# DAV UNIVERSITY JALANDHAR

## Course Scheme & Syllabus
## For
## M.Sc. (Hons.)BOTANY
## (Program ID-95)

## 1st TO 4th SEMESTER
## Examinations 2022-2023 Session Onwards

## Syllabi Applicable For Admissions in 2022

# DAV UNIVERSITY, JALANDHAR

## Scheme of Courses M.Sc.
## M.Sc. (Hons.)Botany

### Semester 1

| S.No | Paper Code | Course Type | Course Title | L | T | P | Cr |
|---|---|---|---|---|---|---|---|
| 1 | BOT521 | Core | Algae, Fungi and Phytopathology | 4 | 0 | 0 | 4 |
| 2 | BOT522 | Core | Algae, Fungi and Phytopathology Laboratory | 0 | 0 | 3 | 2 |
| 3 | BOT527 | Core | Approaches for Crop Improvement | 4 | 0 | 0 | 4 |
| 4 | BOT528 | Core | Approaches for Crop Improvement Laboratory | 0 | 0 | 3 | 2 |
| 5 | BOT529 | Core | Genetics and Cytogenetics | 4 | 0 | 0 | 4 |
| 6 | BOT530 | Core | Genetics and Cytogenetics Laboratory | 0 | 0 | 3 | 2 |
| 7 | BOT539 | Core | Plant Cell Biology and Biochemistry | 4 | 0 | 0 | 4 |
| | Total | | | | | | 22 |

**L: Lecture T: Tutorial P: Practical Cr: Credits**

# DAV UNIVERSITY, JALANDHAR

**Scheme of Courses M.Sc.**
**M.Sc. (Hons.)Botany**
**Semester II**

| S.No | Paper Code | Course Type | Course Title | L | T | P | Cr |
|---|---|---|---|---|---|---|---|
| 1 | BOT531 | Core | Archegoniate Biology | 4 | 0 | 0 | 4 |
| 2 | BOT532 | Core | Archegoniate Biology Laboratory | 0 | 0 | 3 | 2 |
| 3 | BOT533 | Core | Plant Physiology | 4 | 0 | 0 | 4 |
| 4 | BOT534 | Core | Plant Physiology Laboratory | 0 | 0 | 3 | 2 |
| 5 | BOT535 | Core | Conservation of Natural Resources | 4 | 0 | 0 | 4 |
| 6 | BOT536 | Core | Conservation of Natural Resources Laboratory | 0 | 0 | 3 | 2 |
| 7 | BOT540 | Core | Evolutionary Biology of plants | 4 | 0 | 0 | 4 |
| 8 | BOT538 | Core | Seminar | 0 | 0 | 0 | 1 |
| | Open Elective/Interdisciplinary Course I | | | 4 | 0 | 0 | 4 |
| | Total | | | | | | 27 |

**L: Lecture T: Tutorial P: Practical Cr: Credits**

# DAV UNIVERSITY, JALANDHAR

**Scheme of Courses M.Sc.**
**M.Sc. (Hons.)Botany**
**Semester III**

| S.No | Paper Code | Course Type | Course Title | L | T | P | Cr |
|---|---|---|---|---|---|---|---|
| 1 | BOT621 | Core | Scientific Writing and Research Methodology | 3 | 1 | 0 | 4 |
| 2 | BOT622 | Core | Advanced Plant Systematics | 4 | 0 | 0 | 4 |
| 3 | BOT623 | Core | Advanced Plant Systematics Laboratory | 0 | 0 | 3 | 2 |
| 4 | BOT629 | Core | Plant Molecular Biology | 4 | 0 | 0 | 4 |
| 5 | BOT630 | Core | Plant Molecular Biology Laboratory | 0 | 0 | 3 | 2 |
| 6 | BOT624 | Core | Project-I | 0 | 0 | 2 | 2 |
| 7 | Departmental Elective-I | | | 4 | 0 | 2 | 6 |
| 8 | Departmental Elective-I | | | 4 | 0 | 0 | 4 |
| | Total | | | | | | 28 |
| Departmental Elective-I(6Cr)<br>(Choose any one theory course and the related laboratory course) | | | | | | | |
| i. | BOT641 | Elective | Plant Resource Utilization | 4 | 0 | 0 | 4 |
| | BOT642 | Elective | Plant Resource Utilization Laboratory | 0 | 0 | 3 | 2 |
| ii. | BOT627 | Elective | Agricultural Ecology-Principles and Applications | 4 | 0 | 0 | 4 |
| | BOT628 | Elective | Agricultural Ecology-Principles and Applications Laboratory | 0 | 0 | 3 | 2 |
| Departmental Elective II (4Cr)<br>(Choose any one theory course) | | | | | | | |
| i. | BOT636 | Elective | Forestry | 4 | 0 | 0 | 4 |
| ii. | BOT637 | Elective | Advances in Plant Breeding | 4 | 0 | 0 | 4 |

**L: Lecture T: Tutorial P: Practical Cr: Credits**

# DAV UNIVERSITY, JALANDHAR

**Scheme of Courses M.Sc.**
**M.Sc. (Hons.) Botany**

**Semester IV**

| S. No | Paper Code | Course Type | Course Title | L | T | P | Cr |
|---|---|---|---|---|---|---|---|
| 1 | BOT645 | Core | Plant Ecology and Phytogeography | 2 | 0 | 0 | 2 |
| 2 | BOT646 | Core | Plant Ecology and Phytogeography Laboratory | 0 | 0 | 2 | 1 |
| 3 | BOT631 | Core | Project-II | 0 | 0 | 8 | 8 |
| 4 | CEC101 | Core | Community Engagement Course | 1 | 0 | 0 | 1 |
| 5 | CEC102 | Core | Community Engagement Course Laboratory | 0 | 0 | 2 | 1 |
| 6 | Open Elective/Interdisciplinary Course II | | | 4 | 0 | 0 | 4 |
| 7 | Departmental Elective-III | | | 4 | 0 | 2 | 6 |
| | Total | | | | | | 23 |
| Departmental Elective III (6Cr)<br>(Choose any one theory course and the related laboratory course) | | | | | | | |
| i. | BOT647 | Elective | Techniques in Plant analysis | 4 | 0 | 0 | 4 |
| | BOT648 | Elective | Techniques in Plant analysis Laboratory | 0 | 0 | 3 | 2 |
| ii. | BOT649 | Elective | Advanced Plant Physiology and Metabolism | 4 | 1 | 0 | 4 |
| | BOT650 | Elective | Advanced Plant Physiology and Metabolism Laboratory | 0 | 0 | 3 | 2 |
| iii | BOT643 | Elective | Plant Developmental Biology | 4 | 0 | 0 | 4 |
| | BOT644 | Elective | Plant Developmental Biology Laboratory | 0 | 0 | 3 | 2 |

**L: Lecture T: Tutorial P: Practical Cr: Credits**

**Programme Name:** **M.Sc. (Hons.) Botany**
**Course Name:** **Algae, Fungi and Phytopathology**
**Course Code:** **BOT521**
**Total Credits:** **4**
**Credit Components:** **L-4; T-0; P-0**
**Learning Objectives:** To acquaint the students with the origin, history, morphology, biology and importance of prokaryotic and eukaryotic algal and fungal organisms.

**Unit I**

**Algae:** Criteria and systems of algal classification. Comparative account of algal pigments, food reserves, cell wall, flagellation, chloroplasts and eye spots. Molecular taxonomy, markers used in cyanobacterial and algal taxonomy.
**Growth characteristics**: Media for algal growth, growth curve and measurements techniques.
**Algal culturing techniques**: collection, isolation, purification and preservation
**Economic importance of Algae**: Algae as food, fodder, biofertilizer, medicine, industrial uses and other useful products, algae as indicator of water pollution, bio fuels from algae, algae and global warming. **(15 Lectures)**

**Unit II**

**Fungi:** Recent trends in classification of fungi; general account of phylum Chytridiomycota, Ascomycota, Deuteromycota, Basidiomycota, Zygomycota and Myxomycota and their classification (major orders).
**Agricultural significance of Fungi** – Mycorrhyza, Parasites-common fungal parasites of plants, mycoherbicide. **(12 Lectures)**

**Unit III**

**Phytopathology:** Introduction; Process of infection and pathogenesis: penetration and entry of pathogen into host tissue – mechanical, physiological and enzymatic; Host-parasite interaction, enzymes and toxins in pathogenesis.
**Defense mechanism in plants:** Pre-existing structural and biochemical defense mechanisms, induced structural and biochemical defense mechanisms, hypersensitive reaction, role of phytoalexins and other phenolic compounds, PR proteins, role of Jasmonic acid and Salicylic acid. **(15 Lectures)**

**Unit IV**

**Diseases in plants:** Symptoms, etiology and disease cycle.
Wheat- rust, smut; Rice-sheath blight; Cucurbits-Powdery mildew; Sugarcane-red rot; Potato-late and early blight; Crucifers-white rust; dieback disease of grasses.
**Plant disease management:** Exclusion, eradication and protection. Chemical means of disease control; biological means of disease control; biotechnological approaches to diseaseresistance: transgenic approaches to disease resistance, engineering chemicals that elicit defense responses in plants. **(14 Lectures)**

**Learning Strategies:** Class room lectures, practical, field visits, models, charts, power point presentations, online lectures, group discussions, assignments and presentations by students
**Learning Outcome:** This will enable the students to learn the evolutionary and recent trends in lower plants.
**Assessment:** Mid Semester Exam (MSE) – 25 Marks
Written Quiz (MCQs) – 10 Marks

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| | Assignment (written) – 10 Marks<br>End Semester Examination (ESE) – 50 Marks<br>Attendance – 5 Marks |
| **Model Question Paper: MSE** | Q.1 Will Comprise of 5 parts having 1 mark each<br>Q.2 to Q.6 will carry 4 marks each out of which 3 questions are to be attempted.<br>Q.7 and Q.8 will carry 8 marks each out of which 1 question is to be attempted |
| **Model Question Paper: ESE** | Q.1 Will Comprise of 10 parts having 1 mark each<br>Q.2 to Q.9 will carry 4 marks each out of which 6 questions are to be attempted.<br>Q.10 to Q.13 will carry 8 marks each out of which 2 question are to be attempted |

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| **Programme Name:** | **M.Sc. (Hons.) Botany** |
| **Course Name:** | **Algae, Fungi and Phytopathology Laboratory** |
| **Course Code:** | **BOT522** |
| **Total Credits:** | **2** |
| **Credit Components:** | **L-0; T-0; P-3** |
| **Learning Objectives:** | To acquaint the students about various physiological processes at cellular and organ level in plants. |

**List of Experiments**

1. Study of diversity of fresh water and marine algae - Range of thallus and sex organs in major algal groups.
2. Heterocysts and their frequency in some Cyanophycean genera
3. Study of symptoms of plants infected with *Albugo*; asexual and sexual structures of through sections/tease mounts and permanent slides.
4. *Rhizopus*: Students to culture Black bread mould in the laboratory to study asexual stage from temporary mounts. Sexual stages of mould to be studied from permanent slides.
5. *Puccinia*: Herbarium specimens of Wheat Rusts- (Black, Brown and Yellow) and infected barberry leaves; section/tease mounts of spores on wheat, and permanent slides of both the hosts.
6. Smut: tease mount of spores on wheat and permanent slides of the host.

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| **Learning Strategies:** | Collection and field trips, Practical, models, charts, online demonstrations, group discussions and assignments |
| **Learning Outcome:** | This will enable the students to learn the origin, history, morphology, biology and importance of prokaryotic and eukaryotic algal and fungal organisms and phyto pathology. |
| **Assessment:** | Continuous Assessment: 20 Marks<br>Practical Exam: 80 Marks |
| **Model Question Paper:** | Practical Exam component is divided into the following sub components:<br>• Performance – 24 Marks<br>• Spotting – 16 Marks<br>• Viva-voce – 24 Marks<br>• Record – 8 Marks<br>• Internal Assessment – 8 marks |
| **Text Books:** | 1. Fritsch, F. E. *The Structure and Reproduction of the Algae.(Vol.I, Vol II)*.Vikas House Pvt. Ltd, 1979. Print.<br>2. Graham, Linda E., and Lee Warren Wilcox. *Algae*. Upper Saddler River, NJ: Prentice Hall, 2000. Print.<br>3. Kumar, H. D. *Introductory Phycology*. New Delhi: Affiliated East-West, 1999. Print.<br>4. Lee, Robert Edward. *Phycology*. Cambridge: Cambridge UP, 2008. Print. |
| **Reference Books:** | 1. Alexopoulos, Constantine John, and Meredith Blackwell. *Introductory Mycology*.4.th ed. New York [u.a.: Wiley, 1996. Print.<br>2. Bilgrami, K. S., andVerma, R. N. *Physiology of Fungi*. New Delhi: Vikas Pub. House, 1978. Print.<br>3. Bold, Harold Charles, and Michael James Wynne. *Introduction to the Algae: Structure and Reproduction*. Englewood Cliffs, N.J.: Prentice- |

Hall, 1978. Print.
4. Burnett, J. H. *Fundamentals of Mycology*. New York: St. Martin's, 1976. Print**.**
5. Carlile, M. J., and Sarah C. Watkinson. *The Fungi*. 2nd ed. San Diego: Academic, 2001. Print.
6. Chapman, N. J., and Chapman, D.J. *The Algae*. London: ELBS and Macmillan;, 1977. Print.
7. Fritsch, F. E. *The Structure and Reproduction of the Algae.(Vol.I, Vol II)*.Vikas House Pvt. Ltd, 1979. Print.
8. Graham, Linda E., and Lee Warren Wilcox. *Algae*. Upper Saddler River, NJ: Prentice Hall, 2000. Print.
9. Kumar, H. D. *Introductory Phycology*. New Delhi: Affiliated East-West, 1999. Print.
10. Lee, Robert Edward. *Phycology*. Cambridge: Cambridge UP, 2008. Print.
11. Landecker, Elizabeth. *Fundamentals of the Fungi*. Englewood Cliffs, N.J.: Prentice-Hall, 1972. Print.
12. South, G. Robin, and Alan Whittick. *Introduction to Phycology*. Oxford: Blackwell Scientific Publications, 1987. Print.
13. Hoek, C. Van Den, and Mann, D. G. *Algae: An Introduction to Phycology*. Cambridge: Cambridge UP, 1995. Print.

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| **Programme Name:** | **M.Sc. (Hons.) Botany I Semester** |
| **Course Name:** | **Approaches for Crop Improvement** |
| **Course Code:** | **BOT527** |
| **Total Credits:** | **4** |
| **Credit Components:** | **L-4; T-0; P-0** |
| **Learning Objectives:** | To introduce the students about plant breeding, regeneration of plants and genetic variations under artificial conditions. |

**Unit I**

**Plant Breeding:** Introduction, objectives of plant breeding, genetic variability, green revolution, Domestication and centers of origin of cultivated plants.

**Systems of reproduction in plants:** Reproductive systems, Sexual reproduction - Cross and self pollination; asexual reproduction, Incompatibility and Male sterility, pollination control mechanisms.

