PANJAB UNIVERSITY, CHANDIGARH

OUTLINES OF TESTS, SYLLABI
AND
COURSES OF READING FOR
M. Sc. BOTANY
(TWO YEARS’ COURSE)
SEMESTER SYSTEM,

1ST TO 4TH SEMESTERS
EXAMINATIONS of 2019-2020
# PANJAB UNIVERSITY, CHANDIGARH

OUTLINES OF TESTS, SYLLABI AND COURSES OF READING FOR M. Sc. BOTANY (TWO-YEAR COURSE) SEMESTER SYSTEM
EXAMINATIONS of 2019–20, 2020-21 & 2021-22

## FIRST SEMESTER

<table>
<thead>
<tr>
<th>PAPER</th>
<th>SUBJECT</th>
<th>THEORY Max. Marks</th>
<th>PRACTICAL Max. Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Phycology</td>
<td>75 (60A+ 15 HT*)</td>
<td>25 (20+5HT*)</td>
</tr>
<tr>
<td>II</td>
<td>Bryology</td>
<td>75 (60A+ 15 HT*)</td>
<td>25 (20+5HT*)</td>
</tr>
<tr>
<td>III</td>
<td>Mycology and Microbiology</td>
<td>75 (60A+ 15 HT*)</td>
<td>25 (20+5HT*)</td>
</tr>
<tr>
<td>IV</td>
<td>A) Computer Applications &amp; Biostatistics</td>
<td>75 (60A+ 15 HT*)</td>
<td>25 (20+5HT*)</td>
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<td></td>
<td>B) Lab. Techniques</td>
<td></td>
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</tr>
<tr>
<td>V</td>
<td>Anatomy of Angiosperms</td>
<td>75 (60A+ 15 HT*)</td>
<td>25 (20+5HT*)</td>
</tr>
</tbody>
</table>

Total Marks: 375

GRAND TOTAL OF MARKS: 375+ 125 = 500

TEACHING HOURS:
THEORY: 19 Hours per week
PRACTICAL: 15 Hours per week for a group of 10 students

HT*: House Test

## SECOND SEMESTER

<table>
<thead>
<tr>
<th>PAPER</th>
<th>SUBJECT</th>
<th>THEORY Max. Marks</th>
<th>PRACTICAL Max. Marks</th>
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</thead>
<tbody>
<tr>
<td>VI</td>
<td>Pteridophytes</td>
<td>75 (60A+ 15 HT)</td>
<td>25 (20+5HT*)</td>
</tr>
<tr>
<td>VII</td>
<td>Gymnosperms</td>
<td>75 (60A+ 15 HT)</td>
<td>25 (20+5HT*)</td>
</tr>
<tr>
<td>VIII</td>
<td>Angiosperm Morphology, Taxonomy and Phylogeny</td>
<td>75 (60A+ 15 HT)</td>
<td>25 (20+5HT*)</td>
</tr>
<tr>
<td>IX</td>
<td>Reproductive Biology of Angiosperms</td>
<td>75 (60A+ 15 HT)</td>
<td>25 (20+5HT*)</td>
</tr>
<tr>
<td>X</td>
<td>Plant Pathology</td>
<td>75 (60A+ 15 HT)</td>
<td>25 (20+5HT*)</td>
</tr>
</tbody>
</table>

Total Marks: 375

GRAND TOTAL OF MARKS: 375+ 125 = 500

TEACHING HOURS:
THEORY: 19 Hours per week
PRACTICAL: 15 Hours per week for a group of 10 students

HT*: House Test.
# SECOND YEAR

**3rd and 4th SEMESTERS**

## THIRD SEMESTER

<table>
<thead>
<tr>
<th>PAPER</th>
<th>SUBJECT</th>
<th>THEORY Max. Marks</th>
<th>PRACTICAL Max. Marks</th>
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<tbody>
<tr>
<td>XI</td>
<td>Molecular Biology</td>
<td>75 (60A + 15 HT*)</td>
<td>25 (20+5HT*)</td>
</tr>
<tr>
<td>XII</td>
<td>Plant Physiology</td>
<td>75 (60A + 15 HT*)</td>
<td>25 (20+5HT*)</td>
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<tr>
<td>XIII</td>
<td>Biotechnology</td>
<td>75 (60A + 15 HT*)</td>
<td>25 (20+5HT*)</td>
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<tr>
<td>XIV</td>
<td>Cytogenetics</td>
<td>75 (60A + 15 HT*)</td>
<td>25 (20+5HT*)</td>
</tr>
<tr>
<td>XV</td>
<td>Ecology and Environment</td>
<td>75 (60A + 15 HT*)</td>
<td>25 (20+5HT*)</td>
</tr>
</tbody>
</table>

Total Marks: 375

Grand Total of Marks: 375 + 125 = 500

**TEACHING HOURS:**
- Theory: 18 Hours per week
- Practical: 16 Hours per week for a group of 10 students

**HT**: House Test.

## FOURTH SEMESTER

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>XVI</td>
<td>Plant Biochemistry</td>
<td>75 (60A + 15 HT*)</td>
<td>25 (20+5HT*)</td>
</tr>
<tr>
<td>XVII</td>
<td>Forestry</td>
<td>75 (60A + 15 HT*)</td>
<td>25 (20+5HT*)</td>
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<tr>
<td>XVIII</td>
<td>Genetics and Plant Breeding</td>
<td>75 (60A + 15 HT*)</td>
<td>25 (20+5HT*)</td>
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<tr>
<td>XIX</td>
<td>Plant Resource, Utilization and Conservation</td>
<td>75 (60A + 15 HT*)</td>
<td>25 (20+5HT*)</td>
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<tr>
<td>XX</td>
<td>A) Research Project/Field Study Report</td>
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<td>B) Seminar</td>
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<td>40</td>
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Total Marks: 300

Grand Total of Marks: 300 + 200 = 500

**TEACHING HOURS:**
- Theory: 18 Hours per week
- Practical: 16 Hours per week for a group of 10 students

**HT**: House Test.

* The duration of each paper for the examination is 3 hours
FIRST YEAR
1st and 2nd SEMESTERS
EXAMINATIONS 2018–19, 2019-20 & 2020-21
(ADMISSION of 2018, 2019, 2020)

FIRST SEMESTER

PAPER I: PHYCOLOGY

Objective of the paper is to impart knowledge about Algae on various aspects like Classification, Life cycles, Thallus organization and Reproduction in various groups; Evolution, Habitats and Economic importance of algae.

Teaching methodology includes delivery of lectures by the teacher using black board and many other tools like Visual Charts, Over Head projector etc. The students also make group discussions in the class rooms. In practical, the students make observations and work on the plant materials using Microscopes, Micrometers, Computer and Image Projecting system and permanent glass slides of plant materials.

Theory : 75(60A+ 15HT)
Practical : 25(20A+5HT)

Max. Marks : 60

NOTE : Question paper will have four sections. Examiner will set a total of nine questions comprising two questions from each unit, and one compulsory question of short answer/MCQ type covering the whole syllabus. Students will attempt one question from each unit and the compulsory question. All questions may carry equal marks, unless specified.

UNIT-I

1. Criteria for algal classification (pigments, reserve food, flagella, chloroplasts, pyrenoids, eye spots, endoplasmic reticular membrane etc.); Comparative account of important systems of classification (Fritsch, Round, Chapman and Lee).

UNIT-II


UNIT-III

5. Thallus organization in algae including evolutionary trends.
7. Current concepts and relationships of protochlorophycean algae.

UNIT-IV

8. Rhythms and bioluminescence in dinoflagellates.
9. Economic importance of algae (algal biofertilizers, algal blooms, algae as food and feed, uses in industries etc.)
10. Algae in Biotechnology.
PRACTICALS

Max. Marks : 20

1. Algal collections from different habitats and their identification.

2. Morphology and reproductive stages of following genera:

**Cyanophyta**: Chroococcus, Microcystis, Oscillatoria, Lyngbya, Nostoc, Anabaena, Gloeotrichia, Cylindrospermum, Scytonema.

**Chlorophyta**: Volvox, Hydrodictyon, Chlorella, Pediastrum, Scenedesmus, Oedogonium, Bulbochaete, Cosmarium, Closterium, Zygema, Sphaeroplea, Cladophora, Pithophora, Spirogyra, Caulerpa, Codium, Valonia, Halimeda, Acetabularia, Chara, Nitella, Coleochaete, Dreparnaldia.

