine structure analysis in eukaryotes; introns and their significance, RNA splicing; regulation of gene expression in pro- and eukaryotes.

**Protein sorting**: Machinery involved, vesicles, coat proteins; protein targeting to plastids, mitochondria, peroxisomes, nucleus, vacuoles; modification during transport.

Module III:

**Genome organization in prokaryotes and eukaryotic organelles**: Phage genome, genetic recombination in phage and mapping phage genes; mapping of bacterial genes through transformation, conjugation and transduction; genetics of mitochondria and chloroplast.

**Genetic recombination and genetic mapping**: Recombination, independent assortment and crossing over; molecular mechanism of recombination, role of RecA and RecBCD enzymes; site-specific recombination; chromosome mapping, linkage group, genetic markers, construction of molecular maps, correlation of genetic and physical maps; Somatic cell genetics - an alternative approach to gene mapping.

Module IV:

a. **Cell cycle and apoptosis**: Control mechanisms, role of cyclins and cyclin dependent kinases; retinoblastoma and E2F proteins; cytokinesis and cell plate formation; programmed cell death in plants; regulation in plant growth and development.

b. **Signal transduction**: Overview, receptors and G- proteins, phospholipid signaling, role of cyclic nucleotides, calcium-calmodulin cascades, diversity in protein kinases and phosphatases, specific signaling mechanisms e.g. two-component sensor-regulator system in bacteria and plants, sucrose sensing mechanism

c. **Techniques in cell biology**: Electrophoresis, immunotechniques, FISH, GISH, confocal microscopy

**Suggested readings:**


Russel, P. J. 1998 Genetics (5th Edi.) The Banjamin/ Cummings Publishing Com. Inc., USA


**Practicals:**

1. Isolation of nuclei and identification of histones by SDS-PAGE.
2. Isolation of chloroplast and demonstration of two subunits of RUBISCO by SDS PAGE
3. Restriction digestion of plant DNA, its separation by agarose gel electrophoresis, visualization by ethidium bromide staining.
4. To study in vitro transcription.
5. To study in vitro translation.
6. To study conjugation in bacterial cells.
7. To detect the presence of specific antigen by ELISA
8. Isolation of RNA and quantification by spectrophotometric method.

**References:** Online journals available on UGC V-SAT programme
Module I:

a. **Recombinant DNA technology**: Gene cloning and principles and technique; vectors-types and their properties; construction of DNA libraries; splicing of insert into the vector; screening of DNA libraries and introduction of the recombinant DNA into the host cells.

b. **Genetic engineering of plants**: Aims, strategies for development of transgenics (with suitable examples); Agrobacterium- the natural genetic engineer; T-DNA and transposon mediated gene tagging.

Module II:

a. **Microbial genetic manipulation**: Bacterial transformation, selection of recombinants and transformants, genetic improvement of industrial microbes and nitrogen fixers, fermentation technology.

b. **Genomics and proteomics**: Molecular markers for introgression of useful traits; high throughput sequencing; functional genomics; Protein profiling and its significance.

c. DNA synthesis; DNA sequencing; polymerase chain reaction; DNA fingerprinting

Module III:

**Plant tissue culture**: Basic concepts; Principles and scope; tissue culture media; callus induction and cell suspension; aspects of morphogenesis; haploid and triploid production; production of somatic embryos; applications of plant tissue culture; protoplast isolation and culture; production of cybrids

**Transgenic production**: Methods to introduce gene in plants; selection of transformed plants/explants; salient achievements in crop biotechnology.

Module IV:

a. **Bioinformatics**: Introduction, History, Definition and applications of bioinformatics.

b. **Database**: Types and classification of databases – Primary Databases (Nucleic acid sequence, protein sequence, protein structure), Secondary databases (Genomic, cDNA, Organellar, gene expression), special databases (Human, *Escherichia coli*, *Saccharomyces cerevesiae* and *Arabidopsis thaliana*), Literature database (PubMed, OMIM), Information Retrieval system (Entrez). Other databases: GeneBank, KEGG, Taxonomy databases

c. **Data analysis, prediction and submission tools and their uses**: ORF finder, Blasts, FASTA, RASMOL, Prediction of pro- and eukaryotic genes and promoters (Genscan); protein structure (SWISS-Prot, pfam, PDB, PIR); sequin, webin, AutoDep tools.

**Suggested Readings:**
• Kartha, K. K. 1985. Cryopreservation of Plant Cells and Organs. CRC Press, Boca Raton, Florida USA.
• Mount W. 2004 Bioinformatics and sequence genome analysis 2nd Edi. CBS Pub. New Delhi
• Watson, J. , Tooze and Kurtz Recombinant DNA: A short course

Practicals:
1. Growth characteristics of E.coli using plating and turbidimetric methods.
2. Isolation of plasmid from E.coli and its quantification.
3. Restriction digestion of the plasmid and estimation of the size of various DNA fragments.
4. Cloning of a DNA fragment in a plasmid vector, transformation of the given bacterial population and selection of recombinants.
5. Co-cultivation of the plant material (e.g. leaf discs) with *Agrobacterium* and study GUS activity histochemically.
6. Preparation of media for plant tissue culture.
7. To surface sterilize the given seeds/explant for tissue cultural manipulation.
8. To isolate protoplast and determine its viability.
9. To fuse the protoplast for production somatic hybrid.
10. Demonstration of DNA sequencing by Sanger's dideoxy method.
11. To search literature of different organisms and genes from NCBI.
12. Use of various tools to retrieve information available from NCBI.
13. To retrieve gene and protein sequences of various organisms from NCBI.
14. To locate gene(s) on chromosomes for a given disease/disorder.

**Suggested Readings(for laboratory exercises)**
- Shaw, C. H. (Ed.) 1988, Plant Molecular Biology : A Practical Approach. IRI Press,
- Oxford.