**Hybridization:** Role and methods, Back-cross breeding. Heterosis, Inbreeding depression. Mass and pure line selection.

**Breeding for resistance:** Breeding for biotic and abiotic stresses, physical and chemical mutagens; Gamma gardens. **(12 Lectures)**

**Unit II**

**Plant Cell and Tissue Culture:** Principles of plant tissue culture- historical perspectives, Organization of laboratory media composition and preparation, Different types of culture media Cell culture and cell cloning. Cellular totipotency.

**Somatic embryogenesis and synthetic seeds:** Induction and controlling factors. Organogenesis

**Haploids:** Androgenic and gynogenic.

**Somatic hybridization:** Isolation, culture and fusion of protoplasts, Selection of fusion products; regeneration of hybrids and cybrids. Application in biotechnology

**Clonal propagation:** Micropropagation. Somaclonal and gametoclonal variation and their applications. **(14 Lectures)**

**Unit III**

**Micro-propagation**: application in horticulture and forestry. Cryopreservation and germplasm storage; Anther and pollen culture and their importance; Isolation, culture and fusion of protoplasts

*In-vitro* production of secondary metabolites from medicinal plant culture; Microbial production of vitamins, organic acids and alcohols. Energy plantations and petro plants. **(6 Lectures)**

**History of Genetic modified crops; The gene addition approach to plant genetic engineering;** Plants that make their own insecticides; Herbicide resistant crops. **Gene subtraction;** Antisense RNA and the engineering of fruit ripening. **Problems with genetically modified plants;** Safety concerns with selectable markers; The terminator technology; The possibility of harmful effects on the environment. **(7 Lectures)**

**Unit IV**

**Recombinant DNA technology**: Gene Transfer Methods in Plants (direct gene transfer methods: particle bombardment, electroporation, PEG-mediated); Plant transformation vectors; Cloning vehicles, gene engineering through cutting and joining DNA molecules, restriction endonucleases, ligases, applications of genetic engineering; floral-dip.

**Cloning vectors for plants:** *Agrobacterium tumefaciens*—nature's smallest genetic Engineer, Using the Ti plasmid to introduce new genes into a plant cell, Production of transformed plants with the Ti plasmid, The Ri plasmid, Limitations of cloning with *Agrobacterium* plasmids,

Cloning genes in plants by direct gene transfer, Direct gene transfer into the nucleus, Transfer of genes into the chloroplast genome, Attempts to use plant viruses as cloning vectors; Caulimo virus vectors, Gemini virus vectors. **(12 Lectures)**

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| **Learning Strategies:** | Class room lectures, practical, crop land visits, models, charts, power point presentations, online lectures, group discussions, assignments and presentations by students |
| **Learning Outcome:** | The course will impart theoretical knowledge and practical skills about plant breeding objectives, modes of reproduction and breeding methods for crop improvement. The studies will acquire the knowledge of regeneration power of a cell and how a single cell can be used to grow disease free plants. Further, the subject will make the students to understand that how an acquired character can be transferred from one plant to another for some specific function. |
| **Assessment:** | Mid Semester Exam (MSE) – 25 Marks<br>Written Quiz (MCQs) – 10 Marks<br>Assignment (written) – 10 Marks<br>End Semester Examination (ESE) – 50 Marks<br>Attendance – 5 Marks |
| **Model Question Paper: MSE** | Q.1 Will Comprise of 5 parts having 1 mark each<br>Q.2 to Q.6 will carry 4 marks each out of which 3 questions are to be attempted.<br>Q.7 and Q.8 will carry 8 marks each out of which 1 question is to be attempted |
| **Model Question Paper: ESE** | Q.1 Will Comprise of 10 parts having 1 mark each<br>Q.2 to Q.9 will carry 4 marks each out of which 6 questions are to be attempted.<br>Q.10 to Q.13 will carry 8 marks each out of which 2 question are to be attempted |

**Programme Name:** **M.Sc. (Hons.) Botany I Semester**
**Course Name:** **Approaches for Crop Improvement Laboratory**
**Course Code:** **BOT528**
**Total Credits:** **2**
**Credit Components:** **L-0; T-0; P-3**
**Learning Objectives:** To acquaint the students about various breeding processes at different levels and techniques used in plant breeding and tissue culture practices.

**List of Experiments**

1. To study the fertility in pollen grains of given Flowers.
2. To study artificial induction of polyploidy.
3. To study different steps of the process of artificial hybridization.
4. To emasculate different flowers
5. To study seed viability
6. Determination of seed moisture content
7. Laboratory organization and techniques for tissue culture.
8. To study different nutrient media; their preparation and sterilization.
9. To study the techniques of encapsulation of shoot meristem /somatic embryos in calcium alginate beads.

**Learning Strategies:** Practical, models, field trips, charts, online demonstrations, group discussions and assignments,

**Learning Outcome:** The students will come to know about artificial induction of polyploidy, techniques for tissue culture, the process of artificial hybridization and study different nutrient media.

**Assessment:** Continuous Assessment: 20 Marks
Practical Exam: 80 Marks

**Model Question Paper:** Practical Exam component is divided into the following sub components:

- Performance – 24 Marks
- Spotting – 16 Marks
- Viva-voce – 24 Marks
- Record – 8 Marks
- Internal Assessment – 8 marks

**Text Books:**

1 Allard, R. W. *Principles of Plant Breeding*. John Wiley & Sons, 1981. Print.
2. Chopra, V. L. *Breeding Field Crops.* New Delhi: Oxford and IBH Pub., 2001. Print.
3. Chopra, V. L. *Breeding Field Crops.* New Delhi: Oxford and IBH Pub., 2004. Print.
4. Gupta, S. K. *Practical Plant Breeding*. 2nd ed. Jodhpur: Agrobios (India), 2010. Print.

**Reference Books:**

1. Allard, R. W. *Principles of Plant Breeding*. John Wiley & Sons, 1981. Print.
2. Chopra, V. L. *Breeding Field Crops.* New Delhi: Oxford and IBH Pub., 2001. Print.
3. Chopra, V. L. *Breeding Field Crops.* New Delhi: Oxford and IBH Pub., 2004. Print.

4. Gupta, S. K. *Practical Plant Breeding*. 2nd ed. Jodhpur: Agrobios (India), 2010. Print.
5. Poehlman, John Milton, and Dhirendranath Borthakur. *Breeding Asian Field Crops, with Special Reference to Crops of India*. Calcutta: Oxford & IBH Pub., 1969. Print.
6. Roy, Darbeshwar. *Plant Breeding: Analysis and Exploitation of Variation*. Pangbourne, UK: Alpha Science International, 2000. Print.
7. Bhojwani, S. S., and Razdan, M. K. *Plant Tissue Culture: Theory and Practice*. Amsterdam: Elsevier ;, 1983. Print.
8. Chawla, H. S. *Introduction to Plant Biotechnology*. New Delhi: Oxford & IBH Pvt.Ltd., 2002. Print.
9. Hammond, J., McGarvey, P., and Yusibov, V. *Plant Biotechnology: New Products and Applications*. Berlin: Springer, 2000. Print.
10. Kumar, H.D. *A Text Book of Biotechnology*.Affiliated East West, Pvt., 2010. Print**.**
11. Murray, David R. *Advanced Methods in Plant Breeding and Biotechnology*. Melksham: Redwood Press Pvt.Lmt., 1991. Print.
12. Old, R.W., and Primrose, S.B. *Principles of Gene Manipulation: An Introduction to Genetic Engineering*. Oxford: Blackwell Scientific Publications, 1985. Print.
13. Razdan, M. K. *Introduction to Plant Tissue Culture*. New Delhi: Oxford and IBH Pvt. Ltd., 1983. Print.
14. Rainert, J. and Yeoman, M.M. *Plant Cell and Tissue Culture ; A Laboratory Manual*. Berlin: Springer-Verlag, 1982. Print.
15. Street, H. E. *Plant Tissue and Cell Culture*. London: Blackwell Scientific Publications, 1973. Print
16. Smith, Roberta H. *Plant Tissue Culture: Techniques and Experiments*. New York: Academic, 2000. Print.
17. Trevan, M.D., Buffey, S., Goulding, K.H., and Stanbury, P. *Biotechnology–The Biological Principles*. New: Delhi: Tata McGraw-Hill Publishing Company Ltd., 1988. Print.

**Websites and Audio Video lectures:**

CROP WILD RELATIVES GLOBAL PORTAL
www.cropwildrelatives.org

**Programme Name:** **M.Sc. (Hons.) Botany I Semester**
**Course Name:** **Genetics and Cytogenetics**
**Course Code:** **BOT529**
**Total Credits:** **4**
**Credit Components:** **L-4; T-0; P-0**
**Learning Objectives:** To acquaint the students about the hereditary basis of life, prokaryotic and eukaryotic genome organization and its functions.

**Unit I**

**Mendelian genetics**: Dominance, segregation, independent assortment, extension of Mendelian principles: codominance, incomplete dominance, gene interactions, pleiotropy, genomic imprinting, penetrance and expressivity, phenocopy, lethal genes, test cross and back cross. **(6 Lectures)**

**Linkage and genetic mapping**: Linkage and Crossing over - Stern's hypothesis, Creighton and McClintock's experiments, single cross over, multiple cross over, two-point cross, three point cross, map distances, gene order, interference and co-efficient of coincidence. Haploid mapping (*Neurospora*), Mapping in bacteria and bacteriophages. **(6 Lectures)**

**Unit II**

**Mutation**: Types and causes, mutant types – lethal, conditional, biochemical, loss of function, gain of function, germinal verses somatic mutants **(4 Lectures)**

**Structural and numerical alterations of chromosomes**: Deletion, duplication, inversion, translocation, Aneuploidy, nullisomy, monosomy, trisomy, tetrasomy, euploidy, monoploidy and haploidy, polyploidy **(4 Lectures)**

**Sex determination**: Mechanism of sex determination, sex chromatin and dosage compensation, Sex linked inheritance and common genetic disorders. **(6 Lectures)**

**Unit III**

**Genome**: Organization in prokaryotes and eukaryotes, Nuclear DNA content; law of DNA constancy and C-value paradox; Cot curves, DNA-DNA hybridization, Junk DNA, expressed gene in many copies, Globin gene family, human genome project, quantitative genetics **(6 Lectures)**

**Chromosome**: Euchromatin and heterochromatin, unique and repetitive DNA; Karyotype analysis and banding patterns, Types of chromosomes **(8 Lectures)**

**Unit IV**

**Gene mapping methods**: Genetic and physical maps of chromosome, mapping with molecular markers and somatic cell hybrids. **(4 Lectures)**

**Transposons:** Cut and Paste transposons, Replicative transposons and Retrotransposons; Mutations induced by transposons. **(3 Lectures)**

**Molecular cytogenetics**: Chromosome walking; Chromosome jumping; Applications of molecular cytogenetics. **(2 Lectures)**

**Quantitative Genetics:** Polygenic inheritance, heritability and measurements, QTL mapping. **(3 Lectures)**

**Learning Strategies:** Class room lectures, practical, crop land visits, models, charts, power point presentations, online lectures, group discussions, assignments and presentations by students

**Learning Outcome:** To provide insight into structure and functions of chromosomes, chromosome mapping, polyploidy and cytogenetic aspects of crop

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| | evolution. To provide a knowledge of the importance of chromosomal variations in structure and number. The study will make the students clear regarding what forms the basis of variations in living organisms. |
| **Assessment:** | Mid Semester Exam (MSE) – 25 Marks<br>Written Quiz (MCQs) – 10 Marks<br>Assignment (written) – 10 Marks<br>End Semester Examination (ESE) – 50 Marks<br>Attendance – 5 Marks |
| **Model Question Paper: MSE** | Q.1 Will Comprise of 5 parts having 1 mark each<br>Q.2 to Q.6 will carry 4 marks each out of which 3 questions are to be attempted.<br>Q.7 and Q.8 will carry 8 marks each out of which 1 question is to be attempted |
| **Model Question Paper: ESE** | Q.1 Will Comprise of 10 parts having 1 mark each<br>Q.2 to Q.9 will carry 4 marks each out of which 6 questions are to be attempted.<br>Q.10 to Q.13 will carry 8 marks each out of which 2 question are to be attempted |

**Programme Name:** **M.Sc. (Hons.) Botany I Semester**
**Course Name:** **Genetics and Cytogenetics Laboratory**
**Course Code:** **BOT530**
**Total Credits:** **2**
**Credit Components:** **L-0; T-0; P-3**
**Learning Objectives:** To acquaint the students about the hereditary basis of life, prokaryotic and eukaryotic genome organization and its functions.

**List of Experiments**

1. Workout problems related to linkage, crossing over and gene mapping, human pedigree analysis.
2. Study of permanent mounts of different stages of mitosis from onion root tips.
3. Studies of different cell organelles.
4. Study of mitosis and meiosis in higher plants.
5. Study of aberrant mitosis from plants.
6. Study of aberrant meiosis in Rhoeo, Tradescantia and Chrysanthemum.
7. Calculation of mitotic index and chiasma frequency.
8. Linear differentiation of chromosomes through banding techniques, such as G-banding, Cbanding and Q-banding (Photographs/Slides).
9. Preparation of standard curve of carbohydrates. Carbohydrate estimation by different methods
10. Preparation of standard curve of protiens and protiens estimation by different methods.
11. Lipid isolation from plant samples.
12. Paper and Thin layer chromatography for identification of amino acids in plant samples.

**Learning Strategies:** Practical, models, field trips, charts, online demonstrations, group discussions and assignments,

**Learning Outcome:** To provide a knowledge of the importance of chromosomal variations in structure and number. The study will make the students clear regarding what forms the basis of variations in living organisms.

**Assessment:** Continuous Assessment: 20 Marks
Practical Exam: 80 Marks

**Model Question Paper:** Practical Exam component is divided into the following sub components:

- Performance – 24 Marks
- Spotting – 16 Marks
- Viva-voce – 24 Marks
- Record – 8 Marks
- Internal Assessment – 8 marks

**Text Books:**

1. Brooker R.J. Genetics. USA: Addison-Wesley, Longman Publisher, 1999. Print.
2. Brown T.A. Genetics: A Molecular Approach. USA: Chapman & Hall, 1999. Print.

**Reference Books:**

3. Brown T.A. Genomes. USA: Wiley & Sons, 2001. Print.
4. Glick B.R., and Pasternak, J.J. Molecular Biotechnology. USA: American Society for Microbiology, 1998. Print.
5. Griffiths A.J.F., Gelbart, W.M., Miller, J.H., and Lewontin. Modern Genetic Analysis. USA: W.H. Freeman & Company, 2002.Print.

**Programme Name:** **M.Sc. (Hons.) Botany I Semester**
**Course Name:** **Plant Cell Biology and Biochemistry**
**Course Code:** **BOT539**
**Total Credits:** **4**
**Credit Components:** **L-4; T-0; P-0**
**Learning Objectives:** Make students well versed with cell structure and function. To make them understand the basic regulation of cell processes and molecules. To give them an idea about the functioning of cell.