**Xanthophyta**: Vaucheria, Botrydium.

**Bacillariophyta**: Pinnularia, Synedra, Navicula, Cyclotella.

**Phaeophyta**: Ectocarpus, Fucus, Laminaria, Dictyota, Desmarestia, Sporochnus, Sargassum.

**Rhodophyta**: Erythrotrichia, Porphyra, Nemalion, Batrachospermum, Corallina, Gelidium, Polysiphonia

ESSENTIAL READINGS


SUGGESTED READINGS


PAPER II: BRYOLOGY

Objective of the paper is to impart knowledge about Bryophytes on various aspects like Classification, structural organization and developmental studies of gametophyte and sporophyte in various groups; Ecology, Water relations, Chemistry, Cytology, Fossil bryophytes, Origin and evolution, Experimental studies and Economic Importance.

Teaching methodology includes delivery of lectures by the teacher using black board and many other tools like Visual Charts, Over Head projector etc. The students also make group discussions in the class room. In practical the students make observations and work on the plant materials using Microscopes, Micrometers, Computer and Image Projecting system and permanent glass slides of plant materials.

Theory : 75(60A+15HT)
Practical : 25 (20A+5HT)
THEORY

Max. Marks: 60

NOTE: Question paper will have four sections. Examiner will set a total of nine questions comprising two questions from each unit, and one compulsory question of short answer/MCQ type covering the whole syllabus. Students will attempt one question from each unit and the compulsory question. All questions may carry equal marks, unless specified.

UNIT-I

1. General characteristics of Bryophytes: systems of classification with salient features of Anthcerotophyta, Marchantiophyta and Bryophyta.
2. Structure and development of sex organs in Bryophytes.
3. Economic Importance of Bryophytes.
4. Ecology of Bryophytes: Habitats, Growth forms, Bryophytes as Pollution Indicators.
5. Water Relations: Drought Tolerance ; Dessication and Rehydration ; Ectohydric ,Endohydric and Mixohydric mosses.

UNIT-II

6. Comparative structural organization of gametophyte and sporophyte; Asexual reproductive structures; distribution of sex organs; protective structures associated with archegonia and developing sporogonia; spore and elaters / peristome teeth ; spore dispersal mechanisms and spore germination in
   a) Hornworts (Anthocerotales)
   b) Liverworts (Calobryales, Jungermanniales, Metzgeriales, Marchantiales, Monocleales and Sphaerocarpales)

UNIT-III

   c) Mosses (Sphagnopsida, Andreaeopsida – Andreaea and Takakia, Archidiopsida, and Peristomiopsida -- Tetraphidae, Buxbaumidae, Polytrichidae and Bryidae).

7. Experimental studies: Effect of various factors on protonemal differentiation and bud formation; Apogamy and Apospory.

UNIT-IV

8. Chemistry of Bryophytes: A brief account of distribution of various organic compounds in different groups of Bryophytes ; Chemistry in relation to taxonomy.
9. Cytological studies in Bryophytes: Chromosome numbers in major groups of Bryophytes, Polyploidy in brief, m-chromosomes and sex-chromosomes, Cytology in relation to taxonomy.
10. Fossil Bryophytes (A brief account).

PRACTICALS

Max. Marks : 20

2. Study of diagnostic features of following genera: Dumortiera, Athalamia, Conocephalum, Cryptomitrium, Reboulia, Riccia, Riccardia, Metzgeria, Blasia, Sewardiella, Plagiochila, Fissidens, Atrichum, Mnium and Thuidium.
3. Field trips to familiarize with natural habitats, growth forms and diversity of bryophytes.
4. To study permanent slides / photographs of m-Chromosomes and Sex- chromosomes.
ESSENTIAL READINGS


SUGGESTED READINGS


PAPER III : MYCOLOGY AND MICROBIOLOGY

**Objective** of the paper is to impart knowledge about Classification, Mycelium, Reproduction in various groups of Fungi; Nomenclature, Classification, Structure, reproduction, importance of Bacteria, Viruses, MLOs, Spiroplasmas, Viroids, Mycoviruses; Translocation and distribution in host plants, infection, replication and transmission of plant viruses.

**Teaching methodology** includes delivery of lectures by the teachers using black board and many other tools like Visual Charts, Over Head projector etc. The students also make group discussions in the class rooms. In practical the students make observations and work on the plant materials using Microscopes, Micrometers, Computer and Image Projecting system and permanent glass slides of plant materials.

**THEORY**

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<tr>
<th>Theory</th>
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<tr>
<td>Practical</td>
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**Max. Marks : 60**

**NOTE :** Question paper will have *four* sections. Examiner will set a total of nine questions comprising two questions from each unit, and one compulsory question of short answer/MCQ type covering the whole syllabus. Students will attempt one question from each unit and the compulsory question. All questions may carry equal marks, unless specified.

**UNIT-I**

1. Recent trends in the classification of Fungi.
2. General account of Myxomycota, Oomycota and Chytridiomycota

**UNIT-II**

3. General account of Zygomycota, Ascomycota, Basidiomycota and anamorphic fungi.

**UNIT-III**

4. Tissue systems in Fungi.
5. Types of Centrum development in Ascomycota.
6. Heterokaryosis and Parasexuality.
7. Mycorrhizal application in agriculture and plant growth.
UNIT-IV

8. Nomenclature, classification, morphology, translocation and distribution in host plants, infection, replication and transmission of plant viruses.
9. Nomenclature, classification, structure, reproduction, nutrition and economic importance of Eubacteria; General account of Archaeabacteria.
10. Brief account of MLOs, Spiroplasma, Viroids and Mycoviruses.

PRACTICALS

Max. Marks: 20

1. Study of morphological and reproductive structures of following genera:
   MYXOMYCOTA: Stemonitis, Physarum.
   OOMYCOTA: Saprolegnia, Albugo, Peronospora, Phytophthora, Bremia.
   CHYTDIOMYCOTA: Synchitrrium, Allomyces, Blastocladia.
   ZYGOMYCOTA: Mucor, Rhizopus, Pilobolus.
   ASCOMYCOTA: Protomyces, Aspergillus, Penicillium, Claviceps, Phyllactinia, Xylaria, Morchella, Peziza.
   BASIDIOMYCOTA: Puccinia, Melampsora, Agaricus, Ustilago, Polyporus, Ganoderma, Cyathus, Hydnum, Geasterum.
   ANAMORPHIC FUNGI: Fusarium, Cercospora, Colletotrichum, Alternaria, Helminthosporium.

2. Preparation of media to isolate fungi, bacteria and other microbes.
3. Isolation of Rhizobium from legume root nodules.
4. Sensitivity tests of bacteria using different antibiotics.

SUGGESTED READINGS


SUGGESTED READINGS


PAPER IV : A) COMPUTER APPLICATIONS AND BIOSTATISTICS

B) LABORATORY TECHNIQUES

Objective: Now-a-days life sciences have become interdisciplinary. The aim of this paper is to converse and train the students with different modern biological and physico-chemical techniques employed in the study of biological materials.

This paper also aims to impart basic knowledge of Computer (Computer Hardware, software and programming languages etc.) and Biostatistics and use the information in analyzing the biological data.
**Teaching methodology** includes delivery of lectures by the teachers using black board and many other tools like Visual Charts, Over Head projector, LCD projector etc. The students also make group discussions in the class rooms. In practical the students learn the working of different instruments and computer.

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**THEORY**

**Max. Marks : 60**

**NOTE:** Question paper will have *four* sections. Examiner will set a total of nine questions comprising two questions from each unit, and one compulsory question of short answer/MCQ type covering the whole syllabus. Students will attempt one question from each unit and the compulsory question. All questions may carry equal marks, unless specified

**SECTION A : COMPUTER APPLICATIONS AND BIOSTATISTICS**

**UNIT-I**

1. General awareness of Computer Hardware i.e., CPU and other peripheral devices.
2. Introduction to MS Office software, covering word processing, spread sheet & presentation software.
3. Introduction to internet and its applications.
4. Introduction to programming in C & its functions.
5. FORTRAN; Preparation of programme.

**UNIT-II**

1. Principles and practice of statistical methods in biological research samples and populations.
3. Coefficient of variation, standard error, confidence interval.
4. Probability distribution, binomial, Poisson and normal.
5. Tests of statistical significance (Chi square – test, Z-test, F-test, Student t-Test).
6. Analysis of variance – one way ANOVA. Coefficient of correlation; Simple & multiple regression.