**References:** Online journals available on UGC V-SAT programme.
Module I:
General account, distinguished characters, floral variation and evolution, affinities of :- Magnolidae, Hamamelidae, Dilleniidae, Rosidae, Asteridae, circumscription as per Cronquist,1968

Module II:
Alismatidae, commelinidae, Aracidae, Lilidae; Interesting features and systematic position of Cucurbitaceae, Cactaceae, Asteraceae, Amentiferae, Lemnaceae, Palmae, Orchidaceae.

Module III:
Probable ancestors of angiosperms, primitive living angiosperms, speciation and extinction, IUCN categories of threat, distribution and global pattern of biodiversity.

Module IV:
Biological diversity concept and levels, role of biodiversity in ecosystem functions and stability, Endemism, hotspots and hottest hotspots, invasions and introductions, local plant diversities and its socioeconomic importance.

Practicals:
Angiosperms
1. Description of a specimen from representative, locally available families.
2. Description of a species based on various specimens to study intra specific variation: collective exercise.
3.
4. Description of various species of a genus, location of key characters and preparation keys at generic level.
5. Location of key characters and use of keys at family level.
6. Field trips within and around the campus; compilation of field notes and preparation herbarium sheets of such plants, wild or cultivated as are abundant.
7. Training in using floras herbaria for identification of specimens described in the class.
8. Demonstration of the utility of secondary metabolites in the taxonomy of some appropriate genera.
9. Comparison of different species of a genus and different genera of a family to calculate similarity coefficients and preparation of dendrograms.

Suggested Readings


M. Sc. Botany Syllabus
Semester IV
Course code/name: Paper- XIII Plant conservation, IPR and Ethnobotany

Module I
Plant biodiversity – Concept of Biodiversity; Types (Species, Genetic, Ecosystem diversity. Present status in India
Origin of Biodiversity; values of Biodiversity; loss of Biodiversity.
Megabiodiversity Centers with special emphasis on Western Ghats and Indo-Burma region
Biodiversity and agriculture; Bioprospecting; commercial values of Biodiversity.
CBD – General account

Module II
IUCN – General account, categories, Commissions, role in conservation; Red Data Book
CITES – General account, CITES & International trade
Strategies for conservation
Protected areas concept: Sanctuaries, National parks, Man and Biosphere programme, Biosphere reserves
Tiger reserves with reference to Melghat Tiger Project, Tadoba Andhari Tiger Reserve and Pench)
Wetlands – Types, Importance, Measures taken for conservation at National and International levels, Ramsar Convention
Mangroves – Types, Zonations, Importance, Measures taken for conservation at National and International levels

Module III
Coral Reefs – Types, importance, artificial reefs, conservation measures
Legislative framework for protection
Principles and practices for Ex-situ conservation, Botanical gardens, Field Gene Banks, Seed Banks.
In-vitro repositories, Cryobanks,
General accounts and activities of national institutes like Botanical Survey of India (BSI), National Bureau of Plant Genetic Resources (NBPGR), Indian Council of Agricultural Research (ICAR), Department of Biotechnology (DBT) and their role in plant conservation

Module IV
Intellectual property right; patenting: basic requirement, novelty, public domain; plant variety protection act; farmers right protection act; WTO with reference to biotechnological affairs
Ethnobotany: Definition, scope and significance. Status in India Major tribes of Maharashtra – Madia, Korku, Gond, Bhil, Varli (information on customs, traditions, plants used as medicines, scarcity food); Important medicinal plants used by tribals in Vidarbha; Sacred groves and their role in conservation.
M. Sc. Botany Syllabus  
Semester IV  
Course code/name: Paper- XIV Plant resource utilization, Bioethcs, Biosafety, Plant breeding and Biostatistics  

Module 1:  
Centres of diversity of domesticated plants; Green revolution.  
Important fire wood and timber yielding plants; qualities of timber plant, Non-wood forest products (NWFPs) such as Bamboos and rattans  
Origin, evolution, botany and uses of food crop (rice and pigeonpea), Fibre crop (Cotton, jute), Vegetable oil yielding crop (Safflower, Sunflower ) Sugar and biomass crop (Sugarcane, Beet)  
Source, types and uses of – gums, resins, tannins and dyes  
A brief account of major spices, condiments, narcotics, mastigatories and fumitories and beverages  
Fodder and forage plants  
Medicinal and aromatic plants  
General account of petrocrops  

Module 2:  
Sampling-Sampling procedure, homogenization of samples, samples size, Selection of random sample, Limitation of analytical methods  
Types of data, Frequency distribution, Measure of central values - Mean, median and mode, Measures of dispersion - range , mean deviation , standard deviation, coefficient of variation, moment, Statistical Inference of Qualitative & Quantitative Variables, level of significance, Chi square test & its applications, One-Way ANOVA, Two way ANOVA, t-test  

Module 3:  
Population genetics: Hardy-Weinberg equilibrium and deviations from it; quantitative trait loci (Kernel colour in wheat, corolla length in *Nicotiana longiflora*).  
Plant breeding: Methods of breeding sexually (self and cross pollinated) and vegetatively propagated crops; heterosis and inbreeding depression and their genetic basis; use of male sterility in hybrid production.  
Bioethics: Professional ethics, ethical decision making and ethical dilemmas  

Module 4:  
Biosafety in the laboratory institution: Laboratory associated infections and other hazards, assessment of biological hazards and levels of biosafety, prudent biosafety practices in the laboratory/ institution  
Biosafety regulations in the handling of recombinant DNA processes and products in institutions and industries, biosafety assessment procedures in India and abroad  
Biotechnology and food safety: The GM-food debate and biosafety assessment procedures for biotech foods & related products, including transgenic food crops, case studies of relevance.
Ecological safety assessment of recombinant organisms and transgenic crops, case studies of relevance (Eg. Bt cotton).
Biosafety assessment of biotech pharmaceutical products such as drugs/vaccines etc.
International dimensions in biosafety: Catagena protocol on biosafety, bioterrorism and convention on biological weapons