**Unit I**

**Membrane Structure and Membranous Organelles**: Introduction, The fluid-mosaic membrane model, Plasma membrane, Impulse conduction, polarization and depolarization of the membrane. **(7 Lectures)**

**The Cell Wall**: Introduction, Macromolecules of the cell wall, Cell wall architecture, Cell wall biosynthesis and assembly, growth of cell walls and Cell differentiation. **(5 Lectures)**

**Unit II**

**Membrane Transport**: Overview of plant membrane transport systems, Pumps, Ion channels, Cotransporters, Water transport through aquaporins. **(4 Lectures)**

**Protein Sorting and Vesicle Traffic:** The cellular machinery of protein sorting, Targeting proteins to – nucleus, plastids and mitochondria, Protein traffic and sorting in the secretory pathway. **(5 Lectures)**

**The Cytoskeleton:** Introduction to the cytoskeleton, Characteristics of actin filaments and microtubules, intracellular movement, Cortical microtubules and expansion in plants, Acentric Mitosis and cytokinesis. **(4 Lectures)**

**Unit III**

**Cell Division:** Plant cell cycle, Mechanisms of cell cycle control, The logic of cell cycle control, Cell cycle control during development, Senescence and cell death, cancer. **(4 Lectures)**

**Signal Transduction**: Characteristics of signal perception, transduction, and integration in plants, Intracellular signal transduction, amplification, and integration via second messengers and MAPK cascades. **(8 Lectures)**

**Unit IV**

**Carbohydrates:** Classification, structure and function of carbyhydrates a) monosaccharides b) oligosaccharides c) polysaccharides - storage and structural, glycoproteins. **(3 Lectures)**

**Amino Acids:** Assimilation of inorganic nitrogen into amino acids, Aromatic amino acids, Aspartate- derived amino acids, Branched- chain amino acids, Glutamate- derived amino acids, Histidine. **(3 Lectures)**

**Protein Synthesis, Folding, and Degradation:** From RNA to protein, Mechanisms of plant viral translation, Post- translational modification of proteins, Protein degradation. **(3 Lectures)**

**Lipids**: Structure and function of lipids, Fatty acid biosynthesis, Acetyl- CoA carboxylase, Fatty acid synthase, Desaturation and elongation of C16 and C18 fatty acids, Synthesis and catabolism of storage lipids. **(5 Lectures)**

**Learning Strategies:** Class room lectures, practical, crop land visits, models, charts, power point presentations, online lectures, group discussions, assignments and presentations by students

**Learning Outcome:** This will enable the students to learn the working of the cell.

**Assessment:** Mid Semester Exam (MSE) – 25 Marks

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| | Written Quiz (MCQs) – 10 Marks<br>Assignment (written) – 10 Marks<br>End Semester Examination (ESE) – 50 Marks<br>Attendance – 5 Marks |
| **Model Question Paper: MSE** | Q.1 Will Comprise of 5 parts having 1 mark each<br>Q.2 to Q.6 will carry 4 marks each out of which 3 questions are to be attempted.<br>Q.7 and Q.8 will carry 8 marks each out of which 1 question is to be attempted |
| **Model Question Paper: ESE** | Q.1 Will Comprise of 10 parts having 1 mark each<br>Q.2 to Q.9 will carry 4 marks each out of which 6 questions are to be attempted.<br>Q.10 to Q.13 will carry 8 marks each out of which 2 question are to be attempted |
| **Text Books:** | 1. Stryer, L. Biochemistry. 5thed. New York: W.H. Freeman and Co., 1995. Print.<br>2. Voet, D., and Voet, J.G. Biochemistry. New York: John Wiley and Sons Inc., 1995. Print. |
| **Reference Books:** | 3. Buchanan, B.B., Gruissem, W. and Jones, R.L. Biochemistry and Molecular Biology of Plants. India: I K Internationals, 2005. Print.<br>4. Heldt, H.W. Plant Biochemistry. California: Elsevier, 2005. Print |

**Programme Name:** **M.Sc. (Hons.) Botany**
**Course Name:** **Archegoniate Biology**
**Course Code:** **BOT531**
**Total Credits:** **4**
**Credit Components:** **L-4; T-0; P-0**
**Learning Objectives:** To expose the students to evolutionary history, morphology, biology and affinities of Bryophytes and Pteridophytes and Gymnosperms.

**Unit I**

**Bryophytes:** Salient features of (i) Takakiales (ii) Polytrichales (iii) Sphagnales (iv) Andreaeales (v) Jungermanniales (vi) Anthocerotales (vii) Marchantiales. Uptake of water and nutrients, characteristic features of endohydric, ectohydric and mixohydric Bryophytes. **(6 Lectures)**

**Substratum Ecology:** Epiphytes, Epiphylls, Epiliths, Litter species, Fire mosses, Coprophilous species, Calcicoles and Calcifuges, Halophytes, Epizoic Bryophytes. **(3 Lectures)**

**Bryogeography and Conservation:** Indian bryodiversity with particular emphasis to Himalayas; Threatened bryophytes; strategies to conserve diversity at National and Global levels. **(6 Lectures)**

**Unit II**

**Pteridophytes**: Classification of Pteridophytes with special reference to ferns, Criteria used for the classification of ferns. **(4 Lectures)**

Evolution of stellar structure among Pteridophytes; Spore structure, types and patterns of spore germination in ferns. **(4 Lectures)**

Natural and induced apogamy and apospory in pteridophytes.Heterospory and seed habit. **(4 Lectures)**

**Unit III**

**Gymnosperms:** General characteristic features of Gymnosperms and their affinities with pteridophytes and angiosperms; Evolutionary status of pteridosperms and their angiospermic affinities. Current trends in the classification of Gymnosperms; Distribution of Gymnosperms in India. **(6 Lectures)**

Brief account of families of Pteridospermales (Lyginopteridaceae, Medullosaceae, Caytoniaceae, Glossopteridaceae). **(8 Lectures)**

Cytological studies in Gymnosperms. **(1 Lecture)**

**Unit IV**

**Ecological and economic significance of Archegoniate:**

Ecological significance of Bryophytes - role as pollution indicators; biologically active compounds in Bryophytes, Economic importance of Bryophytes.

Ferns as hyper accumulators of arsenic, mechanism of uptake, transfer and tolerance and use in phyto remediation.

Impact of coniferous forest on human life, Gymnosperms as a source of wood, resins, essential oils, food and drugs. **(12 Lectures)**

**Learning Strategies:** Class room lectures, practicals, field visits, models, charts, power point presentations, online lectures, group discussions, assignments and presentations by students

**Learning Outcome:** The students will come to know about bryophytes, pteridophytes and gymnosperms: their classification, identification and distribution as well as their conservation etc.

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| **Assessment:** | Mid Semester Exam (MSE) – 25 Marks<br>Written Quiz (MCQs) – 10 Marks<br>Assignment (written) – 10 Marks<br>End Semester Examination (ESE) – 50 Marks<br>Attendance – 5 Marks |
| **Model Question Paper: MSE** | Q.1 Will Comprise of 5 parts having 1 mark each<br>Q.2 to Q.6 will carry 4 marks each out of which 3 questions are to be attempted.<br>Q.7 and Q.8 will carry 8 marks each out of which 1 question is to be attempted |
| **Model Question Paper: ESE** | Q.1 Will Comprise of 10 parts having 1 mark each<br>Q.2 to Q.9 will carry 4 marks each out of which 6 questions are to be attempted.<br>Q.10 to Q.13 will carry 8 marks each out of which 2 question are to be attempted |

**Programme Name:** **M.Sc. (Hons.) Botany**
**Course Name:** **Archegoniate Biology Laboratory**
**Course Code:** **BOT532**
**Total Credits:** **2**
**Credit Components:** **L-0; T-0; P-3**
**Learning Objectives:** To acquaint the students about morphology, anatomy and reproductive systems of bryophytes, pteridophytes and gymnosperms.

**List of Experiments**

1. Morphology and internal organization in Marchantiales, Jungermanniales, Isobryales and Hypnobryales.
2. To compare the structure and behaviour of endohydric and ectohydric mosses.
4. Study of the morphology, anatomy and reproductive structures of some representative fern and fern allies
5. Herbarium preparation of Pteridophytic collection.
6. Wood Anatomy in *Cedrus*, *Ginkgo*, *Ephedra* and *Gnetum*
7. Leaf Anatomy in *Cedrus*, *Abies*, *Picea*, *Pinus*
8. Male and female cones (external morphology) in *Cedrus*, *Abies*, *Thuja* and *Juniperus*

**Learning Strategies:** Practical, models, charts, online demonstrations, group discussions and assignments

**Learning Outcome:** The students will come know to about morphology, anatomy and reproductive systems of bryophytes, pteridophytes and gymnosperms.

**Assessment:** Continuous Assessment: 20 Marks
Practical Exam: 80 Marks

**Model Question Paper:** Practical Exam component is divided into the following sub components:

- Performance – 24 Marks
- Spotting – 16 Marks
- Viva-voce – 24 Marks
- Record – 8 Marks
- Internal Assessment – 8 marks

**Text Books:**

1. Gilbert M. Smith. Cryptogamic Botany- Bryophytes and pteridophytes. 1938, The Mcgra w-hill Book Company, *inc.*
2. Jeffrey, E. C. 1917. The anatomy of woody plants. Chicago. 478 pp. 306 figs.

**Reference Books:**

1. Chopra, Ram Saran. *Taxonomy of Indian Mosses: An Introduction*. New Delhi: Publications & Information Directorate, Council of Scientific & Industrial Research, 1975. Print.
2. Dyer, A. F. *The Experimental Biology of Ferns*. London: Academic Press, 1979. Print.
3. Dyer, A.F., and Duckett, J.G. *The Experimental Biology of Bryophytes*. London: Academic Press, 1984. Print.
4. Gifford, E.M., and Foster, A.S. *Morphology and Evolution of Vascular Plants*. New York: W.H. Freeman and Company, 1989. Print.
5. Goffinet, B., and Shaw, A.J. *Bryophyte Biology*. Cambridge: Cambridge University Press, 2000. Print.
6. Khullar, S.P. *An Illustrated Fern Flora of West Himalayas* (Vols. I and 2), Dehradun: International Book Distributors, 2000. Print.

7. Mehra, P.N., and Gupta, A. *Gametophytes of Himalayan Ferns*. Chandigarh: Mehra P.N., Botany Department, P.U., 1986. Print.
8. Rashid, A. *An Introduction to Pteridophyta*. New Delhi: Vikas Publishers, 1999. Print.
9. Richardson, D.H.S. *Biology of Mosses*. Oxford: Blackwell Scientific Publications, 1981. Print.
10. Schofield, W.B. *Introduction to Bryology*, New York: Macmillan Publishing Company, 1985. Print.
11. Schuster, Rudolf M. *New Manual of Bryology*. Nichinan, Miyazaki: Hattori Botanical Laboratory, 1984. Print.
12. Sporne, K.R. *The morphology of Pteridophytes*, Bombay: B.I. Publications, 1982. Print.
13. Dalimore, W., Jackson, A.B., and Morrison, S.L. *A Handbook of Coniferae including Ginkgoaceae*, London: Edward Arnold and Co., 1966. Print.
14. Meyen, S.V. "Basic Features of Gymnosperms, Systematics and Phylogeny as Evidenced by the Fossil Record." *Botanical Review*: 50 (1984): 1-112. Print.
15. Rothwell, G.W. "The Role of Comparative Morphology and Anatomy in Interpreting the Systematics of Fossil Gymnosperms." *Botanical Review*: 51 (1985): 318-327. Print.
16. Sporne, K.R. *The Morphology of Gymnosperms*, Delhi: B.I. Publications, 1974. Print.
17. Sharma, O.P. and Dixit, S. *Gymnosperms*. Meerut: Pragati Prakashan, 2001. Print.

**Websites and Audio Video lectures:**

www.bryophyte.org, www.pteridophyte.org, www.gymnosperms.org

**Programme Name:** **M.Sc. (Hons.) Botany**
**Course Name:** **Plant Physiology**
**Course Code:** **BOT533**
**Total Credits:** **4**
**Credit Components:** **L-4; T-0; P-0**
**Learning Objectives:** To acquaint the students about various physiological processes at cellular and organ level in plants.

**Unit I**

**Water and Plant Cells:** Water in plant life; Water transport processes; Concept of water potential; Absorption of water by roots and transport through the xylem; Transpiration and factors affecting transpiration; The Soil-Plant-Atmosphere Continuum. **(6 Lectures)**

**Mineral Nutrition:** Concept of essentiality of mineral elements; Essential nutrients and their deficiency in plants; Absorption of minerals by roots; Role of microbes in nutrient acquisition by plants; Assimilation of mineral nutrients with emphasis on phosphorus and potassium assimilation. **(6 Lectures)**

**Unit II**

**Photosynthesis**: Energy pathways in photosynthesis; Composition and characterization of photosystem-I and -II; electron flow through cyclic, non-cyclic and pseudo-cyclic photophosphorylations, Biochemical events and regulation of $CO_2$ fixation (C3, C4 and CAM); Mechanism of and regulation of photorespiration; RUBISCO as an example of model enzyme for semi-autonomy at the molecular level. **(7 Lectures)**

**Source-sink relationship:** Translocation in the phloem; Phloem loading; Phloem unloading; Regulation of source to sink relationship; Sink strength. **(2 Lectures)**

**Plant Respiration**: Detailed mechanism; Glycolysis and TCA cycle, Mitochondria as biological oxidators; Chemiosmatic regeneration of ATP, Boyer and Walkers confirmation change model; CN- resistant respiration. **(5 Lectures)**

**Unit III**

**Sensory physiology:** Phytochromes; Localization of phytochrome; Physiological responses of phytochrome with special reference to shade avoidance and circadian rythms; Blue-light mediated responses; Photoperiodism. **(4 Lectures)**

**Flowering in plants:** Control of flowering; Floral organ development; Phase changes during floral development; Role of Photoperiodism and Vernalization in flowering. **(2 Lectures)**

**Fruit development and ripening:** Stages of fruit development and their regulation, biochemical and related events during fruit ripening in climacteric and non-climacteric fruits, physiology and biochemistry of fruit abscission, post-harvest changes, production of transgenic fruits. **(4 Lectures)**

**Unit IV**

**Physiology of seed development, maturation, dormancy and germination:** Hormonal regulation of seed development, events associated with seed maturation, factors regulating seed dormancy, mechanisms of mobilization of food reserves during seed germination. **(4 Lectures)**

**Plant Hormones:** Physiological effects and molecular mechanism of action of auxins, gibberellins, cytokinins, ethylene, abscissic acid, jasmonic acid, brassinosteroids, polyamines, salicylic acid. **(8 Lectures)**

**Learning Strategies:** Class room lectures, practicals, models, charts, power point presentations, online lectures, group discussions, assignments and

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| | presentations by students |
| **Learning Outcome:** | The students will come to know that how a plant cell responds to various biotic and abiotic stresses, defence mechanism in plants, events of seed and fruit development, and the various physiological roles of plant hormones. |
| **Assessment:** | Mid Semester Exam (MSE) – 25 Marks<br>Written Quiz (MCQs) – 10 Marks<br>Assignment (written) – 10 Marks<br>End Semester Examination (ESE) – 50 Marks<br>Attendance – 5 Marks |
| **Model Question Paper: MSE** | Q.1 Will Comprise of 5 parts having 1 mark each<br>Q.2 to Q.6 will carry 4 marks each out of which 3 questions are to be attempted.<br>Q.7 and Q.8 will carry 8 marks each out of which 1 question is to be attempted |
| **Model Question Paper: ESE** | Q.1 Will Comprise of 10 parts having 1 mark each<br>Q.2 to Q.9 will carry 4 marks each out of which 6 questions are to be attempted.<br>Q.10 to Q.13 will carry 8 marks each out of which 2 question are to be attempted |

**Programme Name:** **M.Sc. (Hons.) Botany**
**Course Name:** **Plant Physiology Laboratory**
**Course Code:** **BOT534**
**Total Credits:** **2**
**Credit Components:** **L-0; T-0; P-2**
**Learning Objectives:** To acquaint the students about various physiological processes at cellular and organ level in plants.