**ESSENTIAL READINGS**


**SUGGESTED READINGS**

SECTION B : LABORATORY TECHNIQUES

UNIT-III

2. Principles and applications of Tracer Techniques in Biology: Radioactive Isotopes and Half Life of isotopes; Autoradiography.
3. pH metery – Principles and applications.

UNIT-IV

5. Electrophoresis and Isoelectric focusing: Principle, working and applications of Electrophoresis.
7. Centrifugation: Technique and principles; Preparative and Analytical Centrifugation.

PRACTICALS

Max. Marks : 20

1. Data collection, presentation, plots, Chi-square test, Goodness of fit, determination of correlation coefficient.
2. Genomic DNA isolation.
3. DNA and Protein analysis by Gel electrophoresis.
4. To demonstrate Beer’s law using different dyes.
5. Preparation of Phosphate Buffers of different pH values.
6. Practicals pertaining to Chromatographic techniques: Column Chromatography (Exclusion and Affinity Chromatography), Paper Chromatography and Thin Layer Chromatography.
7. Practicals pertaining to centrifugation.

ESSENTIAL READINGS


SUGGESTED READINGS

Objective: This paper deals with the structure, origin, differentiation and phylogeny of meristems cell, tissues and organs of the plant body.

Teaching methodology includes delivery of lectures by the teachers using black board and many other tools like Visual Charts, Over Head projector etc. The students also make group discussions. In practical the students make observations and work on the plant materials using Microscopes, Micrometers, Camera Lucida, Computer and Image Projecting system and permanent glass slides of plant materials

Theory : 75(60A+ 15HT)  
Practical : 25(20A+5HT)

THEORY

Max. Marks : 60

NOTE : Question paper will have four sections. Examiner will set a total of nine questions comprising two questions from each unit, and one compulsory question of short answer/MCQ type covering the whole syllabus. Students will attempt one question from each unit and the compulsory question. All questions may carry equal marks, unless specified.

UNIT-I

1. Shoot Development : Various theories regarding the organization and activity of shoot apical meristem (SAM); Transition to flowering, Floral meristem and Floral development in Arabidopsis and Antirrhinum.
2. Root development: Organization of Root Apical Meristem (RAM); Vascular tissue differentiation; lateral roots.

UNIT-II

3. Leaf growth and differentiation: Phyllotaxy, Leaf development, differentiation of epidermis (with special reference to stomata and trichomes) and mesophyll, Kranz Anatomy and Leaf abscission.

UNIT-III

4. Structure, differentiation and phylogeny of Xylem; Reaction wood.
5. Structure, differentiation and phylogeny of Phloem

UNIT-IV

6. Transfer Cells.
7. Structure and activity of vascular and cork cambium.
8. Seed coat anatomy with reference to legumes and cereals.

PRACTICALS

Max. Marks : 20

1. Study of anomalous type of secondary growth through transverse sections.
2. Maceration of wood.
3. Study of living shoot apices.
4. Study of cyto-histological zonation in the shoot apical meristem and examination of shoot apices in both T.S. and L.S. to show the origin and arrangement of leaf primordia.
5. Study of V.S. of various types of leaves.
7. Study of T.S. of Seed Coat.
ESSENTIAL READINGS


SUGGESTED READINGS


SECOND SEMESTER

PAPER VI: PTERIDOPHYTES

Objective of the paper is to impart knowledge about Pteridophytes on various aspects like Classification, Structural organization and Developmental studies of sporophyte and gametophyte of extant and extinct Pteridophytes, Economic importance, Cytological and Experimental studies.

Teaching methodology includes delivery of lectures by the teachers using black board and many other tools like Visual Charts, Over Head projector etc. The students also make group discussions in the class rooms. In the practical the students make observations and work on the plant materials (including fossils) using Microscopes, Micrometers, Computer and Image Projecting system and permanent glass slides of plant materials.

Theory : 75(60A+ 15HT)
Practical : 25(20A+5HT)

THEORY

Max. Marks : 60

NOTE: Question paper will have four sections. Examiner will set a total of nine questions comprising two questions from each unit, and one compulsory question of short answer/MCQ type covering the whole syllabus. Students will attempt one question from each unit and the compulsory question. All questions may carry equal marks, unless specified.

UNIT-I

1. General characteristics, The emerging concepts and Classification of pteridophytes.
2. Geological Time Table ; Fossils- their types, formation and methods of study ; Calculation of age of rocks / fossils.
3. Distribution, habitat, range, organography, external and internal morphology of sporophyte, spores and their mechanism of dispersal, gametophytic generation and sexuality and embryogeny of following classes of Pteridophytes with reference to the genera mentioned:

**A: PSILOPSIDA**
   i ) Rhyniales : Rhynia, Horneophyton, Yarravia, Cooksonia
   ii ) Trimerophytales : Trimerophyton, Psilophyton
iii ) Zosterophyllales : Zosterophyllum, Kaulangiophyton, Crenaticaulis, Sawdonia

B: PSILOTOPSISDA
Psilotales : Psilotum and Tmesipteris : A discussion on the systematic position of this group in pteridophytes.

UNIT-II

C: LYCOPSIDA
i) Protopsidodendrales : Drepanophycus, Asteroxylon, Protopenodendron,
ii) Lycopodiales : A brief account of Lycopodium and Phylloglossum
iii) Lepidodendrales : Stigmaria
   Family Lepidodendraceae, Family Bothrodendraceae,
   Family Sigillariacea, Family Pleuromiaceae
iv) Isoetales : Isoetes, Nathorstiana, Brief account of Stylites
v ) Selaginellales : Selaginella (A brief account)

D: SPHENOPSIDA
i) Hyeniales : Hyenia
ii) Sphenophyllales : Sphenophyllum, Shenophyllostachys, Eviostachya, Cheirostrobus
iii) Calamitales : Asterocalamites, Protocalamites, Calamites, Calamostachys, Paleostachys
iv) Equisetales : Equisetum (A brief account)

UNIT-III

E: PTEROPSIDA
a) Primofilices
   i) Cladoxylales : Cladoxylon, Pseudosporochnus
   ii) Coenopteridales : Stauropteris, Botryopteris, Rhacophyton
b) Eusporangiatae
   i) Marattiales : Psaronius, Angiopteris, Marattia
   ii) Ophioglossales : Ophioglossum, Botrychium, Helminthostachys
c) Osmundidae : Osmundales – Osmunda
d) Leptospangiatae
   i) Marsileales : A brief account
   ii) Salviniales : Salvinia, Azolla
   iii) Filicales: General account of sporophyte morphology, stellar organization, soral and sporangial characters, gametophytes and embryogeny.

UNIT-IV

4. Apogamy and Apospory
5. Reproductive Biology of ferns.
7. Cytological evolution and Species Concepts – Cytological evolutionary role of polyploidy in the evolution of pteridophytes.
8. Economic importance of Pteridophytes

PRACTICALS Max. Marks :20
1. Study of morphology and anatomy of vegetative and reproductive organs using cleared whole mounts, sections, macerations and permanent preparations of following living genera : Psilotum, Lycopodium, Isoetes, Selaginella, Equisetum, Angiopteris, Ophioglossum, Botrychium, Osmunda, Marsilea, Salvinia, Azolla, Lygodium, Hymenophyllum,
Cyathea, Pteris, Asplenium, Dryopteris, Polystichum, Adiantum, Polypodium, and Lepisorus.

2. Study of some fossil pteridophytes through specimens and permanent slides.
3. Preparation of permanent slides / charts.
4. Field trips to familiarize with the diversity of pteridophytes in their natural habitats.

ESSENTIAL READINGS


SUGGESTED READINGS


PAPER VII: GYMNOSPERMS

Objective of the paper is to impart knowledge about Gymnosperms on various aspects like classification, structural organization and developmental studies of sporophyte and gametophyte of extant and extinct Gymnosperms, Economic importance, Cytological studies and Phytogeography.

Teaching methodology includes delivery of lectures by the teachers using black board and many other tools like Visual Charts, Over Head projector etc. The students also make group discussions in the class rooms. In practical the students make observations and work on the plant materials (including fossils) using Microscopes, Micrometers, Computer and Image Projecting system and permanent glass slides of plant materials.