**Recommended Books:**
- Intellectual Property Rights - Brigitte Anderson, Edward Elgar Publishing
- WIPO Intellectual Property Handbook
- Intellectual Property Rights - William Rodelph Cornish, David Clewelyn
- Patterns of Entrepreneurship - Jack M. Kaplan

**Websites:**
2) Using the Internet for non-patent prior art searches, Derwent IP Matters, July 2000. [www.ipmatters.net/features/000707_gibbs.html](http://www.ipmatters.net/features/000707_gibbs.html)
M. Sc. Botany Syllabus
Semester IV
Course code/name: Paper-XV (Molecular Biology and Plant Biotechnology –special I)

Module I:

a. DNA replication: DNA replication in prokaryotic organism – Initiation, elongation, and termination, DNA replication in eukaryotes – origin, replication form, replication proteins, Comparative account of DNA replication in prokaryotes and eukaryotes, DNA replication proteins

b. DNA damage and repair: Types of DNA damage, factors for DNA damage,

Repair system: Single base change, direct repair, mismatch repair, SOS response.

Module II:

a. Isolation of gene and nucleotide sequence: DNA manipulation enzymes; General methods of gene isolation.

b. Molecular probing: Recombinant DNA libraries (gDNA and cDNA, oligonucleotide probes); nucleic acid hybridization (southern, northern, dot-blot and slot-blot); antibodies as probe for proteins (immunoblotting or western blotting, immunoprecipitation, southwestern screening).

Module III:

a. Splicing of foreign DNA into cloning vector: Vectors for prokaryotes; ligation.

b. Introduction of foreign DNA into host cell: Transformation; transfection; transgenesis

c. Isolation of genes or protein products from clones: Expression vectors- Characteristics; vectors producing fusion proteins

d. Polymerase chain reaction: Types of PCR’s and their applications in molecular biology

Module IV:

a. Sequence alignment and phylogenetic trees: Dot plots, sequence similarity, pairwise and multiple alignment, significance of alignment, phylogeny and phylogenetic trees and evolution.

b. Genomics: Definition; genome analysis (genetic polymorphisms, genetic mutations); microarray technology and applications (gene expression and diseases).

c. Proteomics: Protein stability and folding; application of hydrophobicity; DALI (Distance-matrix alignment); Protein structure- evolution, classification, prediction and modeling, prediction of function. DNA microarrays, mass spectrometry, network and graphs, protein complexes and aggregates, protein interaction networks, regulatory networks.

Suggested Readings:
Alberts, Bruce; Johnson Alexander; Lewis, Julian; Raff, Martin; Roberts, Keith; Walter,
Mount W. 2004 Bioinformatics and sequence genome analysis 2nd Edi. CBS Pub. New Delhi
Russel, P. J. 1998 Genetics (5th Edi.) The Banjamin/ Cummings Publishing Com. Inc., USA
Practicals:
1. Detection of DNA damage by mutagens
2. Bacterial transformation and selection of transformed cells.
3. To detect molecular polymorphism of different species
4. To demonstrate the presence of particular polypeptide by Western blotting.
5. To design PCR primers for isolation of given gene and to clone it in the given vector.
6. Amplification and sequencing of nr DNA by PCR
7. To find the sequences of a given protein in SWISS-Prot, Uni-Prot
8. To work out the sequence from given autoradiogram and to identify it from GeneBank by BLAST method.
9. To generate Pairwise and multiple sequence alignment of a given organisms
10. To generate phylogenetic tree using given sequences.
11. To predict a protein from given sequence by using online tools from NCBI.

Suggested Readings (for laboratory exercises)
- Tools & updated literature available at www.ncbi.com

References: Online journals available on UGC V-SAT programme.
M. Sc. Botany Syllabus
Semester IV
Course code/name: Paper XV- Reproductive Biology of Angiosperms (Special) I

Module I:
General: Need for reproductive system as experimental material, Interdisciplinary approaches: genetic and molecular perspective,
Anther: Structure, anther wall: endothecium, middle layer, tapetum-Structure, types-structure-function relationship, role of tapetum, microsporogenesis- sporogenous cells cytoplasmic reorganization during sporogenesis (Ultrastructural changes), molecular biology of meiosis, DNA and RNA synthesis, Protein synthesis, meiosis specific genes. Pollen tetrad development, pollen wall proteins, adaptive significance of pollen wall,

Module II:
Male gametophyte development: formation of vegetative and generative cells, differential behavior of sperms, gene expression during pollen development.
Pollen: Physiological and biochemical aspects, pollen storage, viability causes for loss of viability. pollen abortion and male sterility, structural, developmental and functional aspects of male sterility environmental factors, role of mitochondrial genome in male sterility, gametocides.

Module III:
Pistill: Carpel determination, ovule and its structural details.
Megasporogenesis: Meiosis, functional megaspores, organization of female gametophyte structure of the embryo sac, egg, synergid-ultrastructure, role central cell, antipodal cell, haustoria, cytoskeleton of the embryo sac, enzymatic isolation of embryo sac, types of embryo sac, nutrition of embryo sac.