**List of Experiments**

1. Determination of Chlorophyll a and Chlorophyll b ratio in C3 and C4 plants.
2. Spectroscopic determination of Chlorophyll a, Chlorophyll b, Carotenoids and Anthocyanin content under varied environmental conditions.
3. TLC and paper chromatography for separation of chlorophyll pigments.
4. Determination of NR activity.
5. Extraction of plant proteins and determination of their contents.
6. Demonstration of GA production bioassay.
7. Demonstration of internodal elongation bioassay for brassinosteroids
8. Experimental study of seed germination under stressful conditions.

**Learning Strategies:** Practicals, models, charts, online demonstrations, group discussions and assignments

**Learning Outcome:** The students will come to know that how a plant cell responds to various biotic and abiotic stresses, defence mechanism in plants, events of seed and fruit development, and the various physiological roles of plant hormones.

**Assessment:** Continuous Assessment: 20 Marks
Practical Exam: 80 Marks

**Model Question Paper:** Practical Exam component is divided into the following sub components:

- Performance – 24 Marks
- Spotting – 16 Marks
- Viva-voce – 24 Marks
- Record – 8 Marks
- Internal Assessment – 8 marks

**Text Books:**


1. Srivastava, L.M. *Plant Growth and Development*. NewYork: Associated Press, 2002. Print.
2. Taiz, L., and Zeiger, E. *Plant Physiology*. California: The Benjamin/Cumming Publishing Company, 1998. Print.


**Reference Books:**


1. Bonner, B., and Varner, J.E. *Plant Biochemistry*. London: Academic Press, 1976. Print.
2. Stryer, L. *Biochemistry*. 5th ed. New York: W.H. Freeman and Co., 1995. Print.
3. Voet, D., and Voet, J.G. *Biochemistry*. New York: John Wiley and Sons Inc., 1995. Print.
4. Wilkins, M.B. *Advanced Plant Physiology*. New York: Pitman, 1984. Print.
5. Buchanan, B.B., Gruissem, W. and Jones, R.L. *Biochemistry and Molecular Biology of Plants*. India: I K Internationals, 2005. Print.


**Websites and Other Supportive Material:** www.plantphys.org

**Programme Name:** **M.Sc. (Hons.) Botany**
**Course Name:** **Conservation of Natural Resources**
**Course Code:** **BOT535**
**Total Credits:** **4**
**Credit Components:** **L-4; T-0; P-0**
**Learning Objectives:** To make the students learn about the significance of different natural resources and their conservation strategies.

**Unit I**

**Conservation:** Concept; Objectives and aims; definition and classification of resources, basic principles of resource management, problems of resource depletion, preservation, conservation and restoration **(4 Lectures)**

**Conservation of Soil:** Soil structure, soil orders, properties and services of soil, reasons of soil degradation, dust bowl, types of soil erosion and its check; Role of soil micro-organisms; Soil reclamation. **(6 Lectures)**

**Conservation of Mineral Resources:** Demographic quotient and mineral exploration, mining, processing and utilization; conservation. **(2 Lectures)**

**Unit II**

**Conservation of Agriculture:** Conservation of arable land; conservation agriculture, conservation tillage, genetic erosion, conservation of crop genome; Strategies of conservation of crops, mulches. **(6 Lectures)**

**Conservation of Aquatic System:** water cycle, significance of wetlands, need and strategies of conservation of Aquatic systems-water pollution (sediment, inorganic, heavy metal, organic, thermal), desalination, reclamation of sewage water, drip irrigation. **(6 Lectures)**

**Unit III**

**Bioremediaton and Phytoremediation:** Major contaminants, plant ecotoxicology, phytosquestration, rhizodegradation, phytoextraction, phytodegradation, phytovolatization,. Bioremediation of pesticides, contaminants and metallic pollutants, Importance of GMOs in crop biodiversity and agroecology. **(8 Lectures)**

**Conservation of Forests:** Joint Forest Management, Plantation Programmes in India – Social and Urban Forestry; Forest Conservation Act. **(4 Lectures)**

**UNIT IV**

**Biodiversity and its Conservation:** Definition, levels, measurement, threats, drivers of biodiversity loss, strategies for biodiversity conservation. **(4 Lectures)**

**Endangered and threatened species:** IUCN Categories of Extinction

**Principles and strategies for biodiversityconservation:** *In-situ* conservation: protected areas sanctuaries, biosphererereserves, national parks. *Ex-situ* conservation: botanical gardens,herbarium; *In-vitro* Conservation: germplasm and gene Bank; tissueculture: pollen and spore bank, DNA bank. **(6 Lectures)**

**Biodiversity Hotspots:**concept; Biodiversity hotspots of India **(3 Lectures)**

**Learning Strategies:** Class room lectures, practicals, models, charts, power point presentations, online lectures, group discussions, assignments and presentations by students

**Learning Outcome:** The students will gain the knowledge of significance of biodiversity, different conservation strategies, biosphere reserves etc.

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| **Assessment:** | Mid Semester Exam (MSE) – 25 Marks<br>Written Quiz (MCQs) – 10 Marks<br>Assignment (written) – 10 Marks<br>End Semester Examination (ESE) – 50 Marks<br>Attendance – 5 Marks |
| **Model Question Paper: MSE** | Q.1 Will Comprise of 5 parts having 1 mark each<br>Q.2 to Q.6 will carry 4 marks each out of which 3 questions are to be attempted.<br>Q.7 and Q.8 will carry 8 marks each out of which 1 question is to be attempted |
| **Model Question Paper: ESE** | Q.1 Will Comprise of 10 parts having 1 mark each<br>Q.2 to Q.9 will carry 4 marks each out of which 6 questions are to be attempted.<br>Q.10 to Q.13 will carry 8 marks each out of which 2 question are to be attempted |

**Programme Name:** **M.Sc. (Hons.) Botany**
**Course Name:** **Conservation of Natural Resources Laboratory**
**Course Code:** **BOT536**
**Total Credits:** **2**
**Credit Components:** **L-0; T-0; P-2**
**Learning Objectives:** To make the students learn about the significance of different natural resources and their conservation strategies.

**List of Experiments**

1. To study pH and EC of different types of soil.
2. To evaluate the status of natural resources present in the University campus.
3. To estimate and categorise the waste generated in University campus.
4. To study the impact of salinity on plant growth
5. To undertake a field visit to understand the concept and consequences soil degradation and erosion.
6. To study different types of ecological systems.
7. Ecological footprint analysis.

**Learning Strategies:** Practicals, models, charts, online demonstrations, group discussions and assignments

**Learning Outcome:** The students will come to know the status of natural resources, land degradation, water pollution and soils in the surrounding area. Also the concept of ecological footprint will enlighten then towards developing a sustainable environment

**Assessment:** Continuous Assessment: 20 Marks
Practical Exam: 80 Marks

**Model Question Paper:** Practical Exam component is divided into the following sub components:

- Performance – 25 Marks
- Spotting – 15 Marks
- Viva-voce – 24 Marks
- Record – 8 Marks
- Internal Assessment – 8 marks

**Text Books:**


1. Michael, L., McKinney and Schoch, R.M.*Environmental science: Systems and Solutions*. West publishing company, 2002.Print.
2. Oehme, W.F. *Toxicity of Heavy Metals in Environment.* Marcel DakkarInc, 1989.Print.
3. James, P. and Lodge, J. R. *Methods of Air sampling and Analysis.* ISc Lewis Pub. Inc, 1971.Print.


**Reference Books:**


1. Oliver, S.O., and Daniel, D.C. *Natural Resource Conservation: Management for a Sustainable Future*. New Jersey: Prentice Hall International, 1990. Print.
2. Rai, G.D. *Non-Conventional Energy Sources*. Delhi: Khanna Publishers, 1993. Print.
3. Ramijhan, S.K. *Agro Industrial by Products and Non-Conventional Feed for Live Stock*. New Delhi: Indian Council for Agriculture Research, 1990. Print.
4. APHA-AWWA-WPCF. *Standard Methods for the Examination of*

*water and Waste water.* (XX Edn), 1990. American Public Health Association. Print.
5. Butter, G.C. *Principles of Ecotoxicology.* 1988. John Wiley and Sons. Print.
6. Cockerham, G. L. and Shane, B.S. (Eds.). *Basic Environmental Toxicology*. CRC Press, 1994. Print.
7. Eisenbude, M. *Environmental Radioactivity*. Academic Press, 1998. Print.
8. Fellenberg, G. *Chemistry of Pollution*. John Wiley and Sons, 1999.Print.
9. Hayes, W.A.*Principles and Methods of Toxicology*. CRC Press, 2001.Print.
10. Klaassen, C.D. andAlkinsJ.B.W.*Essentials of Toxicology*. McGraw-Hill Professional, 2003.Print.
11. Lutgens, F.K. andTarbuek, J.E.*The Atmosphere*. Prentice Hall, 1992.Print.

**Websites and Audio Video lectures:** https://www.footprintnetwork.org/our-work/ecological-footprint/

**Other Supportive Material:** http://www.geokniga.org/bookfiles/geokniga-handbook-soil-analysis.pdf

**Programme Name:** **M.Sc. (Hons.) Botany**
**Course Name:** **Evolutionary Biology of Plants**
**Course Code:** **BOT540**
**Total Credits:** **4**
**Credit Components:** **L-4; T-0; P-0**
**Learning Objectives:** This course presents an overview of biological evolution. Students are introduced to the Darwin's ideas about the mechanisms of evolution, to an up-to-date history of life, to current evolutionary theory.

## Unit I

Historical perspective of evolutionary biology, fundamental concepts in cosmology and geology **(2 Lectures)**

**Earliest forms of plant life**: the earliest environments, accumulation of organic material and formation of the first cell, the first prokaryotes geological evidence, evolution of photosynthesis, evolution of plants using C4 and CAM photosynthetic pathways, evolution of eukaryotes **(6 Lectures)**

Pre-Darwinian and Darwinian theories of organic evolution, Concept of Oparin and Haldane; Experiment of Miller (1953), phylogenetic tress, taxonomic and biological concept of species, dating methods **(5 Lectures)**

## Unit II

Paleontology, geological time scale, eras, periods and epochs, major evolutionary events in the geological time scale, fossil evidence for plant terrestrialization, examples of earliest land plants in the fossil record **(5 Lectures)**

Evolutionary trend: algae to land plants, evolutionary trend in land plants: vascular to non-vascular, influence of land dwelling plants on the earth system **(4 Lectures)**

Mass extinction events in plants: evidence in the geological record, evidence for persistence in the plant fossil record, Pleistocene glaciations **(4 Lectures)**

## Unit III

Origins of multicellularity in the plant kingdom, development and genetics in the evolution of land plant body plans, the evolution of plant development: past, present and future, innovations in the origin of vascular plants **(6 Lectures)**

Altruism, Kin selection, Biological clocks; Mating systems, Parental investment and Reproductive success; Parental care; Aggressive behavior; Habitat selection and optimality in foraging; Migration, orientation and navigation; Domestication and behavioral changes **(7 Lectures)**

## UNIT IV

Allopatric speciation, genetic models, peripetric speciation, disjunct distributions, the theory of island biogeography, Sympatric speciation, the role of genetic drift and gene flow in evolution, models of genetic drift, evolutionary development of plant speciation, macroevolution and the biological diversity of plants, Concepts of neutral evolution, molecular divergence and molecular clocks; Molecular tools in phylogeny, classification and identification; origin of new genes and proteins; Gene duplication and divergence. **(13 lectures)**

**Learning Strategies:** Class room lectures, practicals, models, charts, power point presentations, online lectures, group discussions, assignments and presentations by students

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| **Learning Outcome:** | Students are expected to become familiar with the conceptual models through which we attempt to understand complex biological systems, the facts upon which those models are based, and the processes through which we discover these facts. |
| **Assessment:** | Mid Semester Exam (MSE) – 25 Marks<br>Written Quiz (MCQs) – 10 Marks<br>Assignment (written) – 10 Marks<br>End Semester Examination (ESE) – 50 Marks<br>Attendance – 5 Marks |
| **Model Question Paper: MSE** | Q.1 Will Comprise of 5 parts having 1 mark each<br>Q.2 to Q.6 will carry 4 marks each out of which 3 questions are to be attempted.<br>Q.7 and Q.8 will carry 8 marks each out of which 1 question is to be attempted |
| **Model Question Paper: ESE** | Q.1 Will Comprise of 10 parts having 1 mark each<br>Q.2 to Q.9 will carry 4 marks each out of which 6 questions are to be attempted.<br>Q.10 to Q.13 will carry 8 marks each out of which 2 question are to be attempted |
| **Text Books:** | 1. Bole, P.V., and Vaghani, Y. *Field Guide to Common Indian Trees.* Mumbai: Oxford University Press, 1986. Print.<br>2. Chandel, K.P.S., Shukla, G., and Sharma, N. *Biodiversity in Medicinal and Aromatic Plants InIndia: Conservation and Utilization.* New Delhi: National Bureau of Plant Genetic Resources, 1996.Print. |
| **Reference Books:** | 1. Cristi, B.R. *Handbook of Plant Science and Agriculture*, Vol. I. *In-situ Conservation*, Florida, U.S.A: CRC Press, Boca Raton, 1999.Print.<br>2. Council for Scientific & Industrial Research. *The Useful Plants of India*, New Delhi: Publications and Information Directorate, CSIR, 1986.Print.<br>3. Kocchar, S.L. *Economic Botany of the Tropics*, 2nd ed., New Delhi Macmillan India Ltd., 1998.Print.<br>4. Swaminathan, M.S., and Kocchar, S.L., (eds.). *Plants and Society*. London: MacMillan Publications Ltd., 1989.Print.<br>5. Thakur, R.S., Puri, H.S. and Husain, A.*Major Medicinal Plants of India.* Lucknow: Central Institute of Medicinal and Aromatic Plants, 1989.Print.<br>6. Walter, K.S., and Gillett, H.J.*IUCN Red List of Threatened Plants.* U.K.: World Conservation Union, IUCN, Switzerland, and Cambridge, 1998, 1997.Print. |
| **Websites and Audio Video lectures:** | http://frienvis.nic.in/Database/Dye-Yielding-Plant-Species_2432.aspx;<br>https://www.youtube.com/watch?v=cMacWINhxls |

**Other Supportive Material:** https://www.youtube.com/watch?v=a55PG2d0V9c
**Programme Name:** **M.Sc. (Hons.) Botany**
**Course Name:** **Seminar**
**Course Code:** **BOT538**
**Total Credits:** **1**
**Credit Components:** **L-0; T-0; P-0**
**Learning Objectives:** To develop public talking ability of the students

**Description**

During the course students will come to know about the general understanding of the common problems and recent advances in research. Each student shall be allotted a topic by the instructor. Student will have to understand the topic and collect literature. The students shall give a presentation on the allotted topic, which shall be evaluated by the concerned internal faculty. Through this, the students will develop habit of reading newer topics, will become inquisitive and develop research aptitude.