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<tbody>
<tr>
<td>75(60A+ 15HT)</td>
<td>25(20A+5HT)</td>
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</table>

THEORY                 Max. Marks : 60

NOTE: Question paper will have four sections. Examiner will set a total of nine questions comprising two questions from each unit, and one compulsory question of short answer/MCQ type covering the whole syllabus. Students will attempt one question from each unit and the compulsory question. All questions may carry equal marks, unless specified.

UNIT-I

1. General characteristics and Classification of Gymnosperms (Broad outlines).
2. Detailed study of the vegetative morphology, reproductive organs, structure and evolution of the following orders and families (with reference to the genera mentioned)

I. CLASS : PROGYMNOSPERMOPSIDA
i) ORDER : ANEUROPHYTALES
   Family: Aneurophytaceae : Aneurophyton, Tetraxylopteris, Triloboxylon, Proteokalon

ii) ORDER : PROTOPITYALES
    Family : Protopityaceae : Protopitys

iii) ORDER : ARCHAEOPTERIDALESI
     Family : Archaeopteridaceae : Archaeopteris

UNIT-II

II. CLASS : CYCADOPSIDA

i) ORDER : PTERIDOSPERMALES
   a) Family Lyginopteridaceae : Lyginopteris, Lagenostoma, Telangium, Crossotheca
   b) Family Glossopteridaceae : Vertebraria, Glossopteris,
   c) Family Medullosaceae : Medullosa, Codonotheca Pachytesta, Whittleseya, Goldenbergia
   d) Family Caytoniaceae : Sagenopteris, Caytonia

ii) ORDER : BENNETTITALES ( CYCADEOIDEALES )
    a) Family Bennettitaceae ( = Cycadeoideaceae ) : Bennettites
    ( = Cycadeoidea )
    b) Family Williamsoniaceae : Williamsonia
    c) Family Wiellandiellaceae : Wiellandiella, Williamsoniella

iii) ORDER : CYCADALES
    a) Family Cycadaceae : Macrozamia, Zamia

iv) ORDER : PENTOXYLALES
    a) Family Pentoxylaceae : Pentoxylon, Nepanioxylon, Carnoconites, Sahnia

UNIT-III

III CLASS : CONIFEROPSIDA

i) ORDER : CORDAITALES
   Family Cordaitaceae : Cordaites, Cordianthus, Mitrospermum

ii) ORDER : CONIFERALES
   a) General account with reference to the families : Pinaceae, Taxodiaceae, Podocarpaceae, Cephalotaxaceae, Araucariaceae, Sciadopityaceae
   b) Range of form, structure and evolution of Female Cones in Coniferales

iii) ORDER : GINKGOALES
     Family Ginkgoaceae : Ginkgo

iv) ORDER : TAXALES
     Family Taxaceae : Taxus

IV CLASS : GNETOPSIDA

1) ORDER : GNETALES
   a) Family Gnetaceae : Gnetum
   b) Family Welwitschiaceae : Welwitschia
UNIT-IV

3. Male gametophytes in Gymnosperms.
4. Distribution of Living Gymnosperms in India.
5. Structure and Evolution of Archegonium in Gymnosperms.
7. Economic importance of gymnosperms.

PRACTICALS

2. Study of some Fossil Gymnosperms through specimens and permanent slides.
3. Field trips to familiarize various gymnosperms in nature and field identification of Indian Gymnosperms.
4. Preparation of permanent slides / charts.

ESSENTIAL READINGS


SUGGESTED READINGS


PAPER VIII : ANGIOSPERM MORPHOLOGY, TAXONOMY AND PHYLOGENY

Objective of the paper is to impart knowledge about Angiosperms on various aspects like Taxonomy, Phylogeny, Classification, Botanical gardens, Herbaria, Floras, Manuals, Periodicals and Botanical Survey of India and Biodiversity and structural organization of vegetative and reproductive organs of various groups.

Teaching methodology includes delivery of lectures by the teachers using black board and many other tools like Visual Charts, Over Head projector etc. The students also make group discussions in the class rooms. In practical the students study flowers of different families.

Theory : 75(60A+15HT)
Practical : 25(20A+5HT)

THEORY

Max. Marks : 60

NOTE : Question paper will have four sections. Examiner will set a total of nine questions comprising two questions from each unit, and one compulsory question of short answer/MCQ type covering the
whole syllabus. Students will attempt one question from each unit and the compulsory question. All questions may carry equal marks, unless specified.

UNIT-I
1. Principles of Plant Classification with emphasis on modern tools of taxonomy; Taxonomy as a SYNTHETIC DISCIPLINE, Numerical Taxonomy, Chemotaxonomy, Serology and Taxonomy, Biosystematics.
2. Taxonomic literature, General Indexes, Floras, Manuals, Important periodicals with emphasis on Indian floristics.
3. Important Botanical Gardens and Herbaria.

UNIT-II

UNIT-III
8. Salient features of following families:

(a) DICOTYLEDONS

(b) MONOCOTYLEDONS:
- Orchidaceae, Cannaceae, Amaryllidaceae, Liliaceae, Palmae, Araceae, Cyperaceae, and Gramineae.


PRACTICALS       Max. Marks : 20
1. Study of morphology, primitive and advanced characters of cultivated and wild representatives of various families. Study of basic structure of flower, variations, floral parts in detail, floral symmetry, insertion of floral parts etc.
2. Location of key characters and use of keys to derive families.
3. Field study of angiosperms in different types of habitats and preparation of Plant album.
4. Training in using floras for identification of specimens described in field or class.

ESSENTIAL READINGS
SUGGESTED READINGS


PAPER IX: REPRODUCTIVE BIOLOGY OF ANGIOSPERMS

Objective of the paper is to impart knowledge about various biological aspects of reproduction in Angiosperms like structure of male and female Gametophyte, Palynology, Pollination, Pollen-pistil interaction, Self incompatibility, Apomixis, Fertilization, Endosperm, Embryo and Seed formation.

Teaching methodology includes delivery of lectures by the teachers using black board and many other tools like Visual Charts, Over Head projector etc. The students also make group discussions. In practical the students make observations and work on the reproductive parts of the plant materials using Microscopes, Micrometers, Computer and Image Projecting system and permanent glass slides of plant materials.

Theory: 75(60A+15HT)
Practical: 25(20A+5HT)

THEORY

Max. Marks: 60

NOTE: Question paper will have four sections. Examiner will set a total of nine questions comprising two questions from each unit, and one compulsory question of short answer /MCQ type covering the whole syllabus. Students will attempt one question from each unit and the compulsory question. All questions may carry equal marks, unless specified

UNIT-I

1. **Apomixis**: Types and evolutionary significance.
2. **Male Gametophyte**: Structure of anthers; Microsporogenesis; Role of tapetum; Pollen development; Sperm dimorphism.
3. **Palynology**: Pollen wall structure; Male sterility; Hybrid seed production; Pollen viability and storage.

UNIT-II

4. **Female Gametophyte**: Ovule development; Megasporogenesis; organization of Embryo sac, structure of embryo sac cells.
5. **Pollination, Pollen-pistil interaction and fertilization**: Floral characteristics; Pollination mechanisms and vectors; breeding systems; structure of the pistil; Pollen-stigma interactions and pollen tube growth and guidance.

UNIT-III

UNIT-IV
8. **Endosperm**: Development and types.
9. **Embryo**: Development of embryo in Monocots and Dicots.
10. **Seed**: Structure and formation.

**PRACTICALS**

Max. Marks: 20

1. Study of microsporogenesis and gametogenesis in sections of anthers.
2. Examination of modes of anther dehiscence and collection of pollen grains for microscopic examination (maize, grasses, *Cannabis sativa, Crotolaria, Tradescantia, Brassica, Petunia, Solanum melongena* etc.
4. Study of ovules in cleared preparations; study of monosporic, bisporic and tetrasporic types of embryo sac development and embryos through examination of permanent stained serial sections.
5. Field study of several types of flowers with different pollination mechanisms (Wind pollination, Bee / butterfly pollination, Bird pollination).

**ESSENTIAL READINGS**


**SUGGESTED READINGS**


**PAPER X : PLANT PATHOLOGY**

**Objective** of the paper is to impart knowledge on various aspects of Plant Pathology like Symptomatology, Defence mechanisms, Host Parasite interactions, Role of enzymes and toxins in pathogenesis, Nutrition of fungi and Disease forecasting. It also aims to study the Etiology, Epidemiology and Control of different plant diseases caused by Fungi and other micro-organisms.