Module IV:
Pollination-pollination mechanism, biotic and abiotic pollination, floral attractants and rewards,
Pollen-pistil interaction: The stigma-Types and structure, stigmatic exudates, style-transmitting tissue, canal cell, post pollination events (stigma receptivity, pollen adhesion, pollen hydration, pollen germination and pollen tube growth, biochemistry of pollen germination, RNA and protein metabolism during pollen tube, calcium gradient in the pollen tube (Chemotropism) pollen allelopathy.
Incompatibility: General concept, self incompatibility (Intraspecific type) heteromorphic, homomorphic types, mechanism of self compatibility, importance of self compatibility, methods of overcoming self incompatibility, Parasexual hybridization,

Suggested Readings:
M. Sc. Botany Syllabus
Semester IV
Course code/name: Paper XV- ADVANCED PHYCOLOGY   PAPER- I (Special)

MODULE 1:
1 Prokaryotic characters , ultra structure of cell, reproduction and affinities.
2 Sources of Nitrogen and its assimilation, importance and activity of biofertilizers , biotechnological implication and Biological Nitrogen fixation.
3 Biotechnology and international market, Nif gene transformation and present status of genetic engineering
4 Toxic algae: Phycotoxins, characteristics and their effects on human beings.
5 Algae cytology and genetics
6 Calcification, extracellular products of algae and fossil algae.( )

MODULE 2:
Bacteria: Strain selection, sterilization, growth, fermentation production, application technology for major biofertilizers, viz. Rhizobium , Azotobacter, Azospirillum, Bacillus megaterium (PSB), Pseudomonas fluorescens.
Cyanobacteria: Phormidium, Aulosira, Cylindrospermum, Rivularia, Symbiotic algae and their role in other plan.

MODULE 3:
1 Algae as a food feed and medicine.
2 Eukaryotic characters (morphology) reproduction, life cycle patterns, taxonomy, Phylogeny , and interrelationship of Protochlorophyta, Chlorophyta, Charophyta, Xanthophyta, Bacillariophyta, Pheophyta and Rhodophyta;
3 Prochlorophyta : Prochloron.
4 Chlorophyta: Microspora, Draparnaldia,Trentopholia, Fritschiella, Cosmarium, Codium, Bryopsis .

MODULE 4:
Industrial product from algae of marine and freshwater
Phaeophyta : Thallus range, cell structure, alternation of generation, Cutleria, Padina, Laminaria, Turbinaria.
Rhodophyta : Nemalion, Gelidium, Gracilaria, Corallina, Polysiphonia.
Euglenophyta : Euglena, Phacus.
Bacillariophyta : Cyclotella, Synedra, Cymbella, Navicula, Gomphonem
Chrysophyta:- Synura and Dinobryon.
M. Sc. Botany Syllabus
Semester IV
Course code/name: Paper- XV (Mycology and Plant pathology- special I)

MODULE I: General Microbiology –
Bacteria – Morphology, size, shape, structure, Characters of Eubacteria, Actinomycetes, Archaeabacteria, Bacterial nutrition, reproduction.
Viruses – General Characteristics, structure, classification (LHI System), replication (lytic cycle & lysogeny)
Rikettsia – General characters

MODULE II: Mycorrhiza :
2. Rhizosphere and phyllosphere - General concept and importance.

MODULE III: Production of Metabolites By Fungi:
A) Industrial Fungal Metabolites:
i) Antibiotics - Penicillin, Cephalosporin, Griseofulvin, Industrial production. of Penicillin
ii) Enzymes -. Amylase, proteases, Lipases, Pectinases, Cellular and xylanases.
iii) Organic acids - Critic acid, Gluconic acid, lactic acid, kojic acid. Itaconic acid.
B) Non Industrial Fungal Metaboilites :
i) Phytoalexins , ii) Mycotoxins ,

MODULE IV :Fungi as welfare to human beings:
i) Fungi in food processing
ii) Fungi in Medicine
iv) Fungi as food - edible mushrooms, methods of their cultivation
v) and economic importance.
vi) Concept of biodeterioration and Biodegradation
a) Biodeterioration of noncellulosic materials.
b) Biodeterioration of cellullosic materials.
c) Role of microorganisms in Biodegradation of organic wastes. Factors affecting the process of Biodegradation.

Suggested Readings  

On line Journals available on UGC - VSAT
M. Sc. Botany Syllabus
Semester IV
Course code/name: Paper- XV (Palaeobotany - special I)

MODULE – I:
Introduction to the science of Petrology- The earth zones, chemical composition of earth crust. The classification of rocks i.e. Endogenetic and Exogenetic (igneous, metamorphic and sedimentary) and their brief account. Glaciations, volcanic eruption and earthquake.

MODULE – II

MODULE – III:

MODULE – IV:

Suggested Laboratory and Field Exercises for Paper I

- Stratigraphy Maps of the India and World
- Geological Maps of India
- Geological column and time scale.
- Study of different rocks.
- Different techniques to study fossils. (Ground sectioning, peel technique) Study different types of fossils
- Study of plant fossils as per syllabus based on specimens and slides.
- Study of Rhyniopsida (primitive vascular plants)
- Arborescent Lycopods of Carboniferous-study of Lepidodendrales members
- Sphenophyllales, Calamitales members.
- Study of primitive ferns and their relatives- Cladoxylales, Stauropteridales, Zygopteridales. Filicales- Coenopteridales- Ankyropteris. Marratiales - Psaronius
- Preparation of practical record.
M. Sc. Botany Syllabus  
Semester IV  
Course code/name: Paper- XV (PALYNOLOGY - special I)

MODULE -I: -
General aspects of Palynology: -Historical background, Definition, basic concepts, scope, inter-relationship with other branches of Botany, Applications, Indian work on Palynology, Palynological centres in India.
Microsporogenesis : Stamen initiation, anther differentiation- anther initiation, anther wall, Tapetum, structure and functions, its role in pollen development, Functions of callose wall, pollen/microspore and wall development, production and deposition of sporopollenin.
Pistil : Structure and function of stigma and style, stigma receptivity and its importance.