**Programme Name:** **M.Sc. (Hons.) Botany**
**Course Name:** **Scientific Writing and Research Methodology**
**Course Code:** **BOT621**
**Total Credits:** **4**
**Credit Components:** **L-4; T-0; P-0**
**Learning Objectives:** To make the students learn how to design an experiment and what are the various research strategies.

**Unit I**

**Biostatistics:** Definition and relevance in biological research; Measures of Central Tendency: Arithmetic Mean, median, mode, quartiles and percentiles; Measures of Dispersion: Range, variance, standard deviation, coefficient of variation; Skewness and Kurtosis. **(5 Lectures)**

**Correlation and Regression:** Correlation coefficient (r), properties, interpretation of r, partial and multiple correlations, linear regression: Fitting of lines of regression, regression coefficient, Bivariate and Multiple Regression. **(5 Lectures)**

**Probability theory:** Origin and concept, deterministic and random experiments, concept of events, sample space, mutually exclusive and equally likely events; classical concept of probability, addition theorem and multiplication theorem in probability. **(3 Lectures)**

**Unit II**

**Inferential Statistics**: Hypothesis testing, Errors in Hypothesis Testing- Null Hypothesis, Alternative Hypothesis, Type I and Type II errors, Confidence Limits. Setting up of level of significance. One tailed and Two- tailed tests. **(2 Lectures)**

**Parametric and Non-Parametric Statistics**: Definition, Advantages, Disadvantages, Assumptions; Parametric Tests: Student's t-test, One Way Analysis of Variance, Two Way Analysis of Variance; Non-Parametric Tests: Analysis of Variance, Chi square and Kendall Rank Correlation **(6 Lectures)**

**Experimental Set-up**: Basic principles and significance of research design; Randomized Block Designs (RBD), completely randomized designs (CRD); Latin square design and Factorial design **(4Lectures)**

**Unit III**

Data collection, organization and interpretation.

Research articles, research papers, popular research articles and reviews; difference between periodicals; journals; monographs, magazines; proceedings.

How to write a research paper, reference styles, process of submission of a paper; process of proof reading of a research manuscript; process of reviewing.

Important journals in plant sciences. **(14 Lectures)**

**Unit IV**

An introduction to Science citation index; H-index, i10 index, Impact factor calculation, Impact factor of a journal; Eigen factor, Major journal search engines.

Copyright act; Academic frauds; Plagiarism; Software's to check plagiarism. **(10 Lectures)**

**Learning Strategies:** Class room lectures, power point presentations, online lectures, group discussions, assignments and presentations by students

**Learning Outcome:** This course will impart the comprehensive knowledge of designing a research experiment, how to write a research paper, the relevant ethics, copy right, impact factor etc.

**Assessment:** Mid Semester Exam (MSE) – 25 Marks
Written Quiz (MCQs) – 10 Marks

| | |
|---|---|
| | Assignment (written) – 10 Marks<br>End Semester Examination (ESE) – 50 Marks<br>Attendance – 5 Marks |
| **Model Question Paper: MSE** | Q.1 Will Comprise of 5 parts having 1 mark each<br>Q.2 to Q.6 will carry 4 marks each out of which 3 questions are to be attempted.<br>Q.7 and Q.8 will carry 8 marks each out of which 1 question is to be attempted |
| **Model Question Paper: ESE** | Q.1 Will Comprise of 10 parts having 1 mark each<br>Q.2 to Q.9 will carry 4 marks each out of which 6 questions are to be attempted.<br>Q.10 to Q.13 will carry 8 marks each out of which 2 question are to be attempted |
| **Text Books:** | McKillup, S. *Statistics Explained. An Introductory Guide for Life Scientists*. Cambridge, UK: Cambridge University Press, 2006. Print. |
| **Reference Books:** | 1. Kothari, C.R. *Research Methodology – Methods and Techniques*. 2nd revised ed. New Delhi: New Age International (P) Ltd. Publishers, 2007. Print.<br>2. Selvin, S. *Biostatistics – How it Works.* First Impression. New Delhi: Pearson Education Inc., 2007. Print.<br>3. Agarwal, B.L. *Basic Statistics*. New Delhi: New Age International, 2006. Print. |

**Programme Name:** **M.Sc. (Hons.) Botany**
**Course Name:** **Advanced Plant Systematics**
**Course Code:** **BOT622**
**Total Credits:** **4**
**Credit Components:** **L-4; T-0; P-0**
**Learning Objectives:** The students will learn to describe, identify, name and classifyplants. They will also be acquainted with the hierarchical evolution of plant classification. Students will learn about various changes effected in International Code of Nomenclature for algae, fungi and plants over the period of time. They will also learn various techniques to find out phylogenetic relationships between various taxonomic groups of plants.

**Unit I**

General evolutionary trends and criteria of primitive and advance taxa of flowering plants. Morphology of stamens and carpels- a brief account. **(4 Lectures)**

A brief account on various taxonomic tools like herbarium, Botanical gardens, floras, computers and GIS. Relevance of taxonomy to plant conservation. **(5 Lectures)**

A brief account on the origin and phylogeny of Angiosperms. **(3 Lectures)**

**Unit II**

Plant systematics; an overview; Phylogenetic systematics: character analysis, cladogram construction and cladogram analysis. **(7 Lectures)**

Plant molecular systematics, numerical taxonomy and serotaonomy: a brief account. **(6 Lectures)**

**Unit III**

Salient features of various systems of classification (Bentham & Hooker, Engler and Prantl, Cronquist, Takhtajan, Hutchinson). **(5 Lectures)**

Salient features of International code of Botanical Nomenclature (Principles, Ranks of taxa, typification, Principle of priority and citation of authors' names). **(8 Lectures)**

**Unit IV**

Salient features and socio-economic importance of the following families of Dicots: Magnoliaceae, Nymphaeaceae, Tiliaceae, Meliaceae, Sapindaceae, Anacardiaceae, Myrtaceae, Rubiaceae, Sapotaceae, Apocynaceae, Bignoniaceae, Scrophulariaceae, Lamiaceae, Polygonaceae, Chenopodiaceae and Moraceae.

Salient features and socio-economic importance of the following families of Monocots: Orchidaceae, Amaryllidaceae, Agavaceae, Cyperaceae and Poaceae.

**(4 Lectures)**

**Learning Strategies:** Class room lectures, power point presentations, online lectures, group discussions, assignments and presentations by students

**Learning Outcome:** The students will be able to derive evolutionary links between various taxa of plants. They will have the knowledge of various principles, rules and amendments in International Code of Nomenclature for algae, fungi and plants.Students will be able to identify and classify the local flora of Jalandhar.

**Assessment:** Mid Semester Exam (MSE) – 25 Marks
Written Quiz (MCQs) – 10 Marks
Assignment (written) – 10 Marks

| | |
|---|---|
| | End Semester Examination (ESE) – 50 Marks<br>Attendance – 5 Marks |
| **Model Question Paper: MSE** | Q.1 Will Comprise of 5 parts having 1 mark each<br>Q.2 to Q.6 will carry 4 marks each out of which 3 questions are to be attempted.<br>Q.7 and Q.8 will carry 8 marks each out of which 1 question is to be attempted |
| **Model Question Paper: ESE** | Q.1 Will Comprise of 10 parts having 1 mark each<br>Q.2 to Q.9 will carry 4 marks each out of which 6 questions are to be attempted.<br>Q.10 to Q.13 will carry 8 marks each out of which 2 question are to be attempted |

**Programme Name:** **M.Sc. (Hons.) Botany**
**Course Name:** **Advanced Plant Systematics Laboratory**
**Course Code:** **BOT623**
**Total Credits:** **2**
**Credit Components:** **L-0; T-0; P-2**
**Learning Objectives:** Students will also learn various techniques to find out phylogenetic relationships between various taxonomic groups of plants.

**List of Experiments**

1. Live plants/ Herbarium specimens of the following families will be provided in the class for description and identification (classification based on APG II, 2003):
   a) Basal Angiosperm and Magnoliids: Nymphaeaceae, Magnoliaceae
   b) Basal Monocots: Araceae, Alismataceae
   c) Petaloid monocots: Liliaceae, Smilacaceae, Alliaceae, Orchidaceae
   d) Commelinids: Arecaceae, Poaceae, Cyperaceae
   e) Basal Eudicots and Caryophyllids: Ranunculaceae, Caryophyllaceae
   f) Rosids: Euphorbiaceae, Rosaceae, Fabaceae, Cucurbitaceae
   g) Asterids: Solanaceae, Lamiaceae, Apiaceae, Asteraceae
2. Cladogram construction and analysis
3. Preparation of herbarium by the students having at least 20 specimens.

**Learning Strategies:** Practicals, models, charts, online demonstrations, group discussions and assignments

**Learning Outcome:** Students will have the knowledge of various principles, rules and amendments in International Code of Nomenclature for algae, fungi and plants.

**Assessment:** Continuous Assessment: 20 Marks
Practical Exam: 80 Marks

**Model Question Paper:** Practical Exam component is divided into the following sub components:

- Performance – 24 Marks
- Spotting – 16 Marks
- Viva-voce – 24 Marks
- Record – 8 Marks
- Internal Assessment – 8 marks

**Text Books:**

1. Judd, W.S., Campbell, C.S., Kellogg, E.A., Stevens, P.F., and Donoghue, M.J. *PlantSystematics: A Phylogenetic Approach*. Massachusetts: Sinauer Associates, Inc., 2002. Print.
2. Simpson, M.G. *Plant Systematics*. Amsterdam: Elsevier, 2006. Print.

**Reference Books:**

1. Angiosperm Phylogeny Group. "An Update of the Angiosperm Phylogeny Group Classification for the Orders and Families of Flowering Plants: APG II." *Botanical Journal of the Linnaean Society*: 141 (2003): 399-436. Print.
2. Crawford, D.J. *Plant Molecular Systematics*. Cambridge, UK: Cambridge University Press, 2003. Print.
3. Cronquist, A. *An Integrated System of Classification of Flowering Plants*. New York: Columbia University Press, 1981. Print.
4. Maheshwari, J.K. *The Flora of Delhi*. New Delhi: CSIR, 1963. Print.
5. Nei, M., and Kumar, S. *Molecular Evolution and Phylogenetics*. New York: Oxford University Press, 2000. Print.

6. Radford, A.E., Dickison, W.C., Massey, J.R., and Bell, C.R. *Vascular Plant Systematics*. New York: Harper and Row, 1974. Print.
7. Semple, C., and Steel, M.A. *Phylogenetics*. Oxford: Oxford University Press, 2003. Print.
8. Stuessy T.F. *Plant Taxonomy: The systematic Evaluation of Comparative Data*. New York: Columbia University Press, 2009. Print.
9. Bierhorst, D.W. *Morphology of Vascular Plants*. New York: The Macmillan and Co., 1971. Print.
10. Cronquist, A. *The Evolution and Classification of Flowering Plants*. Boston: Houghton Miffin, 1968. Print.
11. Naik, V.N. *Taxonomy of Angiosperms*. New Delhi: Tata McGraw Hill, 1984. Print.
12. Pandey, S.N., and S.P. Misra. *Taxonomy of Angiosperms*. India: Ane Reference Books, 2008. Print.

**Programme Name:** **M.Sc. (Hons.) Botany**
**Course Name:** **Plant Molecular Biology**
**Course Code:** **BOT629**
**Total Credits:** **4**
**Credit Components:** **L-4; T-0; P-0**
**Learning Objectives:** To acquaint the students with the basic machinery governing the maintenance of life as it is in the living world.

## UNIT I

**Maintenance of the genome**: Structure of DNA and RNA, significance of major and minor groove, DNA topology, RNA structure, Chromosome, Chromatin and the Nucleosome – structure and organization, Higher order chromatin structure, Regulation of chromatin structure.
**Chemistry of DNA synthesis**: replication machinery – helicase, gyrase, topoisomerase, ligase, mechanism of DNA polymerase, replication fork, specialization of DNA polymerases, DNA synthesis at replication fork, replication initiation and termination, mechanism of telomere duplication, telomerase. **(15 Lectures)**

## UNIT II

**Replication errors and their repair:** direct reversal of DNA damage, base and nucleotide excision repair, recombination repair and translesion repair. Homologus and site-specific recombination. **(6 Lectures)**
**Expression of genome**: mechanism of transcription, RNA polymerases and transcription cycle, transcription in prokaryotes and eukaryotes. RNA splicing mechanism and methods, the spliceosome machinery, splicing pathways, alternate splicing, exon shuffling and RNA editing, mRNA transport. **(9 Lectures)**

## UNIT III

**Translation** – mRNA, tRNA, attachment of amino acids to tRNA, ribosome, initiation, elongation and termination of translation. Translation dependent stability of mRNA.The genetic code – degeneracy and governing rules. **(6 Lectures)**
**Gene regulation**: transcription regulation in prokaryotes (– lac, trp and ara operons) with special mention to phage lambda. Gene regulation in eukaryotes, the two hybrid assay, role of transcription factors and transcription repressors, gene silencing, gene regulation at steps after transcription initiation, RNA in gene regulation. **(6 Lectures)**

## UNIT IV

**Techniques in molecular biology**: Agarose gel electrophoresis for DNA and RNA, DNA hybridization, hybridization probes, PCR, DNA sequencing – mechanisms and instrumentation, model organisms, gene engineering through cutting and joining of DNA molecules, enzymes for DNA modifications. **(12 Lectures)**

**Learning Strategies:** Class room lectures, practicals, models, charts, power point presentations, online lectures, group discussions, assignments and presentations by students

**Learning Outcome:** To provide insight into structure and functions of DNA and RNA as important hereditary molecules, their regulation and the control they exercise on the individuals metabolism and different techniques used frequently to study the underlying mechanisms to DNA and RNA metabolism. The study will make the students clear regarding what forms the basis of variations in living organisms.