**Teaching methodology** includes delivery of lectures by the teacher using blackboard and many other tools like Visual Charts, Over Head projector etc. The students also make group discussions. In practical the students make observations and study the diseased specimens using Microscopes, Micrometers, Computer and Image Projecting system and permanent glass slides.

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THEORY

Max. Marks: 60

NOTE: Question paper will have four sections. Examiner will set a total of nine questions comprising two questions from each unit, and one compulsory question of short answer/MCQ type covering the whole syllabus. Students will attempt one question from each unit and the compulsory question. All questions may carry equal marks, unless specified.

UNIT-I

1. History, concept of plant diseases.
2. Role of enzymes and toxins in pathogenesis.
3. Defense mechanism.
4. Host-parasite interactions.

UNIT-II

5. Disease forecasting and assessment.
6. Principles of Plant Disease control; Biocontrol

UNIT-III

8. Etiology, epidemiology and control of following diseases:
   i) Paddy: Paddy Blast, Brown Leaf Spot, Bacterial Blight
   ii) Wheat: Rusts, Bunt and Smuts, Tundu Disease
   iii) Maize: Smut leaf blight, powdery mildew
   iv) Sugarcane: Red Rot, Smut
   v) Grapes: Downy and Powdery Mildews
   vi) Peach: Leaf Curl
   vii) Groundnut: Tikka disease
   viii) Apple: Apple Scab
   ix) Mustard: White Rust, Downy Mildew
   x) Potato: Early and Late Blight, Wart Disease
   xi) Linseed: Rust
   xii) Damping off of the seedlings
   xiii) Ergot of Rye

UNIT-IV


PRACTICALS

Max. Marks: 20

1. Study and diagnosis of plant diseases mentioned in Theory syllabus.
2. Isolation, purification and single spore culture of pathogens.

ESSENTIAL READINGS

4. 

SUGGESTED READINGS
Objective of the paper is to impart knowledge about various aspects of Molecular Biology like Chemical nature and Biosynthesis of Genetic material, Mechanism of Translation, Control function of genes, Cancer, Antigens, Cell cycle and Apoptosis.

Teaching methodology includes delivery of lectures by the teachers using black board and many other tools like Visual Charts, Over Head projector etc. The students also make group discussions. In practical the students learn techniques of histochemical localization, extraction and estimation of DNA, RNA and Protein and Antigen- antibody reaction.

Theory : 75(60A+ 15HT)
Practical : 25(20A+5HT)

NOTE : Question paper will have four sections. Examiner will set a total of nine questions comprising two questions from each unit, and one compulsory question of short answer /MCQ type covering the whole syllabus. Students will attempt one question from each unit and the compulsory question. All questions may carry equal marks, unless specified

UNIT-I


2. Chemical Nature of Genetic Material : Nomenclature, composition and structure of nucleic acids; three dimensional structure of DNA (Prokaryotes, eukaryotes and viral); shape of DNA studied from various physico-chemical properties (A-, B-, Z-DNA) ; Structure and functions of different types of RNA ; Biosynthesis of Nucleotides and Biological importance of the nucleotides.

UNIT-II

3. Mechanism of Nucleic Acid Biosynthesis :
   a) Replication of DNA (Double-stranded and single stranded); rolling circle model of replication; types of DNA polymerase, DNA topoisomerase, DNA ligase, DNAase, Reverse transcriptase.

   b) Biosynthesis of different types of RNA: Transcription factors and machinery, Formation of Initiation complex, Transcription activators and repressors, RNA polymerases, elongation and termination, RNA Processing: RNA editing, Splicing, Polyadenylation, Capping ; RNA transport.
UNIT-III

4. **Mechanism of Translation:** Structure of ribosomes; initiation, elongation and termination of polypeptide chain; Translational proof reading; post-translational processing of polypeptide chain; Inhibitor of protein synthesis.

5. **Control Functions of the Gene:** Constitutive and induced genes; Regulatory genes, structural genes and repressors; Regulation of gene expression in phages; Regulation of gene expression in Prokaryotes; operon model, Role of cAMP in the transcription of operon, lactose and arabinose operons; Regulation of gene expression in eukaryotes, histone, non-histone proteins; different models of control, translation enzymatic and hormonal control.

UNIT-IV

6. **Cancer:** Biochemistry and molecular biology of cancer, Genetic rearrangements in progenitor cells, Oncogenes and Tumour suppressing genes, Cancer and Cell cycle, Virus induced cancer, Metastasis, Interaction of cancer cells with normal cells, Apoptosis, Therapeutic interventions of uncontrolled cell growth, Chemical carcinogenesis.

7. **Antigen:** Structure and functions of different clauses of immunoglobulins; Primary and Secondary immune response; lymphocytes and accessory cells; Humoral and Cell Mediated Immunity; MHC; Mechanism of Immune response and generation of immunological diversity; Genetic control of immune response, Effector mechanisms; Application of Immunological principles (Vaccines and Diagnostics).

PRACTICALS

2. To draw a standard curve of proteins
3. Estimation of protein content of plant tissues by Lowry’s method.
4. Extraction and estimation of DNA contents of plant material.
5. Extraction and estimation of RNA contents of plant material.
6. Demonstration of Antigen – Antibody reactions.

ESSENTIAL READINGS


SUGGESTED READINGS


PAPER XII : PLANT PHYSIOLOGY

Objective of the paper is to impart knowledge about various aspects of Plant Physiology like Cellular organelles, Membranes, Water relations of plants, Inorganic nutrition, Photosynthesis, Respiration, Nitrogen metabolism, Phytohormones, Growth, Stress physiology and Role of plant physiology in agriculture.

Teaching methodology includes delivery of lectures by the teachers using black board and many other tools like Visual Charts, Over Head projector etc. The students also make group discussions in the class rooms. In practical the students perform experiments pertaining to the syllabus using different equipment.

Theory : 75(60A+15HT)
Practical : 25(20A+5HT)

THEORY

Max. Marks : 60

NOTE : Question paper will have four sections. Examiner will set a total of nine questions comprising two questions from each unit, and one compulsory question of short answer /MCQ type covering the whole syllabus. Students will attempt one question from each unit and the compulsory question. All questions may carry equal marks, unless specified.

UNIT-I


2. Membrane structure and function : Structure of model membrane, Lipid bilayer and membrane protein, diffusion, osmosis, ion channels, active transport, ion pumps, mechanism of sorting and regulation of intracellular transport, electrical properties of membranes.


UNIT-II

4. Inorganic Nutrition: Occurrence, availability and physiological roles of various elements, ion uptake and active and passive transport, Role of calmodulin, phloem transport.


6. Respiration: Glycolysis, Krebs cycle and Electron Transport Chain (Cytochrome System), Gluconeogenesis, Factors affecting respiration.

UNIT-III


8. Phytohormones : Auxins, gibberellins, cytokinins, abscissins and ethylene : their transport, biosynthesis, physiological roles and mechanism of action; phenols, synthetic regulators, retardants and inhibitors.
UNIT-IV


10. **Stress Physiology**: Mechanism of plant response to water (low and high), temperature (low and high), Salt (Salinity and Alkalinity) and biotic stresses (Pathogens and insects).

11. Applications of Plant Physiology in Agriculture.

**PRACTICALS**

Max. Marks : 20

1. Experiments pertaining to photosynthesis, respiration and water relations.
2. Determination of water potential by various methods.
4. Spectroscopic determination of Chrophyll a, Chlorophyll b, Carotenoids and Anthocyanin under varied environmental conditions.
5. Experimental study of hormonal effects in plant material.
7. Study of seed germination as effected by different factors.
8. Experimental study of stress physiology.

**ESSENTIAL READINGS**


**SUGGESTED READINGS**


**PAPER XIII: BIOTECHNOLOGY**

**Objective** of the paper is to impart knowledge about various aspects of Plant Biotechnology like Concept, Scope, Tools, Tissue Culture Techniques, Protoplast Culture and Somatic Hybridization, Anther and Pollen Culture, Recombinant DNA Technology, Biosensors and Application of Biotechnology in Medicines, Agriculture, Transgenic plants, Industry and Pollution control etc.

**Teaching methodology** includes delivery of lectures by the teachers using black board and many other tools like Visual Charts, Over Head projector etc. The students also make group discussions. In practical the students perform experiments pertaining to the syllabus using different equipment.