MODULE II: -
Pollination Biology -Origin of pollination biology/anthecology, Spore and pollen dispersal in lower plants and gymnosperms, Pollination in angiosperms- types of pollination, floral adaptation to different pollinators (mode, style) flowers pollinated biotically (Hymenoptera, Diptera, Coleoptera, Lepidoptera, birds, bats) and abiotically (wind, water), pollination-plant interactions and evolution of breeding systems, special devices associated with pollinator attraction - pollen, nectar, Elaiophores, resin glands, osmophores, floral scent and perfume flowers.
Palaeopalynology: - Palynomorphs, their preservation in diverse lithic types, techniques involved in the recovery and concentration of spores and pollen from clays, shales, coals and lignites. Maceration techniques, Application of Palynology in relation to oil and coal exploration. Role of spores and pollen in stratigraphy, index spores.

MODULE III: -
Phylogeny of Pollen and spores, Systematic palynology - monocotyledoneae and dicotyledoneae, evolutionary trends among pollen grains based on palynotaxonomical works, Palynology of spores / pollen- Algae, Fungi, Bryophytes, Pteridophytes and pollen types of Gymnosperms. 
Pollen morphology of Angiosperms.: -
Introduction- Pollen units, polarity, symmetry, Shape, size, Apertures size, shape of the pollen grain, saccate pollen grain, sporoderm stratification, Apertures-NPC System of classification, Apertural types, Exine ornamentation, LO analysis Pollen wall morphogenesis, evolutionary trends in exine structure, trends of evolution in apertural pattern, Techniques for the preparation of pollen slides, Light and scanning election microscopic studies of pollen, significance of SEM and TEM studies.

MODULE -IV:
Melittopalynology- pollen analysis of honey-methods, qualitative and quantitative, social behaviour of honey bees, floral fidelity, foraging behavior, geographical and floral origin of honey, its’ chemical analysis, adulteration of honeys, physical characteristics of honey, honey
quality standard, deterioration of honey, heavy metal contamination in honey, honey as environmental monitors, honey and allergy, unifloral and multifloral honey, pollen toxicity, Applied Palynology with special reference to Agriculture and Horticulture - Bees as pollinators, role of apiaries in crop production. Bee keeping and enhanced honey production, recognition of areas suitable for honey production, use of honey in medicine, cosmetics, confectionary and other applications, pollen loads, analysis, Bee pollen, chemical composition, utility, and its role in curing various human ailments.
M. Sc. Botany Syllabus
Semester IV
Course code/name: Paper- XVI (Molecular Biology and Plant Biotechnology- Special II)

Module I:

a. **Transgenics**: Cloning vectors for higher plants; Methods for gene transfer, *Agrobacterium tumefaciens* mediated- Basis of tumor formation, features of Ti and Ri plasmids, mechanisms of DNA transfer, role of virulence genes, use of Ti and Ri genetic markers, use of reporter genes and introns; Direct DNA transfer; particle bombardment; electroporation; microinjection; macroinjection; liposomes; electrophoretic; pollen tube method; pollen transformation; PEG method; transformation of monocots; transgene stability and gene silencing; chloroplast transformation.

Module II:

a. **Applications of transformation**: Herbicide resistance; insect resistance; Bt genes, disease resistance; Nutritional quality; biopesticides and biofertilizers; hazards and safety regulations for transgenic plants.

b. **Metabolic engineering through transgenic plants**: Production of secondary metabolites; industrial enzymes; biodegradable plastics (PHB and any other); edible vaccines; antibody production and other important drugs.

Module III:

**Plant tissue culture**: History, Culture types: Callus culture, organ culture, suspension culture for production of secondary metabolites, protoplast culture, fusion and somatic hybrids, Somatic embryogenesis, anther and pollen culture, haploid plants, somaclonal variations, organogenesis (direct and indirect).

**Gene expression**: Gene expression in Mitochondria, chloroplast, yeast

**Regulation of gene expression**: Regulation of gene expression in translation and post-translation level

Module III:

a. **Nitrogen fixing genes**: Organization, function and regulation of nitrogen fixing genes in *Klebsiella, hup* genes.

b. **DNA fingerprinting and marker assisted breeding**: RFLP maps; linkage analysis; RAPD markers; STS; SSR (microsatellites); ISSR; SCAR (sequence characterized amplified regions); SSCP (single strand conformational polymorphism); AFLP; QTL: map based cloning; molecular marker assisted selection

a. **Cleaner Biotechnology**: Pollution control through genetically modified organisms.
Suggested Readings:

- Alberts, Bruce; Johnson, Alexander; Lewis, Julian; Raff, Martin; Roberts, Keith; Walter,

Practicals:
1. Agrobacterium tumefaciens mediating gene transfer in a suitable plant
2. Elisa testing of Bt gene in cotton
3. Induction of secondary metabolite synthesis in suspension culture.
4. Isolation of secondary metabolites by gel filtration.
5. Purification of plant metabolite/protein by column chromatography.
6. Use of RAPD/RFLP/SSCP etc. markers to detect molecular polymorphism of different species.
7. Isolation and protein profiling in different plant species by SDS-PAGE.
8. Raising of suspension culture and plotting of growth curve.
10. DNA ligation and analysis of ligated DNA on agarose gel (cloning and analysis using GUS gene).
11. Study of expression of inducible genes at biochemical level.
12. Organogenesis and somatic embryogenesis using appropriate explants and preparation of artificial seeds.

**Suggested Readings (for laboratory exercises)**


**References**: Online journals available on UGC V-SAT programme.
Module I:
Fertilization: Cellular nature of sperm, the sperm cytoskeleton, the male germ unit, isolation and characterization of sperm, growth of the pollen tube through the style, passage of sperm into the embryo sac, fusion of nuclei, double fertilization, triple fusion, unusual features. In-vitro approaches to the study of fertilization-Intra-ovarian pollination, test tube fertilization, in-vitro fertilization, placental pollination, Gynogenesis.
Endosperm: types of endosperms, ruminate endosperm, cytological status. endosperm haustoria, chemical composition of endosperm, food reserve in endosperm, role of endosperm in embryo development, endosperm mutants.