**Assessment:** Mid Semester Exam (MSE) – 25 Marks

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| | Written Quiz (MCQs) – 10 Marks<br>Assignment (written) – 10 Marks<br>End Semester Examination (ESE) – 50 Marks<br>Attendance – 5 Marks |
| **Model Question Paper: MSE** | Q.1 Will Comprise of 5 parts having 1 mark each<br>Q.2 to Q.6 will carry 4 marks each out of which 3 questions are to be attempted.<br>Q.7 and Q.8 will carry 8 marks each out of which 1 question is to be attempted |
| **Model Question Paper: ESE** | Q.1 Will Comprise of 10 parts having 1 mark each<br>Q.2 to Q.9 will carry 4 marks each out of which 6 questions are to be attempted.<br>Q.10 to Q.13 will carry 8 marks each out of which 2 question are to be attempted |

**Programme Name:** **M.Sc. (Hons.) Botany**
**Course Name:** **Plant Molecular Biology Laboratory**
**Course Code:** **BOT630**
**Total Credits:** **2**
**Credit Components:** **L-0; T-0; P-3**
**Learning Objectives:** To acquaint the students with the basic machinery governing the maintenance of life as it is in the living world.

**List of Experiments**

1. Demonstration of Equipments: Spectrophotometer; Centrifuge; Electrophoresis unit; pH meter; Water bath; Incubator; Hot air oven; Shaker; Magnetic stirrer; Test tube shaker; Heating plate; Distillation plant; Autoclave; Laminar air flow; PCR; Analytical digital balance; Single-pan balance; Good quality microscope.
2. Isolation of Genomic DNA.
3. DNA detection by Gel electrophoresis.
4. Study of meiosis by smear preparation of PMCs.
5. Study of giant chromosomes in Drosophila/Chironomus.
6. Work out problems based on DNA structure, replication, gene expression and genetic code.

**Learning Strategies:** Class room lectures, practicals, models, charts, power point presentations, online lectures, group discussions, assignments and presentations by students

**Learning Outcome:** To provide insight into structure and functions of DNA and RNA as important hereditary molecules, their regulation and the control they exercise on the individuals metabolism and different techniques used frequently to study the underlying mechanisms to DNA and RNA metabolism. The study will make the students clear regarding what forms the basis of variations in living organisms.

**Assessment:** Continuous Assessment: 20 Marks
Practical Exam: 80 Marks

**Model Question Paper:** Practical Exam component is divided into the following sub components:

- Performance – 24 Marks
- Spotting – 16 Marks
- Viva-voce – 24 Marks
- Record – 8 Marks
- Internal Assessment – 8 marks

**Text Books:**

1. Cooper, G.M., and Hausman, R.E.*The Cell: A molecular approach* (V Edn). Sinaeur, 2009.Print.
2. Karp, G.*Cell and Molecular biology: Concepts and experiments* (V Edn). John Wiley & Sons, 2008.Print.

**References books:**

1. Becker,W.M.,Kleinsmith,L.J. and Hardin, J. *The world of the cell* (VI Edn).Pearson.,2007.Print.
2. Lodish, H., Berk, A., Zipursky, L., Matsudaira, P., Baltimore, D. and Darnell, J.*Molecular cell biology* (IV Edn). W H Freeman & Company, 2000.Print.
3.Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K. and

Walter, P.*Molecular biology of the cell* (IV Edn). Garland Science, Taylor and Francis group, 2002.Print.
4. Brooker, R.J.*Genetics: analysis and principles* (III Edn). McGraw Hill, 2009.Print.
5. Krebs, J.E., Goldstein, E.S. and Kilpatrick, S.T.*Lewin's Genes X*. Jones and Bartlett Publishers, 2011. Print.
6. Buchanan, B.B., Gruissem, W. and Jones, R.L.*Biochemistry and Molecular biology ofplants*. I K International Pvt. Ltd, 2000.Print.
7. Hartl, D.L. and Jones, E.W. *Genetics: Analysis of genes and genomes* (VII Edn). Jonesand Bartlett publishers, 2012.Print.
8. Watson, J.D., Baker, T.A., Bell, S.P., Gann, A., Levine, M. andLosick, R.*Molecular biology of the gene* (V Edn). Pearson, 2009.Print.
9. Klug, W.S. and Cummings, M.R.*Concepts of Genetics* (VII Edn). Pearson, 2004.Print.
10. Weaver, R.F.*Molecular biology* (II Edn).McGraw Hill, 2002.Print.
11. Alberts, B., Bray, D., Hopkin, K., Johnson, A., Lewis, J., Raff, M., Roberts, K. and Walter, P.*Essential Cell Biology*. Garland Science, 2010.Print.

**Programme Name:** **M.Sc. (Hons.) Botany**
**Course Name:** **Project-I**
**Course Code:** **BOT624**
**Total Credits:** **2**
**Credit Components:** **L-0; T-0; P-2**
**Learning Objectives:** To develop research aptitude in the students

## Description

During the course students will come to know about the general understanding of the common problems and recent advances in research. Each student shall be allotted a topic by the instructor. The students shall submit a synopsis on the allotted topic, which shall be evaluated by the concerned internal faculty. Student will have to understand the topic and collect literature. Through this, the students will develop habit of reading newer topics, will become inquisitive and develop research aptitude.

**Programme Name:** **M.Sc. (Hons.) Botany**
**Course Name:** **Plant Resource Utilization**
**Course Code:** **BOT641**
**Total Credits:** **4**
**Credit Components:** **L-4; T-0; P-0**
**Learning Objectives:** To familiarize the students about the botanical names, family to which they belong and economic importance of various herbs, shrubs and trees of daily use.

**Unit I**

**Centers of origin:** Concept, their importance with reference to Vavilov's work; World centers of primary diversity and secondary centers of cultivated plants. **(3 Lectures)**
**Plant introductions and exchange:** history, plant introduction and exchange agencies in India, activities of NBPGR. **(4 Lectures)**
**Fibers**: Classification of fibres, physical and chemical processes involved in the manufacturing of fibres from different types of fibre yielding plants **(5 Lectures)**
**Sugars:** Extraction of sugar from sugar cane- process with a critical study of the steps involved. By-products of sugar industry and their uses. **(3 Lectures)**

**Unit II**

**Gums and resins**: Sources of gums and resins and their classifications according to their chemical nature. **(3 Lectures)**
**Essential oils**: Essential oil yielding plants, their use in perfumery **(4 Lectures)**
**Natural dyes**: Sources and types of natural dyes in India and their extraction methods, merits and limitations of plant based dyes. **(4 Lectures)**
**Natural Rubber:** Para rubber, tapping and processing, various substitutes of Para rubber. **(3 Lectures)**

**Unit III**

**Woods**: Physical characteristics of Indian woods, methods of seasoning and chemical treatment. Industrial manufacturing of packing material and plywood. Some important commercial woods: *Dalbergia* spp., *Shorea robusta*, *Tectona grandis*, *Cedrus deodara*, Bamboo - the 'green gold' of India **(6 Lectures)**
**Paper:** Manufacturing of paper and board from raw plant material. Manufacturing of crude and high quality paper, recycled paper. **(5 Lectures)**
**Beverages:** tea, coffee, cocoa **(4 Lectures)**

**UNIT IV**

**Ethnobotany:** Indigenous traditional knowledge, Traditional Knowledge Digital Library (TKDL),Systems of medicines- Ayurveda, Sidda, Unani **(6 Lectures)**
**Bioprospecting and Intellectual property rights:** Patenting of higher plants, genes and DNA sequences, Plant Breeders Rights and Farmers Rights, bioprospecting (Biotic, chemical and gene prospecting, Benefits sharing and Ethanopharmacology) and biopiracy: examples of turmeric and rice **(7 Lectures)**
**Green Revolution***:* Introduction, the wheat revolution, rice varietal improvement, the brown rice, side of green revolution. **(2 Lectures)**
**Learning Strategies:** Class room lectures, practicals, models, charts, power point presentations, online lectures, group discussions, assignments and presentations by students
**Learning Outcome:** The students will learn the origin, cultivation, high yielding

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| | varieties, part used, active principles etc. of some food, oil, drugs, spice, rubber etc yielding plants. |
| **Assessment:** | Mid Semester Exam (MSE) – 25 Marks<br>Written Quiz (MCQs) – 10 Marks<br>Assignment (written) – 10 Marks<br>End Semester Examination (ESE) – 50 Marks<br>Attendance – 5 Marks |
| **Model Question Paper: MSE** | Q.1 Will Comprise of 5 parts having 1 mark each<br>Q.2 to Q.6 will carry 4 marks each out of which 3 questions are to be attempted.<br>Q.7 and Q.8 will carry 8 marks each out of which 1 question is to be attempted |
| **Model Question Paper: ESE** | Q.1 Will Comprise of 10 parts having 1 mark each<br>Q.2 to Q.9 will carry 4 marks each out of which 6 questions are to be attempted.<br>Q.10 to Q.13 will carry 8 marks each out of which 2 question are to be attempted |

**Programme Name:** **M.Sc. (Hons.) Botany**
**Course Name:** **Plant Resource UtilizationLaboratory**
**Course Code:** **BOT642**
**Total Credits:** **2**
**Credit Components:** **L-0; T-0; P-2**
**Learning Objectives:** To acquaint the students about various economic uses of plants by providing them knowledge about plant sources and processing methodologies.

**List of Experiments**

**Laboratory Work**

1. Morphology, anatomy, microchemical tests for stored food materials*:* Wheat, jute, rice, maize, chickpea (Bengal gram), potato, sugarcane.
2. Learn the processing of various plant products (cotton, jute, rubber, essential oils, sugarcane etc.)
3. To learn Recycling of paper.
4. To demonstrate methods for extraction of essential oils and their use in perfume making
5. Extraction and use of natural dyes.

**Field Survey:**

1. Prepare a list of 10 most important sources of firewood and timber in your locality. Give their local names, scientific names and families to which they belong.
2. The students should be taken to a recognized botanical garden or a museum (such as those at the Forest Research Institute, Dehra Dun; National Botanical Research Institute, Lucknow) to a CSIR Laboratory doing research on plants and their utilization and an ICAR Research Institute or a field station dealing with crops.

**Learning Strategies:** Practicals, models, charts, online demonstrations, group discussions and assignments

**Learning Outcome:** The students will come to know the various economically important plants, their products and processing to yield commercial products.

**Assessment:** Continuous Assessment: 20 Marks
Practical Exam: 80 Marks

**Model Question Paper:** Practical Exam component is divided into the following sub components:

- Performance – 25 Marks
- Spotting – 15 Marks
- Viva-voce – 24 Marks
- Record – 8 Marks
- Internal Assessment – 8 marks

**Text Books:**

1. Thakur, R.S., Puri, H.S. and Husain, A.*Major Medicinal Plants of India.* Lucknow: Central Institute of Medicinal and Aromatic Plants, 1989.Print.
2. Walter, K.S., and Gillett, H.J.*IUCN Red List of Threatened Plants.* U.K.: World Conservation Union, IUCN, Switzerland, and Cambridge, 1998, 1997.Print.

**Reference Books:**

1. Council for Scientific & Industrial Research. *The Useful Plants of India*, New Delhi: Publications and Information Directorate, CSIR, 1986.Print.

2. Kocchar, S.L. *Economic Botany of the Tropics*, 2nd ed., New Delhi Macmillan India Ltd., 1998.Print.
3. Swaminathan, M.S., and Kocchar, S.L., (eds.). *Plants and Society*. London: MacMillan Publications Ltd., 1989.Print.

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| **Websites and Audio Video lectures:** | https://www.youtube.com/watch?v=Zq99Ev69GD8&t=16s; https://iinrg.icar.gov.in/; http://sugarcane.dac.gov.in/ |
| **Other Supportive Material:** | https://www.nite.go.jp/data/000007615.pdf |

**Programme Name:** **M.Sc. (Hons.) Botany**
**Course Name:** **Agricultural ecology –principles and application**
**Course Code:** **BOT627**
**Total Credits:** **4**
**Credit Components:** **L-4; T-0; P-0**
**Learning objective:** To provide an understanding of the basic theories and principles of ecology and to help study various aspects related to ecology

## UNIT I

**Ecology:**Introduction, evolutionary ecology, environmental concepts – laws and limiting factors, ecological models, Significance of habitat, biodiversity, ecological niche **(3 lectures)**
**Evolution and Natural Selection:** Agents of evolution, types of natural selection, allopatric and sympatric speciation, reproductive isolating mechanisms, Galapogos finches **(7 lectures)**

## UNIT II

**Autecological concepts - Population Ecology:** Characteristics of populations - size and density, dispersion, age structure, natality and mortality. **(3 lectures)**
**Population growth** - factors affecting population growth, environmental resistance, biotic potential,carrying capacity, positive and negative interaction, migration, subsistence density, security and optionaldensity.Exponentialgrowth, limits of population growth, population dynamics, life history pattern, fertility rate andage structure. Ecological consequence of overpopulation. **(9 lectures)**

## UNIT III

**Genecology** - ecological amplitude, ecads, ecotypes, ecospecies, coenospecies, k-selection and r-selectionpopulations. **(2 lectures)**
Competition and coexistence, intra-specific interactions, inter-specific interactions, scramble and contest competition model, mutualism and commensalism,prey-predator interactions. **(3 lectures)**
**Synecological concepts - Community ecology:** Ecological processes of community formation, ecotone, edge effect. Classification of communities criteriaof classification,dynamicsystem of classificationby Clement.
Special plant communities - quantitative, qualitative and synthetic characteristics of plant communities, Sorenson's Index of similarity, coefficient of communities.
Dynamic community characteristics - cyclic replacement changes and cyclic no-replacement changes. **(7 lectures)**

## UNIT IV

**Dynamic Ecology - Ecological succession:** The concept, definition and reasons of succession. Classification of succession: Changes - autogenic and allogenic, primary and secondary, autotrophic and heterotrophic.
Retrogressive changes or the concept of degradation, concept of climax or stable communities, resilience of communities, ecological balance and survival thresholds, changes in ecosystem properties during succession. **(6 lectures)**
**Biosphere and Ecosystem**
**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, controlling factors); global biogeochemical cycling and ecosystem nutrient cycles. Primary and secondary productivity, food chains, food webs, ecological pyramids, energy flow and

nutrient cycles. **(6 lectures)**

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| **Learning Strategies:** | Class room lectures, practical's, models, charts, power point presentations, online lectures, group discussions, assignments and presentations by students |
| **Learning Outcome:** | This course is designed to present an introduction to current theories and practices in ecology. Students will learn the basic principles of ecology, emphasizing population, community and ecosystem ecology. They will understand ecological concepts. |
| **Assessment:** | Mid Semester Exam (MSE) – 25 Marks<br>Written Quiz (MCQs) – 10 Marks<br>Assignment (written) – 10 Marks<br>End Semester Examination (ESE) – 50 Marks<br>Attendance – 5 Marks |
| **Model Question Paper: MSE** | Q.1 Will Comprise of 5 parts having 1 mark each<br>Q.2 to Q.6 will carry 4 marks each out of which 3 questions are to be attempted.<br>Q.7 and Q.8 will carry 8 marks each out of which 1 question is to be attempted |
| **Model Question Paper: ESE** | Q.1 Will Comprise of 10 parts having 1 mark each<br>Q.2 to Q.9 will carry 4 marks each out of which 6 questions are to be attempted.<br>Q.10 to Q.13 will carry 8 marks each out of which 2 question are to be attempted |

**Programme Name:** **M.Sc. (Hons.) Botany**
**Course Name:** **Agricultural Ecology-Principles and Applications Laboratory**
**Course Code:** **BOT628**
**Total Credits:** **2**
**Credit Components:** **L-0; T-0; P-3**
**Learning Objectives:** To provide an understanding of the basic theories and principles of ecology and to help study various aspects related to ecology

**List of Experiments**

1. Quantitative and qualitative community analysis. Carry out a project on species structure and thefrequency, abundance, density of different species and similarity index of different communities in anatural system. Students must be able to explain the structure of vegetation from the given data on theabove mentioned characteristics.
2. Phytoplankton counting using Sedgwick Rafter counter.
3. Field visit to natural ecosystem and identification of trophic levels, food webs and food chains, plantdiversity (species and community).