Theory : 75(60A+ 15HT)
Practical : 25(20A+5HT)
NOTE: Question paper will have four sections. Examiner will set a total of nine questions comprising two questions from each unit, and one compulsory question of short answer/ MCQ type covering the whole syllabus. Students will attempt one question from each unit and the compulsory question. All questions may carry equal marks, unless specified.

UNIT-I

1. **History and Scope of Biotechnology and tools.**
2. **Tissue Culture Techniques**: Introduction to the techniques of plant tissue culture, concept of cellular totipotency, Nutritional requirements, cell and organ differentiation, Somaclonal variation, Somatic embryogenesis, Mentor pollen technology, Embryo culture, Embryo rescue, Germplasm storage including Cryopreservation.

UNIT-II

3. **Protoplast Culture and Somatic Hybridization**: Isolation of protoplasts, culture and fusion methods, selection of fusion products, production of hybrids and cybrids.
4. **Anther and Pollen Culture**: Culture procedures for the induction of haploids, media and nutritional requirements, significance of haploids.

UNIT-III

5. **Recombinant DNA Technology**: Isolation and purification of DNA from plant cells, DNA sequencing, DNA engineering through cutting and joining DNA molecules, Restriction Endonucleases, Ligases.
6. **Application of Biotechnology** in Medicines, Agriculture, Transgenic production and role in Human Welfare.

UNIT-IV

7. **Scope and applications of Microbes in** (a) Agriculture with special reference to Biological N\textsubscript{2} fixation, (b) Industry Fermentation (Ethanol, Cheese, Curd) (c) Food (Single Cell Protein), (d) Pollution (degradation of pesticides and Hydrocarbons) and (e) Biogas Production.
8. **Biosensors**: Principles of detection and Applications.
9. **Biosafety and IPR** (a) Objectives of biosafety, guidelines, risk assessment, containment and planned introduction of GMOs and GEMs (b) Intellectual property and protection of IPR, protection of Biotechnological inventions, PBR and management of IPR.

PRACTICALS

1. Composition and preparation of various culture media:
   (a) Knop’s medium, (b) Knudson’s medium, (c) Moore’s medium
2. (d) Murashige & Skoog’s medium.
3. Inoculation of Plant Materials, leaf, root, stem.
4. Demonstration and or experimentation to study callus induction, organogenesis, plant regeneration, anther culture, embryo culture, protoplast isolation and fusion in vitro.
5. Visit to university/regional laboratories for demonstration of modern instruments employed in recent biotechnological techniques.
ESSENTIAL READINGS


SUGGESTED READINGS


PAPER XIV : CYTOGENETICS

Objective of the paper is to impart knowledge about various aspects of Cytogenetics like Chromatin organization, types of chromosomes and karyotype, Structural and numerical changes in chromosomes, Molecular cytogenetics, Restriction mapping, Alien gene transfer, Transposons, Mutations, DNA Damage and DNA Repair mechanisms.

Teaching methodology includes delivery of lectures by the teachers using black board and many other tools like Visual Charts, Over Head projector etc. The students also make group discussions. In practical the students study different types of chromosomes, mitosis and meiosis of diploids. They also study the meiosis of polyploids and translocation heterozygotes.

Theory : 75(60A+15HT)
Practical : 25(20A+5HT)

Max. Marks : 60

NOTE : Question paper will have four sections. Examiner will set a total of nine questions comprising two questions from each unit, and one compulsory question of short answer /MCQ type covering the whole syllabus. Students will attempt one question from each unit and the compulsory question. All questions may carry equal marks, unless specified.

UNIT-I

1. Chromatin Organization: Chromosome structure and packaging of DNA; Molecular organization of centromere and telomere; nucleolus and ribosomal RNA genes; Unique and Repetitive DNA; Euchromatin and heterochromatin.
2. Karyotype: Karyotype analysis; Karyotype evolution; Various banding techniques and their uses.

UNIT-II

4. Structural changes in Chromosomes: Origin, meiosis, breeding behaviour and evolutionary significance of Duplication, Deficiency, Inversion and Translocation heterozygotes; Translocation tester sets; Robertsonian translocations; B-A translocations.
5. Numerical Changes in Chromosomes: Origin, occurrence, production and meiosis of Haploids, Aneuploids and Euploids; origins and production of Autopolyploids; chromosome
and chromatin segregation; Allopolyploids; types, genome constitution and analysis; induction and characterization of Trisomics and Monosomics; Use of monosomics and trisomics in chromosome mapping.

UNIT-III

6. **Restriction Maps and Molecular Genetic Maps:** Restriction mapping RFLP as marker for mapping; chromosome walking; *in situ* hybridization as an aid in physical mapping of chromosome, FISH, GISH; chromosome jumping; Random amplified polymorphic DNA and AFLP techniques.

7. **Molecular Cytogenetics:** Nuclear DNA contents; C-value paradox, cot curve and its significance; Southern Northern and Western Blotting Techniques, Polymerase Chain Reaction.

8. **Alien Gene Transfer through Chromosome Manipulations:** Transfer of whole genome, transfer of individual chromosomes and chromosome segments; methods for detecting alien chromatin, production, characterization and utility of alien addition and substitution lines.

UNIT-IV

9. **Transposable Elements in prokaryotes and eukaryotes:** Cut and Paste transposons, Replicative transposons and Retrotransposons; Mutations induced by transposons.

10. **Mutations:** Spontaneous and induced mutations; physical and chemical mutagens; molecular Basis of gene mutations, site-directed mutagenesis applications of mutations.

11. **DNA damage and repair mechanisms:** Sources and types of DNA damage. Light dependent repair, Base Excision repair, Nucleotide Excision repair, Mismatch repair, Double-strand breaks Repair and Error-prone repair; Prokaryotic SOS response and Eukaryotic transcriptional response to DNA damage.

**PRACTICALS**

Max. Marks : 20

1. Study of meiosis in materials *Allium, Phlox, Chrysanthemum, Delphinium, Papaper*, Pollen and seed fertility and fruit set.
2. Mitotic studies and Karyotype analysis.
3. Linear differentiation of chromosomes through banding techniques, such as G-banding, C-banding and Q-banding (Photographs/Slides).
4. Orcein and Feulgen staining of the salivary gland chromosomes of *Chironomas and Drosophila* (Photographs/Slides).
5. Study of B chromosomes using maize or any other appropriate material.
6. Induction of polyploidy using colchicines, different methods of the application of colchicines.
7. Meiosis of complex translocation heterozygotes.

**ESSENTIAL READINGS**

SUGGESTED READINGS


PAPER XV: ECOLOGY AND ENVIRONMENT

Objective of the paper is to impart knowledge about various aspects of Ecology and Environment like Plant Communities and Ecosystems, Population Ecology, Biosphere Reserves, Biogeochemical cycles, Biodiversity and its conservation strategies, Pollution, Natural Resources and Non-conventional sources of energy, Climate change, Global Warming, Ozone depletion, Alien plant’s invasion and Weed management.

Teaching methodology includes delivery of lectures by the teachers using black board and many other tools like Visual Charts, Over Head projector etc. The students also make group discussions. In practical the students study the soil samples for pH, conductivity, water holding capacity etc. They also study the ecosystems using Quadrat methods.

Theory : 75(60A+15HT)  
Practical : 25(20A+5HT)  

THEORY  

Max. Marks : 60

NOTE : Question paper will have four sections. Examiner will set a total of nine questions comprising two questions from each unit, and one compulsory question of short answer /MCQ type covering the whole syllabus. Students will attempt one question from each unit and the compulsory question. All questions may carry equal marks, unless specified.

UNIT-I

1. Environment & Ecosystem: Concept and Principles.
3. Plant Communities: Definition, quantitative characters of Plant Communities. Different sampling techniques to study quantitative characters of plant communities.

UNIT-II

4. Biosphere Reserve: The concept, Major functions, Nilgiri Biosphere Reserve (a brief account)
5. Bio-Geochemical Cycles: General account types, brief account of the following bio-geochemical cycles: Carbon cycle, Nitrogen cycle, Phosphorus cycle and Sulphur cycle.
6. Biodiversity: Concept, level, measuring of biodiversity; significance in terms of economic, spiritual, scientific, educational, ecological and genetical values; reasons for depletion, magnitude, distribution and conservation strategies; diversity loss from monoculture plantations. Concepts of phytogeography: Endemism, Hotspots and hottest hotspots; Plant Explorations; Invasions and Introductions.