Module II:
Embryogenesis: Zygote and its ultra-structure, milieu of the developing embryo, symmetry and polarity, rest period in zygote embryonic formulae, embryonomic law. Suspensor-Ultrastructure of suspensor cells, cytology of suspensor cell, physiology and biochemistry of suspensor; Nutrition of embryo- nutrient supply of the zygote, embryo-endosperm relation.
Polyembryony: Definition, causes, classification, induction of polyembryony, practical importance of polyembryony.

Module III:
Apomixis: Definition, causes, classification, - Diplospory, Apospory, pseudogamy, autogamous development of endosperm, causes of apomixes, significance.
Parthenocarpy: Definition, causes, practical importance
Mellitopalynology: Pollen analysis of honey, Role of apiary in crop production.
Biotechnology: Concept and scope of biotechnology; Cell structure, cellular totipotency
   a) Anther and pollen culture,
   b) ovule and nucellus culture
   c) Endosperm culture and its practical applications
   d) Embryo culture: Techniques, nutritional aspects of embryo culture morphological and physiological considerations, culture of mature embryo and proembryo.
   e) Somatic embryogenesis: historical background, embryogenesis from callus, direct embryogenesis- recurrent embryogenesis; cytology of somatic embryogenesis, nutritional factors, hormonal factors.

Module IV:
f) Protoplast culture and somatic hybridization- isolation of protoplast, culture methods, fussion of protoplast, selection of fussion products, consequences of fussion, production of Cybrids and hybrids.
g) Biotransformation and production of useful compounds through cell culture, factor affecting yield, biotransformation, bioreactors, perspective.
Practicals
1) Study from the permanent preparations.
   a) Development and structures of anther pollen.
   b) Structure of ovule, types, megasporogenesis, embryo sac types.
   c) Development of endosperm, types.
   d) Structure and development of embryo- types
   e) Pericarp and seed coat structure from sections and macerations.
   f) Sketching of ovular structure, embryo sac, anther wall, embryo with the help of camera lucida.
2) Techniques, Familiarity with phase contrast, polarizing, fluroscence and electron microscopy, wholemounts, fissionation and macerations, permanent double stained microtome sections, photo microscopy.
3) Preparation of dissected wholemounts of endothecium, tapetum, endosperm and embryo, squash preparations of tapetum, microspore mother cells, dyads, tetrads pollinia and massulae. Study of mitosis and meiosis and identification of various stages.
4) Study of different pollen using acetolysed and non acetolysed pollen, preparation of permanent slides for morphological study. (polarity, symmetry, shape, size, aperture, sporoderm stratification: minimum 15 slides to prepare).
5) Interpretation of electron micrographs (SEM, TEM) of pollen.
6) Short term exercises on pollen production, viability and their percentage of germination. Rate of growth of germ tube to be studied in a given period.
7) Viability of seed through germination, biochemical and excised embryo methods.
8) Cytology of pollen inhibition in self and interspecific incompatibility, application of some technique to overcome incompatibility.
9) Experiments on intra-ovarian pollination.
11) Responses of calli to stress condition viz. temp. (low, high), moisture, salinity.
12) Induction of androgenesis through anther culture.
13) Physiology of embryo development, using electropheratic and histochemical methods embryo culture.
14) Somatic embryogenesis
15) Protoplast culture.

Suggested Readings:
M. Sc. Botany Syllabus  
Semester IV  
Course code/name: Paper XVI- ADVANCED PHYCOLOGY PAPER- II (Special)

MODULE 1:  
Algae Physiology and Cultivation:-  
1. Cyanide resistance, respiration in algae, heavy metal pollution and their role in Biotechnology.  
2. Intracellular substance of *Spirulina*, *Scenedesmus*, *Chlorella* and marine algae.  
3. Algae cultures & continuous and mass cultivation in laboratory and their field applications.

MODULE 2: Hydrobiology / Limnology  
1. Lentic environment: General consideration, physico-chemical factors, and their influence, Phytoplankton nature and adaptation of plankters, periodicity and succession, vertical distribution, productivity and factors influencing it.  
2. Lotic environment: General consideration, physico-chemical factors, and their influence.  
3. Marine benthic: General principal, shore types, zonation patterns and factors governing them, Life forms, Geographical distribution, Marine Algae in India.  
Eutrophication and algal blooms: Definition factor: responsible for water quality, use of algal blooms and their control measures.

MODULE 3: Study of phytoplanktons  
Terminology, population, adaptations  
Distribution, productivity and succession  
Primary productivity and measurement of growth rate and natural mortality.  
Chemical features and chemical cycles in epilimnion and hypolimnion.

MODULE 4: Ecology and environmental Biotechnology:  
1. Distribution, community structure in fresh and marine water. Role of algae as indicators of pollution and its concept.  
3. Ecobiotechnology for the remediation of eutrophic lentic and lotic water bodies.
M. Sc. Botany Syllabus
Semester IV
Course code/name: Paper- XVI (Mycology and Plant Pathology - special II)

Module I:
**History**: Milestones in phytopathology with particular reference to India. Major epidemics and their social impacts. Historical developments of chemicals, legislative, cultural and biological protection measures including classification of plant diseases.

**Physiological and Molecular Plant Pathology**

Module II: Principles of Plant pathology
i. Principles of plant pathology- Importance, nature, classification and general symptoms of plant diseases.
ii. Koch's Postulates: Pathogenecity of microorganisms and pathogenesis.
iii. Host parasite relationship and Interaction, mechanism of infection, path of infection.
iv. Defence mechanism in host plants against pathogens - morphological or structural defence mechanism, Biochemical defence mechanisms, defence, role of phenolic compounds, enzymes and toxins,
v. Epidemiology and forcasting of plant diseases- the form of epidemic conditions for decline of epidemic, methods used in forecasting.
v. Principles and methods of plant disease control - cultural methods, chemical methods, Biological control, integrated pest management (IPM), Biopesticides.