**Learning Strategies:** Class room lectures, practical's, models, charts, power point presentations, online lectures, group discussions, assignments and presentations by students

**Learning Outcome:** This course is designed to present an introduction to current theories and practices in ecology.Students will learn the basic principles of ecology, emphasizing population, community and ecosystem ecology. They will understand ecological concepts.

**Assessment:** Continuous Assessment: 20 Marks
Practical Exam: 80 Marks

**Model Question Paper:** Practical Exam component is divided into the following sub components:

- Performance – 24 Marks
- Spotting – 16 Marks
- Viva-voce – 24 Marks
- Record – 8 Marks
- Internal Assessment – 8 marks

**Text books:**

1. Sharma, P.D. *Environment and Ecology*. New Delhi: Rastogi Publications. 2009. Print.
**2.** Odum, E.P. *Fundamentals of Ecology*. 3rd ed. Philadelphia: Saunders, 1971. Print.

**Reference books:**

1.Conklin, Alfred R., and Rolf Meinholtz. *Field Sampling: Principles and Practices in Environmental Analysis*. New York: Marcel Dekker, 2004. Print.
2. Fahey, Timothy J. *Principles and Standards for Measuring Primary Production*. Oxford: Oxford UP, 2007. Print.
3. Grant, William E., and Todd M. Swannack. *Ecological Modeling: A Common-sense Approach to Theory and Practice*. Malden, MA: Blackwell Pub., 2008. Print.
4. Wilkinson, D.M. *Fundamental Processes in Ecology: An Earth system Approach*.Oxford: Oxford Scholarship Online. 2007. Print.

5. Briggs, D. and Walters, S.M. *Plant Variation and Evolution*. Cambridge: CambridgeUniversity Press. 1997. Print.
6. Futuyma, Douglas J. *Evolutionary Biology*. 3rd ed. Sunderland, Mass.: Sinauer Associates, 1998. Print.
7. Ridley, M. *Evolution*. New York: Blackwell. 2003. Print.

**Programme Name:** **M.Sc. (Hons.) Botany**
**Course Name:** **Plant Ecology and Phytogeography**
**Course Code:** **BOT645**
**Total Credits:** **4**
**Credit Components:** **L-2; T-0; P-0**
**Learning Objectives:** To inspire the students about ecological importance of the environment, natural resources, various problems related to environment and its protection.

**UNIT-I**

**Ecology and Environment:** Definition, history and scope of ecology, sub divisions of ecology, ecology vs environmental science, ecological footprinting, ecological backlash. Interdisciplinary nature of environmental science. **(2 Lectures)**

**Global Environmental Changes:** Global warming; Climate change, reasons, Factors contributing to climate change; consequences of climate change and measures to combat the problem. **(3 Lectures)**

**UNIT-II**

**Ozone hole:** General account of ozone layer and hole; Factors contributing to ozone hole; Effects and Remedies. **(2 Lectures)**

**Environment Protection:** International concern and efforts for environment protection, global plan, Stockholm summit, Earth summits **(2 Lectures)**

**Resource Economics:** Introduction and significance. **(2 Lectures)**

**Environment Impact assessment:** Introduction and significance. **(1 Lectures)**

**UNIT-III**

**Phytogeography:** Definition, principles governing plant distribution, factors affecting plant distribution, theories of distribution, different types of distribution of vegetations on the earth, continuous and discontinuous distribution. **(6 Lectures)**

Climate, vegetation and botanical zones of India, role of precipitation and temperature in determining the major types of vegetation and endemism in India. **(3 Lectures)**

Remote sensing: Definition and data acquisition techniques. Application of remote sensing invegetation classification, understanding the key environmental issues and ecosystem management**.** **(6 Lectures)**

**UNIT-IV**

**Environmental biotechnology and solid waste management:** Concept of waste, types and sources of solid wastes including e-waste. Bioindicator and biomarkers of environmental health. Bioremediation, bioaugmentation, biofilms, biofilters, bioscrubbers and trickling filters. Use of bioreactors in waste management. **(6 Lectures)**

**Learning Strategies:** Class room Lectures, practicals, models, charts, field visit, power point presentations.

**Learning Outcome:** The students will understand the various conservation strategies, man-made environmental issues at local, national and global level and the measures to control their adverse effects at individual and collective level.

**Assessment:**
Mid Semester Exam (MSE) – 25 Marks
Written Quiz (MCQs) – 10 Marks
Assignment (written) – 10 Marks
End Semester Examination (ESE) – 50 Marks

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| | Attendance – 5 Marks |
| **Model Question Paper: MSE** | Q.1 Will Comprise of 5 parts having 1 mark each<br>Q.2 to Q.6 will carry 4 marks each out of which 3 questions are to be attempted.<br>Q.7 and Q.8 will carry 8 marks each out of which 1 question is to be attempted |
| **Model Question Paper: ESE** | Q.1 Will Comprise of 10 parts having 1 mark each<br>Q.2 to Q.9 will carry 4 marks each out of which 6 questions are to be attempted.<br>Q.10 to Q.13 will carry 8 marks each out of which 2 question are to be attempted |

**Programme Name:** **M.Sc. (Hons.) Botany**
**Course Name:** **Plant Ecology and Phytogeography Laboratory**
**Course Code:** **BOT646**
**Total Credits:** **2**
**Credit Components:** **L-0; T-0; P-2**
**Learning Objectives:** To inspire the students about ecological importance of the environment, natural resources, various problems related to environment and its protection.

**List of experiments**

1. An introduction to various methods of sampling vegetation
2. Determination of density, dominance and cover area and Importance values Index
3. Determination of various ecological indices.
4. Evaluation of dominance and importance value index.
5. Study of similarity and dissimilarity index between two communities.
6. Vegetation analysis – Direct gradient analysis and Ordination and indirect methods
7. Demonstration of impact of pollutants on plants through field studies and laboratory experiments.
8. Demonstration of allelopathy under laboratory and field conditions
9. An assignment on the floral diversity of weeds and other common herbs of the DAV University Campus

**Learning Strategies:** Class room Lectures, practicals, models, charts, field visit, power point presentations.

**Learning Outcome:** The students will understand the various conservation strategies, man-made environmental issues at local, national and global level and the measures to control their adverse effects at individual and collective level.

**Assessment:** Continuous Assessment: 20 Marks
Practical Exam: 80 Marks

**Model Question Paper:** Practical Exam component is divided into the following sub components:

- Performance – 24 Marks
- Spotting – 16 Marks
- Viva-voce – 24 Marks
- Record – 8 Marks
- Internal Assessment – 8 marks

**Text Books:**

1. Singh, H.P., Batish, D.R., and Kohli, R.K. *Handbook of Sustainable Weed management*. New York, USA: Food Products Press, 2006. Print.
2. Odum, E.P. *Fundamentals of Ecology*. USA: Saunders Toppan, 1971. Print.

**Reference Books:**

1. Altieri, M.A., and Liebman, M. *Weed Management in Agrocosystems: Ecological Approaches*. Florida, USA: CRC Press, 1988. Print.
2. Botkin, D. and Keller, E. *Environmental Science*.New York, USA: John Wiley Publishers, 1995. Print.
3. Enger, E.D., and Smith, B.F. *Environmental Science*. Iowa,

U.S.A.: WCB, Publishers, 1992. Print.
4. Hunter, M.L. *Maintaining Biodiversity in Forest Ecosystems*. Cambridge: Cambridge University Press, 1999. Print.
5. Newman, E.I. *Applied Ecology*. UK: Blackwell Scientific Publishers, 1994. Print.
6. Ramakrishanan, P.S. *Ecology of Biological Invasion in the Tropics*. New Delhi: International Scientific Publications, 1991. Print.
7. Raven, P.H., Berg, L.R., and Hassenzahl, D.M. *Environment*. 7thed. USA: Wiley, Hoboken, 2010. Print.
8. Shibu, J., Singh, H.P., Batish, D.R. and Kohli, R.K. *Invasive Plant Ecology*.New York, USA: CRC Press, Taylor and Francis Group, Boca Raton, 2013. Print.
9. Singh, J.S., Singh, S.P., and Gupta, S.R. *Ecology,Environment and Resource Conservation*. New Delhi: Anamaya Publishers, 2006. Print.

**Programme Name:** **M.Sc. (Hons.) Botany**
**Course Name:** **Project-II**
**Course Code:** **BOT631**
**Total Credits:** **8**
**Credit Components:** **L-0; T-0; P-8**
**Learning Objectives:** To develop research aptitude in the students

**Description**

Students have to carry out a project on any topic from the syllabus and submit a report on the work done in the project for assessment.

**Programme Name:** **M.Sc. (Hons.) Botany**
**Course Name:** **Techniques in Plant Analysis**
**Course Code:** **BOT647**
**Total Credits:** **4**
**Credit Components:** **L-4; T-0; P-0**
**Learning Objectives:** To acquaint the students about the various techniques used to analyze a biological system.

**Unit I**

**Histochemical and Immuno techniques**: Antibody generation, detection of molecules using ELISA, RIA. **(4 Lectures)**

**Microscopy:** Principles and applications of Light, Phase Contrast, Fluorescence, Scanning and Transmission Electron Microscopy, STEM fixation and staining of EM, Freeze-etch and Freeze fracture methods for EM, image processing methods in molecules. **(6 Lectures)**

**Unit II**

**Chromatography:** Paper Chromatography, Thin Layer Chromatography, Gel filtration, Ion Exchange and Affinity Chromatography, GLC; High Pressure Liquid Chromatography; and Flame Photometry, GC-MS, LC-MS, Atomic absorption spectrometery. **(6 Lectures)**

**Biophysical Methods**: Principle, procedure and applications of UV/visible spectrophotometry, fluorescence, UV, circular dichroism, NMR and ESR spectroscopy, Structure determination using X-ray fluorescence and X-ray diffraction and NMR. **(7 Lectures)**

**Unit III**

**Centrifugation:** Technique and principles; Preparative and analytical centrifugation. **(4 Lectures)**

**Sequencing:** Protein sequencing methods, detection of post translation modification of proteins.DNA sequencing methods, strategies for genome sequencing. **(7 Lectures)**

**Unit IV**

**Radiolabeling techniques:** Detection and measurement of radioisotopes used in biology; molecular imaging of radioactive material, safety guidelines; Autoradiography. **(6 Lectures)**

**Molecular techniques:** Restriction Fragment Length Polymorphism (RFLP); Fluorescence in-situ Hybridization (FISH), Genomic In-Situ Hybridization (GISH), Fiber-FISH, Q-FISH; Flow FISH: Flow Cytogenetics, Flow karyotyping; Random amplified polymorphic DNA. **(5 Lectures)**

**Learning Strategies:** Class room lectures, practicals, models, charts, power point presentations, online lectures, group discussions, assignments and presentations by students

**Learning Outcome:** This course will make the students learn the principles, procedures and uses of various bioanalytical techniques used for plant/animal analysis.

**Assessment:**
Mid Semester Exam (MSE) – 25 Marks
Written Quiz (MCQs) – 10 Marks
Assignment (written) – 10 Marks
End Semester Examination (ESE) – 50 Marks
Attendance – 5 Marks

**Model Question Paper:**
**MSE**
Q.1 Will Comprise of 5 parts having 1 mark each
Q.2 to Q.6 will carry 4 marks each out of which 3 questions are to be attempted.

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| | Q.7 and Q.8 will carry 8 marks each out of which 1 question is to be attempted |
| **Model Question Paper: ESE** | Q.1 Will Comprise of 10 parts having 1 mark each<br>Q.2 to Q.9 will carry 4 marks each out of which 6 questions are to be attempted.<br>Q.10 to Q.13 will carry 8 marks each out of which 2 question are to be attempted |

**Programme Name:** **M.Sc. (Hons.) Botany**
**Course Name:** **Techniques in Plant Analysis Laboratory**
**Course Code:** **BOT648**
**Total Credits:** **2**
**Credit Components:** **L-0; T-0; P-2**
**Learning Objectives:** To acquaint the students about the various techniques used to analyze a biological system.

**List of Experiments**

1. Genomic DNA isolation.
2. DNA and Protein analysis by Gel electrophoresis.
3. To demonstrate Beer's law using different dyes.
4. Preparation of Phosphate Buffers of different pH values.
5. Practicals pertaining to Chromatographic techniques: Column Chromatography (Exclusion and Affinity Chromatography), Paper Chromatography and Thin Layer Chromatography.
6. Practicals pertaining to centrifugation.

**Learning Strategies:** Practicals, models, charts, online demonstrations, group discussions and assignments

**Learning Outcome:** This course will make the students learn the principles, procedures and uses of various bioanalytical techniques used for plant/animal analysis.

**Assessment:** Continuous Assessment: 20 Marks
Practical Exam: 80 Marks

**Model Question Paper:** Practical Exam component is divided into the following sub components:

- Performance – 24 Marks
- Spotting – 16 Marks
- Viva-voce – 24 Marks
- Record – 8 Marks
- Internal Assessment – 8 marks

**Text Books:**

1. Plummer, D.T. *An Introduction to Practical Biochemistry*. New Delhi: Tata McGraw Hill Publishing Ltd., 1994. Print.
2. Potter, G.W.H. *Analysis of Biomolecules: An introduction to Principles, Instrumentation and Techniques*. London: Chapman and Hall, 1995. Print.

**Reference Books:**

1. Primrose, S.B., Twyman, R.M., and Old, R.W. *Principles of Gene Manipulation.* UK: Blackwell Publishers, 2001. Print.
2. Sawhney, S.K., and Singh, R. *Introductory Practical Biochemistry.* New Delhi: Narosa Publishing House, 2002.
3. Wilson, K., and Walker, J. *Principles and Techniques of Practical Biochemistry.* Cambridge: Cambridge University Press. 2000. Print.