UNIT-III

7. Pollution: Definition, different types of pollutants. Air pollution; different pollutants of air, control of Air pollution; Water pollution : different sources of water pollution, control of water pollution; Land pollution : sources, control of land pollution; Bioremediation and Phytoremediation.
8. **Management and Conservation of Natural Resources**: Aims and objectives of conservation; renewable and non-renewable resources; special interest and total ecosystem conservation policy; maintenance of ecological processes; management of agriculture, forest and soil; preservation of plant genetic diversity; conservation strategies required at national and international level, sustainable development.


**UNIT-IV**

10. **Ozone Depletion**: Reasons and its effects on plants, methods to check ozone depletion.

11. **Invasion of Alien Plants**: Concept, ecological impact and management

12. **Global Warming and Climate Change**: Reasons, effects and the techniques used to control global warming.

13. **Weed Management**: The impact, use and ecological role of weeds in agro-ecosystems, weed characteristics related to success; Major weeds of the world; Ecological approach to weed management, Problems of the weeds; Allelopathy, its mode and Exploitation in weed management.

**PRACTICALS**

Max. Marks: 20

1. Techniques for collection of soil samples. Chemical analysis of soil samples taken from different types of soils and to assess their suitability for healthy plant growth.
2. To determine soil pH, conductivity, soil texture and water holding capacity of soil.
3. Chemical analysis of underground water samples taken from different depths and to assess its suitability for healthy plant growth.
4. To work out the size of the quadrat and number of Quadrats required to study the ecosystem of a given locality.
5. To determine density, abundance and frequency of species by quadrat method.
6. To determine the Importance Value Index (IVI) and Species Diversity Index of grassland ecosystem.
7. To study the stomatal behaviour in response to herbicides and pesticides.

**ESSENTIAL READINGS**


**SUGGESTED READINGS**

FOURTH SEMESTER
PAPER XVI : PLANT BIOCHEMISTRY

Objective of the paper is to impart knowledge about various aspects of Plant Biochemistry like Bioenergetics, Role of Water, Structure, types, properties and metabolism of Amino acids and Proteins, Enzymes, Carbohydrates and Lipids; Compounds of energy transfer and Redox reactions, Catabolism and Generation of phosphate bond energy; Vitamins and Secondary metabolites.

Teaching methodology includes delivery of lectures by the teachers using blackboard and many other tools like Visual Charts, Over Head projector etc. The students also make group discussions. In practical the students perform experiments pertaining to the syllabus using different equipment.

Theory : 75 (60A+15HT)
Practical : 25 (20A+5HT)

THEORY

Max. Marks : 60

NOTE : Question paper will have four sections. Examiner will set a total of nine questions comprising two questions from each unit, and one compulsory question of short answer / MCQ type covering the whole syllabus. Students will attempt one question from each unit and the compulsory question. All questions may carry equal marks, unless specified.

UNIT-I

2. Water: Structure and Properties; Weak intereactions in aqueous systems, Ionization of water Weak acids and Weak bases; Buffering against pH changes in biological systems, Henderson-Hassalbach equation. The fitness of the aqueous environment for living organisms.

UNIT-II

3. Amino acids and Proteins: Structure types, properties and Metabolism of Amino acids; Primary, Secondary, Tertiary and Quatemary structure of proteins; domains, motif and folds; stability of protein structure; Classification of proteins based on composition, solubility function; Reverse turns and Ramachandran plot.
4. Enzymes: Nomenclature and Classification; Enzyme Kinetics; Mode and Mechanism of Enzyme Action, Enzyme Regulation, Activators, Inhibitors and Isoenzymes: Allosteric enzymes.

UNIT-III

5. Carbohydrates: Classification, composition and structure of Carbohydrates (Polysaccharides, Glycoproteins and Peptidoglycan), Stereoisomerism, Transformation of Carbohydrates, Synthesis and degradation of Sucrose, Starch, Cellulose.
6. Lipids: Classification, Structure and functions; Biosynthesis of Fatty Acids.
7. Compounds of Energy Transfer and Redox Reactions:
   a. Compounds of Energy Transfer: Adenosine Triphosphate, Uridine Triphosphate, Cytidine Triphosphate, Guanosine Triphosphate. Biosynthesis of purines and pyrimidines.
b. Compounds of Redox Reactions: Nicotinamide Adenine Dinucleotide (NAD), Nicotinamide Adenine Dinucleotide Phosphate (NADP), flavin Mononucleotide (FMN), Flavin Adenine Dinucleotide (FAD), Ascorbic Acid, Coenzyme, Cytochromes.

UNIT-IV

8. **Catabolism and Generation of Phosphate Bond Energy:** Sites and mechanism of Oxidative phosphorylation; Coupled Reactions, Group Transfer, Biological energy Transducers; Oxidation of Carbohydrates (Regulation and Mechanism of T.C.A. cycle) and Oxidation of fats.

9. **Vitamins:** Structure, and functions of Thiamine, Riboflavin, Nicotinic Acid, Pantothenic Acid, Pyridoxine, Biotin, Folic Acid, Vitamin B12, Ascorbic Acid, Vitamin A, D, E and K.

10. **Secondary Metabolites:** Biosynthesis of terpenes and phenols and alkaloids and their role.

**PRACTICALS**

1. Detection of reducing, non reducing and total sugars: Molisch test, Fehling’s test, Benedict’s test, Barafoed’s test, Saliwoffs test and Iodine test.
3. Qualitative tests of protein like Biuret test, Xanthoproteic test, Ninhydrin test.
4. Quantitative estimation of amino acid and phenols by using Spectrophotometer.

**ESSENTIAL READINGS**


**SUGGESTED READINGS**


**PAPER XVII: FORESTRY**

**Objective** of the paper is to impart knowledge about various aspects of Forestry like Silviculture, Forest Protection, Social and Urban Forestry, Forest Laws, Conservation of Forests, Types of Forests and Effects of forests.

**Teaching methodology** includes delivery of lectures by the teachers using black board and many other tools like Visual Charts, Over Head projector etc. The students also make group discussions. In practical the students measure the diameter and height of trees. They study anatomy, moisture contents and
specific gravity of common timber trees of Punjab. They also take an account of the nearest natural forest visited by them.

Theory : 75(60A+ 15HT)
Practical : 25(20A+5HT)

Max. Marks : 60

NOTE : Question paper will have four sections. Examiner will set a total of nine questions comprising two questions from each unit, and one compulsory question of short answer/MCQ type covering the whole syllabus. Students will attempt one question from each unit and the compulsory question. All questions may carry equal marks, unless specified.

UNIT-I

1. **Silviculture**: Definition, Regeneration : Types, Natural regeneration from seeds (different factors on which regeneration depends, seedlings establishment period), Regeneration from vegetative parts (Coppice, Root suckers, Cuttings, Layering, Grafting, Budding, Pollarding, Lopping and Pruning); Nursery making.

2. **Forest Protection**: Protection, causes and control of forest fires; Major diseases of forest plants.

UNIT-II

3. **Social and Urban Forestry**: Social forestry - Non commercial farm forestry, scope and limitations of Non commercial forestry, community forestry, scope and limitations of community forestry, social land allocation programmes (Taungya system). Economic benefits of social forestry, Urban forestry.

4. **Forest Laws and Forest Conservation**: Salient features of the Indian Forest Act 1972 (preliminary, reserved forests, protected forests), different methods employed for conservation of forests.

UNIT-III

5. **Forests Types**: Climate of India, different climatic regions of India. Central characters and distribution of the different forest types of India, Mensuration.

UNIT-IV

6. **Forest Effects**: General effects of forests on climate, control of runoff, effects on snow, soil erosion, wild life, pollution control, nutrient cycling, social values and ecotourism, economic values, floods, green belts and control of temperature.

PRACTICALS

Max. Marks : 20

1. To measure diameter at breast height (dbh), diameter over bark (dob) and diameter under bark (dub) and girth of trees.