Module III:
A Detailed study of the Diseases of the following crops caused by fungal pathogens with effective control measures.

**Diseases of Cereals**:
Seedling blight of cereals, Smut of wheat, Foot rot of wheat, Loose smut, Covered smut of Barley, False smut of rice, Leaf spot of rice, Downey mildew of jowar, Green ear disease of Bajra, Ergot of Bajra, Downey mildew of maize.

**Diseases of Vegetable crops with special reference to the important diseases of the following**:
Chilli, Brinjal, Tomato, Potato, Coriander, Ginger, Onion, Bhindi.
General knowledge of post harvest diseases of fruits and vegetables and their control.

**Diseases of Oil Seed Crops**: Viz. - Linum, Seasamum, Groundnut, Mustard and Sunflower

**Diseases of Fruit Trees**:
With special reference to important diseases of the following Citrus, Apple, Mango, Papaya, Banana and Grapes.

Module- IV :Bacterial Diseases of Plants:
Important Pathological aspects of the following bacterial diseases.
Bacterial blight of rice, Tundu disease of wheat, Angular leaf spot of cotton, stalk rot of maize, Fire blight of Apple, Bacterial soft rot of fruits and Vegetables.

**Viral Diseases of Plant:**  
Bunchy top of Banana, Leaf curl of Papaya, Yellow vein mosaic of Bhindi. Mosaic of Cucurbits, Viral diseases of Tobacco, Potato and Tomato.

**Mycoplasma Diseases of Plants:**  
Citrus greening, Rice yellow dwarf: Little leaf of Brinjal, Sandal Spike.

**Nematode Diseases of Plants:**  
General knowledge of plant parasitic nematodes and Important nematode diseases viz. Root knot of Vegetables, Ear cockle of wheat.

**Suggested Readings**

30. On line Journals available on UGC -VSAT

Laboratory Exercises:
1. Principles & working of tools, equipments and other requirements in the Mycology & Plant Pathology laboratory.
2. Micrometry and measurement of organisms.
4. Drawing of Camera Lucida diagrams and knowledge of computer based photomicrography and image processing
5. Preparation of different cultural media for cultivation of Fungi and Bacteria.
8. Demonstrate antifungal activities of different antibiotics and leaf, flower and root extract.
10. Cultivation of Mushrooms.
12. Isolation of Soil fungi by soil plate (War cup) and serial dilution (Walksman) method.
13. Isolation and identification of Rizosphere mycoflora.
14. Isolation of external and internal seed borne mycoflora by blotter and Agar Plate method. Cereals, pulses, oil seeds, fruit seeds.
15. Demonstration of Koch’s Postulate.
16. Monographic study of locally available plant diseases caused by fungi (atleast 10).
17. Study of locally available crop plant diseases caused by Bacteria (Five)
18. Study of locally available plant diseases caused by viruses & Phytoplasma (Five)
19. Demonstration of morphological & physiological changes in disease plants.
20. Preparation and presentation of herbarium of pathological specimens available in the region (Atleast 20)

21. Field visit to different localities
Visit to Agriculture University, Plant Pathological research centers
M. Sc. Botany Syllabus
Semester IV
Course code/name: Paper- XVI (Palaeobotany - special II)

MODULE –I:

MODULE -II:
Gymnosper-Caytoniales, Glossopteridales, Penntoxylales.fossil Cordaitales, Voltziales and phylogenetic consideration of all the orders.

MODULE –III:

MODULE – IV
Paleopalynology-Important features of spores and pollen morphology, their role in stratigraphy and in exploration of coal and oil. Palaeopalynological studies, microfossils and its application. Paleocology and paleogeography. Indian Gonwana-Its stratigraphy and classification (Two fold and three fold). Index fossil.

Suggested Laboratory and Field Exercises for Paper II
- Study different types of fossils
- Study of plant fossils as per syllabus based on specimens and slides.
- Gymnosperm- Caytoniales, Glossopteridales, Penntoxylales.fossil Cordaitales.
- Lyginopteridaceae, Medullosaceae, Cycadeoidales-Cycadeoidaceae, Williamsoniaceae, Wielandiellaceae.and Fossil Cycads (Nilssonia, Baenia, Androstrobus).
- Study of Deccan Intertrappean flora of India. Pteridophytes, Gymnosperms and Angiosperms-flowers and fruits.
- Important features of spores and pollen morphology and technique to study them (Maceration)
- Study of wood anatomy of fossils.
- Exploration and excursion to different fossiliferous localities.
- Preparation of practical record/submission of collection and tour report of excursion.
SPECIAL PRACTICAL-II

Time: 5 hours) (Full marks: 70
Preparation of slide by maceration technique of a given material 10
Write the monograph on given specimens 20
Comment on the spots (five spots) 15
Practical record, Viva-voce and Field report 20
(10+05+05)
Project 05
M. Sc. Botany Syllabus
Semester IV
Course code/name: Paper- XVI (Palynology - Special II)

UNIT-I. Pollen physiology and biochemistry-
Pollen production,
Pollen viability, tests for pollen viability,
Pollen germination of pollen in vivo and in vitro, germination requirements, germination of 3-nucleated pollen grain, effect of pH and light, effects of hormones and other substances radiation effect, release of metabolites in germination and tube growth, Role of boron and calcium in pollen germination,
Chemical composition of pollen wall and pollen contents (amino acids, proteins, carbohydrates, lipids, vitamins, pectin, DNA, RNA, ascorbic acid, flavones, pigments etc.) in pollen and pollen tube at different steps in germination & their significance, pattern of pollen tube elongation,
Fine structure inside the tube, pollen culture movements of nuclei-and formation of callose plug, promotion and inhibition of pollen tube, elongation, pollen enzymes and isozymes,

UNIT II- Pollen biotechnology and genetics
Pollen storage-Factors affecting viability in storage, freeze-drying of pollen, storage of pollen in organic solvents, causes of decreased viability in storage and pollen germination.
Pollen - pistil interaction - significance, self incompatibility (regulation of fertilization).Pollen allelopathy, chemotropism, Pollen herbarium,
Forensic palynology- Introduction, methodology, role in criminology, problems

UNIT III :-
Aerobiology-Introduction, Historical background, applications of Aeropalynology Aeromycology Aerophycology. Importance in medical field, importance of aero mycological studies in various types of crop infection by spores, disease forecasting , aerobiological work in India and abroad.
Intramural and extramural studies, different devices to collect spores, pollen grains such as kite, balloons, trap air strips and slides, volumetric samplers, culturing techniques, analysis of data and their processing, seasonal changes of air-spora
Indoor environments, Sick buildings & hazards, occupational environment and immunology Outdoor airspora, characteristics, identification,

UNIT IV :-
Airborne allergens- Introduction, allergens and their types, Impact of airborne materials on human system, Lung as particulate sampler,
Source, causes, symptoms of Pollen allergy, fungal spore allergy, dust mite allergy, algal allergy other allergies, Prevention and cure, isolation & culturing of spores, mites, algae. antibodies to human immunoglobulin, types, and significance in diagnosis of allergy, diagnosing allergic diseases based on total and specific IgE determinations, radio immunoassay, (RAST, PRIST, ECP-immunoassay technique), ELISA (competitive, Double-antibody sandwich, indirect ELISA), Western blotting, allergen standardization, Testing and treatment, pollinosis, nasobroncheal allergy, Immunotherapy and prevention of allergy, pollen calendar and daily census of airborne pollen, circadian periodicities of pollen, Correlation between aerobiological, clinical and meteorological data.

LIST OF PRACTICALS:

Section A. Basic aspects / Pollen Morphology
1. To study structure of stamen
2. Study of permanent slides of microsporogenesis
3. Field study on different pollination mechanism
4. To study structure of pistil
5. Preparation of glycerin jelly
6. Preparation of pollen- Acetolysis technique
8. Study of pollen types using acetolysed and non-acetolysed pollen. Pollen morphology polarity, symmetry, shape, size, sporoderm stratification aperture NPC (To study the pollen types from at least 30 different species, Angiosperms preparation of permanent slides.)
10. Interpretation of selected electron micrographs (SEM, TEM) of pollen.

Section B. Aeropalynology/Melittopalynology/Palaeopalynology
12. Use of pollen traps to study local air-spora.
14. Preparation of reference slides by different techniques, culture method (culture of fungi/Algae)
15. Preparation of slides honey samples
17. Estimation of pollen load from bee hive or bees/ pollinator
19. Preparation of allergenic extract of pollen.

Section C Pollen Physiology/ ecology/ biochemistry/ ecology. (Expt. No.29 is compulsory)
20. To study pollen production and pollen viability of the given flowers.
21. To study percentage of pollen germination & rate of pollen tube growth.
22. To study different techniques of pollen storage
23. Effect of temperature and relative humidity on viability of stored pollen
24. Effect on Boron and Calcium on pollen germination and tube growth.
25. Semi-vivo technique to study pollen germination and pollen tube growth.
26. Multiple staining for localizing pollen tubes in the pistil
27. To study pollen germination and pollen tube growth in the pistil by employing
   aniline-blue fluorescence method
28. Cytochemical localization of esterase on stigma surfaces
29. Cytochemical analysis of pollen and pollen tube for various metabolites like
   proteins, amino acids, carbohydrates, starch, ascorbic acid, DNA, RNA, lipids,
   lignin, pectin, cellulose, etc (at least five metabolites)
30. Study of pollen contents by paper chromatography/TLC.
31. Colorimetric estimation of proteins/carbohydrates of pollen grains
32. To separate pollen proteins by SDS-PAGE electrophoresis
33. Enzyme bioassay in pollen grains.
M.Sc. PART –II PRACTICAL EXAMINATION
BOTANY (Practical –III)
M.Sc. PART-II  BOTANY
PRACTICAL–III-PALYNOLOGY (Elective)

Time: - hrs] [Max. Marks-
1. Any ONE experiment from Section A.
2. Any ONE experiment from Section B.
3. Any ONE experiment from Section C.
4. Any ONE experiment from Section C.
   (Other than asked in Question 3)
5. Spots (1-5)
6. Practical Record, Permanent slides & field record and Viva-voce

-----------------------------------------------------------------------------------

RECOMMENDED READING

1. Afzelius, B.M. 1956 Electron-microscope investigation into exine stratification *Grana Palynologica* (N.S.) 1:2,
14. Caulton Eric, Agashe S. N. - Pollen and Spores applications with special emphasis on Aerobiology and Allergy.


of pollen vedamse Book (P) Ltd. New Delhi.
82. Sowunmi, M.A. 1976. The potential value of Honey in palaeopalynology and
83. Sporne, K.R. 1972. Some observations on the evolution of pollen types in
dicotyledons. Newphytol. 71:181-185,
Springer-Verlag, Berlin,
88. Swamy, B.G.L. and K.V. Krishnamurthy. 1980 From Flower to Fruit. Tata McGraw-
Hill Publisher,
89. Takhtajan A.L. 1980. Outline of the classification of flowering plants
(Magnoliophyta). Bot.rev. 46(3):
90. Talde U.K. 1994. Advances in Mycology and Aerobiology- Dr S T Tilak
commendation volume.
Tomorrow Pub., New Delhi
Prakashan, Aurangabad.
Delhi.
Knowledge of the structure of acetylised pollen grains, I. Palyn Bull. II and III
14(1):
angiosperms. Amer. J. Bot 61(8):
J. Bot. 61(10): 197b.
104. Walton, John. 1940. An Introduction to the Study of Fossil Plants. Adam and
Charles Black, London