2. To measure height of standing trees by Abney’s level.

3. To determine the moisture content, specific gravity and weight density of common timber trees of Punjab.

4. To compare the anatomy of Hard wood and soft wood.

5. Students should be taken to nearest natural forests and they should prepare a field report regarding the following points:
   - Height above Sea level, Mean annual rain fall and temperature, Soil texture, soil pH, Topography
   - Dominant tree species and the general characters of the forest (Distribution of trees in different storeys, ground flora, nature of leaf fall, average height of dominant tree species etc.) The students will submit the field report.
6 Propagation studies on important common forest trees of Punjab regarding height and diameter increments (under similar soil conditions) at two months intervals under natural conditions of day length and temperature for young tree saplings of known age and represent the results in a graphic form.

7 Visit to the nearby forest nursery.

ESSENTIAL READINGS


SUGGESTED READINGS


PAPER XVIII: GENETICS AND PLANT BREEDING

**Objective** of the paper is to impart knowledge about various aspects of Genetics like Linkage, Gene Mapping, Microbial Genetics, Quantitative Genetics, Population Genetics and Human Genetics. The paper also deals with various methods of breeding in plants reproducing sexually and asexually.

**Teaching methodology** includes delivery of lectures by the teachers using black board and many other tools like Visual Charts, Over Head projector etc. The students also make group discussions. The students make analysis of different problems relating to genetics.

<table>
<thead>
<tr>
<th>Theory</th>
<th>75(60A+15HT)</th>
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<tbody>
<tr>
<td>Practical</td>
<td>25(20A+5HT)</td>
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**THEORY**

**Max. Marks**: 60

**NOTE**: Question paper will have *four* sections. Examiner will set a total of nine questions comprising two questions from each unit, and one compulsory question of short answer /MCQ type covering the whole syllabus. Students will attempt one question from each unit and the compulsory question. All questions may carry equal marks, unless specified.

**UNIT-I**

1. **Allelism and Linkage**: Multiple Alleles, Pseudo-alleles, Complementation tests, Pleiotropy, Genomic imprinting, Penetrance and Expressivity, Phenocopy, Linkage and Crossing over, Sex Linkage, Sex limited and Sex influenced characters.

2. **Genetic Recombination and Gene Mapping methods**: Recombination, Molecular Mechanism of Recombination, Role of RecA and RecBCD enzymes, Site-specific recombination, Linkage maps, Tetrads analysis - Centromere mapping in linear tetrads and Analysis of unordered tetrads.
UNIT-II
3. Extrachromosomal Inheritance: Introduction, mitochondrial DNA and chloroplast DNA.
4. Microbial Genetics: Mapping the bacteriophage genome; phage phenotypes; genetic recombination in phage; genetic transformation, conjugation and transduction in bacteria
5. Multigene families: Multigene families and their evolution.

UNIT-III
7. Human Genetics: Pedigree analysis, Lod score for linkage testing, Genetic disorders.

UNIT-IV
10. Asexual Breeding Systems: Methods of breeding of vegetatively propagated crops; Non-conventional methods; Applications of polyploidy in improvement of crop plants; gene variability.
11. Male Sterility: Concept, Genetic control and Breeding utility.

PRACTICALS
Max. Marks : 20
1. Study of problems on Mendelian Genetics, Gene Interactions, Multiple alleles and Multiple gene inheritance.
2. To test the Genetic Hypothesis by Chi-Square Test and study goodness of fit.
3. Preparation of Linkage Maps in Diploids using three point test cross method.
4. Tetrads analysis and Centromere mapping in ordered and unordered tetrads.
5. Pedigree analysis.
6. Problems relating to Population genetics.

ESSENTIAL READINGS

SUGGESTED READINGS
PAPER XIX : PLANT RESOURCE, UTILIZATION AND CONSERVATION

Objective of the paper is to impart knowledge about various economic aspects of plants like Origin of Agriculture; Origin, Distribution, Types, Botany, Cultivation, Harvesting and Uses of different Cereals, Fruits, Vegetables, Spices, Beverages and Legumes; Medicinal plants and Insecticides; Uses of important plant products like Gums, Tannins, Vegetable oils and fats, Fibres and Wood; Unexploited plants of economic value and Genetic resources and their conservation.

Teaching methodology include delivery of lectures by the teachers using black board and many other tools like Visual Charts, Over Head projector etc. The students also make group discussions. In practical students study morphology, anatomy and histochemistry of cereals, vegetables, fruits, spices and oil yielding plants.

Theory : 75(60A+ 15HT)
Practical : 25(20A+5HT)

THEORY

Max. Marks : 60

NOTE : Question paper will have four sections. Examiner will set a total of nine questions comprising two questions from each unit, and one compulsory question of short answer/MCQ type covering the whole syllabus. Students will attempt one question from each unit and the compulsory question. All questions may carry equal marks, unless specified.

UNIT-I

2. World Centres of Primary diversity of domesticated plants: The Indo-Burmese Centre, Plant Introductions and Secondary Centres.
4. Cultivation and uses of following fruits and vegetables: Citrus, Mango, Apple, Banana, Potato, Allium, Cabbage, Spinach, Tomato, Brinjal and Sweet Potato.

UNIT-II

5. General Account of the Spices: Ginger, Turmeric, Cinnamon, Clove, Umbelliferous spices and Peppers.
7. Legumes: Origin, Botany, Cultivation and uses of Pigeon pea, Chick pea, Cluster bean, French bean etc.
8. Medicinal Plants and Insecticides: History and classification of drugs, antibiotics, plants as sources of drugs, parts used, composition and uses. Insecticides of plant origin, Pyrethrum and Rotenone.

UNIT-III

10. Tannins and Dyes: Sources and their uses.
11. Vegetable Oils and Fats: Distinction between fatty and essential oils. Drying (Soyabean and linseed), nondrying (Groundnut and Mustard oil) and Semi drying (cottonseed and Sunflower oil) oils and their uses.
12. Fibres: Classification, uses, type of fibres - Soft fibres, Hard fibres, Surface fibres, Brush fibres and Braiding fibres.

UNIT-IV
13. **Wood and its Uses:** Soft woods and hard woods, wood as fuel, construction material (Pilings, Veneers, Plywood), wood containers (cooperage), chemically derived products and wood distillation.
14. Unexploited plants of potential economic value; plants as a source of renewable energy.
15. Genetic Resources and their conservation.

**PRACTICALS**

Max. Marks : 20

1. Morphology, Anatomy, Microchemical tests of stored food materials of Wheat, Rice, Chick Pea, Potato, Sweet Potato; Comparison of Starch grains of Wheat, Rice, Potato and Mung.
2. Morphology of fruits and vegetables pertaining to theory syllabus.
3. Histochemical tests for cellulose, cutin, suberin, hemicellulose, fat, oils, proteins and starch.
4. Morphology and microscopic structure of umbelliferous fruits, turmeric and clove.
5. Vegetable Oils: Mustard, groundnut, soya bean, coconut, sunflower, castor; Morphology, microscopic structure of the oil yielding tissues, tests for oil.
6. Prepare a list of 10 important sources of firewood and timber in your locality. Give their local names, scientific names and families to which they belong. Mention their properties.
7. The students should be taken to a recognized Botanical Garden or a Museum to show different plants of economic importance.

**ESSENTIAL READINGS**


**SUGGESTED READINGS**


**PAPER-XX: RESEARCH PROJECT / FIELD STUDY REPORT AND SEMINAR**

Max. Marks : 100

This paper aims at inculcating the aptitude for research in the students so that after completing their postgraduate course they can opt for M. Phil. and / or Ph.D. courses.

Field study provides the students an opportunity to study the plant diversity in their natural habitats.

The purpose of presenting seminar is to train the students to prepare the topic and to deliver it before the students and teachers using the recent tools like Computer, CDs, LCD projector etc. This would instill a sense of confidence in the students to deliver lectures in classrooms and to present any paper before the academicians and scientists.

A): **RESEARCH PROJECT/FIELD STUDY REPORT**
RESEARCH PROJECT

The students will be given a small research project under the guidance of a supervisor which will be evaluated by a panel of two examiners.

OR

FIELD STUDY REPORT

The students will visit the field for study of plants pertaining to Algae, Fungi, Bryophytes, Pteridophytes, Gymnosperms and Angiosperms. The students will also submit a Field Study Report on the flora of the place visited by them.

A panel of 2-3 examiners will evaluate the field study report.

B): SEMINAR

The Seminar will be presented by all the students and it will be compulsory for all the students to attend the seminars.

The break-up of 40 marks will be as under:-

1. Presentation  30
2. Contents      10

Every seminar will be evaluated by a team of two examiners individually and the average of marks awarded by these examiners will be considered as the “Marks obtained”.

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