**Programme Name:** **M.Sc. (Hons) Botany**
**Course Name:** **Advanced Plant Physiology and Metabolism**
**Course Code:** **BOT649**
**Total Credits:** **4**
**Credit Components:** **L-4; T-1; P-0**
**Learning Objectives:** To acquaint the students about molecular regulation of various physiological processes in plants.

**Unit I**

**Nitrogen metabolism:** Process of biological nitrogen fixation; nodule formation-role of NOD genes and nodulins; NIF genes; molecular biology of nitrogenase complex; regulation of nitrogen fixation; nitrogen assimilation in higher plants. **(5 Lectures)**

**Secondary metabolism:** Biosynthesis and roles of alkaloids, flavonoids, steroids, terpenoids, lignin and carotenes; commercial and economic importance of secondary metabolites; role of secondary metabolites in plant defence. **(6 Lectures)**

**Unit II**

**Sulfur metabolism:** Overview of sulphur in biosphere and plants, sulphur chemistry and function, sulphur uptake and transport, reductive sulphate assimilation pathway, cysteine synthesis, glutathione and its derivatives synthesis and function, sulphated compounds, regulation of sulphate assimilation and interaction with nitrogen and carbon metabolism.

**(11 Lectures)**

**Unit III**

**Lipid metabolism:** Fatty acid biosynthesis, brief idea about acetyl Co-A carboxylase and fatty acid synthase, desaturation and elongation of $C_{16}$ and $C_{18}$ fatty acids, synthesis of unusual fatty acids, synthesis and function of membrane lipids, synthesis and function of extracellular lipids, synthesis and catabolism of storage lipids, genetic engineering of lipids. **(4 Lectures)**

**Unit IV**

**Plant Stress Biology:** Plant responses to abiotic stresses, mechanisms of abiotic stress tolerance.

**Water stress:** Membranes and water stress, Stomatal response to water stress-Role of ABA and drought tolerance **(4 Lectures)**

**Salinity stress:** Effect of high salt concentration of plants – water stress, nutrient ion deficiency, ion toxicity, regulation of salt content – Salt elimination, salt succulency, Mechanisms of salt resistance and tolerance

**Metal toxicity:** Metal toxicity and tolerance with special reference to i) Aluminum ii) Iron iii) Zinc **(4 Lectures)**

**Freezing and heat stress**: Effect of low temperature and frost injury on plant productivity; **Cellular responses to high temperature:** enzyme activities, photosynthesis, Heat shock proteins. High temperature tolerance mechanisms in plants. Plant stress signalling; NO mediated signaling, markers of nitrosative stress, NO crosstalk with other hormones, antioxidant mechanisms. **(5 Lectures)**

**Learning Strategies:** Class room lectures, practicals, models, charts, power point presentations, online lectures, group discussions, assignments and presentations by students

**Learning Outcome:** The students will have a comprehensive knowledge aboutthe physiological and biochemical regulation of the processes that are necessary for sustenance of life on earth.

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| **Assessment:** | Mid Semester Exam (MSE) – 25 Marks<br>Written Quiz (MCQs) – 10 Marks<br>Assignment (written) – 10 Marks<br>End Semester Examination (ESE) – 50 Marks<br>Attendance – 5 Marks |
| **Model Question Paper: MSE** | Q.1 Will Comprise of 5 parts having 1 mark each<br>Q.2 to Q.6 will carry 4 marks each out of which 3 questions are to be attempted.<br>Q.7 and Q.8 will carry 8 marks each out of which 1 question is to be attempted |
| **Model Question Paper: ESE** | Q.1 Will Comprise of 10 parts having 1 mark each<br>Q.2 to Q.9 will carry 4 marks each out of which 6 questions are to be attempted.<br>Q.10 to Q.13 will carry 8 marks each out of which 2 question are to be attempted |

**Programme Name:** **M.Sc. (Hons.) Botany**
**Course Name:** **Advanced Plant Physiology and Metabolism Laboratory**
**Course Code:** **BOT650**
**Total Credits:** **2**
**Credit Components:** **L-0; T-0; P-3**
**Learning Objectives:** To acquaint the students about various physiological processes at cellular and organ level in plants.

**List of Experiments**

1. Isolation of lipids from green gram cotyledons.
2.Production and Isolation of gibberellic acid from *Fusariummoniliformae* and demonstration of its activity in pea seedling bioassay.
3. To grow plants under salt and drought stress and demonstration of different stress enzymes like catalase, superoxide dismutase, peroxidise.
4. Qualitative estimat ion of alkaloids from suitable plant material.
5. Isolation of mitochondria from suitable plant material.

**Learning Strategies:** Practicals, models, charts, online demonstrations, group discussions and assignments

**Learning Outcome:** The students will have a comprehensive knowledge about the Physiological and biochemical regulation of the processes that are necessary for sustenance of life on earth.

**Assessment:** Continuous Assessment: 20 Marks
Practical Exam: 80 Marks

**Model Question Paper:** Practical Exam component is divided into the following sub components:

- Performance – 24 Marks
- Spotting – 16 Marks
- Viva-voce – 24 Marks
- Record – 8 Marks
- Internal Assessment – 8 marks

**Text Books:**


1. Srivastava, L.M. *Plant Growth and Development*. NewYork: Associated Press, 2002. Print.
2. Taiz, L., and Zeiger, E. *Plant Physiology*. California: The Benjamin/Cumming Publishing Company, 1998. Print.


**Reference Books:**


1. Stryer, L. *Biochemistry*. 5th ed. New York: W.H. Freeman and Co., 1995. Print.
2. Voet, D., and Voet, J.G. *Biochemistry*. New York: John Wiley and Sons Inc., 1995. Print.
3. Wilkins, M.B. *Advanced Plant Physiology*. New York: Pitman, 1984. Print.
4. Buchanan, B.B., Gruissem, W. and Jones, R.L. *Biochemistry and Molecular Biology of Plants*. India: I K Internationals, 2005. Print.
5. Heldt, H.W. Plant Biochemistry. California: Elsevier, 2005. Print.


**Websites and Audio Video lectures:** www.plantphys.org

**Other Supportive Material:** https://www.nature.com/subjects/plant-physiology

**Programme Name:** **M.Sc. (Hons) Botany**
**Course Name:** **Plant Developmental Biology**
**Course Code:** **BOT643**
**Total Credits:** **4**
**Credit Components:** **L-4; T-0; P-0**
**Learning Objectives:** The students will learn to describe various tissue systems in plants and their relative distribution. They will also understand the reason behind evolution of different thickening materials used by different plants for strengthening their axis. They will also be acquainted with development processes of plant parts.

**UNIT I**

**Plant Morphogenesis:** Growth in general, cellular basis of growth- cell division, cell size, cell shape and plane of cell division; physiological and genetic correlation of morphogenesis.
**Polarity:** Polarity as expressed in external and internal structures, polarity in isolated cells, polarity in plasmodia and coenocytes, physiological manifestations of polarity, developmental patterns.
**Symmetry:** Inorganic and organic symmetries, radial symmetry, bilateral symmetry, dorsiventral symmetry, development of symmetry. **(13 Lectures)**

**UNIT II**

**Differentiation:** Growth and differentiation, differentiation as expressed in structure, external and internal differentiation, differentiation during ontogeny, differentiation in relation to environment, physiological differentiation, differentiation without growth.
**Tissue Mixtures:** Stock – scion interrelations, chimeras, somatic mutations.
**Abnormal Growth:** Abnormal development of organs, production of new types of organized structures, amorphous structures. **(14 Lectures)**

**UNIT III**

**Development in flowering plants:** Angiosperm life cycle, Anther: Structure and development, microsporogenesis, male gametophyte development **(4 Lectures)**
**Palynology**: Pollen morphology, pollen kit, NPC formula. Applications of palynology. Viability of pollen grains. Pollination, pollen germination, growth and nutrition of pollen tube **(6 Lectures)**
**Ovule**: Structure, ontogeny and types. Megasporogenesis. Embryosac – development, types, ultrastructure, and nutrition of embryosac. Female gametophyte development. **(5 Lectures)**

**UNIT IV**

**Pollination and Fertilization:** Structural, Functional aspects of pollen style stigma. Current view of double fertilization and development of endosperm and its function. Embryo development - different types. Endosperm development, types of endosperm, haustorial behavior of endosperm. Xenia and metaxenia. **(9 Lectures)**
**Cellular and biochemical aspects of embryogenesis:** Gene activity during zygotic embryogenesis. Structure and function of embryo suspensor. **(6 Lectures)**
**Learning Strategies:** Class room lectures, practicals, models, charts, power point Presentations, online lectures, group discussions, assignments and presentations by students.
**Learning Outcome:** The students will be able to explain the stages from germination to seed development in Angiosperms. They can recognize various reproductive stages in angiosperms. They can use knowledge of

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| | vegetative propagation to develop new plants own their own especially in seedless varieties. |
| **Assessment:** | Mid Semester Exam (MSE) – 25 Marks<br>Written Quiz (MCQs) – 10 Marks<br>Assignment (written) – 10 Marks<br>End Semester Examination (ESE) – 50 Marks<br>Attendance – 5 Marks |
| **Model Question Paper: MSE** | Q.1 Will Comprise of 5 parts having 1 mark each<br>Q.2 to Q.6 will carry 4 marks each out of which 3 questions are to be attempted.<br>Q.7 and Q.8 will carry 8 marks each out of which 1 question is to be attempted |
| **Model Question Paper: ESE** | Q.1 Will Comprise of 10 parts having 1 mark each<br>Q.2 to Q.9 will carry 4 marks each out of which 6 questions are to be attempted.<br>Q.10 to Q.13 will carry 8 marks each out of which 2 question are to be attempted |

**Programme Name:** **M.Sc. (Hons.) Botany**
**Course Name:** **Plant Developmental Biology Laboratory**
**Course Code:** **BOT644**
**Total Credits:** **2**
**Credit Components:** **L-0; T-0; P-3**
**Learning Objectives:** Students will also understand the reason behind evolution of different thickening materials used by different plants for strengthening their axis. They will also be acquainted with development processes of plant parts.

**List of Experiments**

1. Study of angiosperm leaf epidermis in the following taxa: *Crotalaria, Petunia* or *Datura, Rheo discolo*r, *Brassica* and Grass.
2. Estimation of stomatal frequency and stomatal index in the materials studied.
3.Study of wood structure with the help of T.S., R.L.S. in the following: *Tectona*, *Bombax,* and *Azadiratha*
4. Histochemical tests for identification of the following: a) Callose b) Lignin c) Pectin d) Starch e) Suberin f) Silica bodies in the leaf of grasses and sedges.
5. Study of roots in Monocots and Dicots.
6. Anomalous secondary growth in the following examples: Stems of *Aristolochia*, *Nyctanthes*, *Tinospora*, *Achyranthes*,
7. Ecological anatomy.
8.Study of the pollen grains of *Hibiscus, Tribulus, Ocimum* and Grass.
9. Embryology: i) Study of ovules by Hand section of ovaries and their identification ii)Pollen germination studies in different locally available plants and estimation of pollenfertility.
10. Study of embryos and Haustoria in locally available.

**Learning Strategies:** Practicals, models, charts, online demonstrations, group discussions and assignments

**Learning Outcome:** The students will be able to explain the stages from germination to seed development in Angiosperms. They can recognize various reproductive stages in angiosperms. They can use knowledge of vegetative propagation to develop new plants own their own especially in seedless varieties.

**Assessment:** Continuous Assessment: 20 Marks
Practical Exam: 80 Marks

**Model Question Paper:** Practical Exam component is divided into the following sub components:

- Performance – 24 Marks
- Spotting – 16 Marks
- Viva-voce – 24 Marks
- Record – 8 Marks
- Internal Assessment – 8 marks

**Text Books:**

1. Parihar, N.S. *An introduction to Embryophyta: Vol. I. Bryophyta*. Allahabad, India: Central Book Depot. 1991. Print.
2. Raven, P.H., Johnson, G.B., Losos, J.B. and Singer, S.R. *Biology*. New Delhi: Tata McGraw Hill, 2005. Print.

**Reference Books:**

1. Dickison, W.C. *Integrative Plant Anatomy*.USA: Academic Press, 2000. Print.
2. Fahn, A. *Plant Anatomy*. Sydeny: Pergamon Press. Print.

3. Beck, Charles B. *An introduction to plant structure and development: plant anatomy for the twenty-first century*. Cambridge University Press, 2010.Print.
4. Johansen, Donald Alexander. *Plant embryology*.ChroniceBotanica Company; Waltham, Mass,1950.Print.
5. Johri, Brij M., Kunda B. Ambegaokar, and Prem S. Srivastava. *Comparative embryology of angiosperms*.Vol.1.Springer Science & Business Media, 2013.Print.
6. Bhojwani, Sant Saran, and Woong-Young Soh, eds. *Current trends in the embryology of angiosperms*. Springer Science & Business Media, 2013.Print.
7. Steeves, Taylor A., and Vipen K. Sawhney. *Essentials of Developmental Plant Anatomy*.Oxford University Press, 2017.Print.10. Hacke, Uwe, ed. *Functional and ecological xylem anatomy*. Springer, 2015.Print.

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| **Programme Name:** | **M.Sc. (Hons) Botany** |
| **Course Name:** | **Forestry** |
| **Course Code:** | **BOT636** |
| **Total Credits:** | **4** |
| **Credit Components:** | **L-4; T-0; P-0** |
| **Learning Objectives:** | To expose the students about the practice of growing trees, their legal and social protection, plantation of trees for different purposes etc. |

**Unit I**

**Common forestry Practices and Forest dynamics:** Forest regeneration, tending, thinning, pruning and harvesting. Various interactions within forest communities, disturbances and succession, Gap dynamics **(8 Lectures)**

**Unit II**

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

**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. **(2 Lectures)**

**Ecosystem Services:** Definition, General account; Different types; Significance. **(1 Lecture)**

**Unit III**

**Forests Types:** Climate of India, different climatic regions of India; Central characters and distribution of the different forest types of India. **(4 Lectures)**

**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. **(9 Lectures)**

**Unit IV**

**Social Forestry:** Social forestry- social land allocation programmes (Taungya system). Economic benefits of social forestry.

**Agroforestry:** Role in- soil conservation, soil restoration, conservation of biodiversity.

**Watershed Management:** Physiographic features, infiltration, soil water storage, pore spaces, available water, evapotranspiration.

**Climate change and Forestry:** Definition of climate change, impact of climate change on forests, adaptation of trees to climate change. **(12 Lectures)**

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| **Learning Strategies:** | Class room Lectures, models, charts, power point presentations. Cultivated land and crops visits. |
| **Learning Outcome:** | The studies will provide students with the knowledge of importance and conservation of forests. |
| **Assessment:** | Mid Semester Exam (MSE) – 25 Marks<br>Written Quiz (MCQs) – 10 Marks<br>Assignment (written) – 10 Marks<br>End Semester Examination (ESE) – 50 Marks<br>Attendance – 5 Marks |
| **Model Question Paper: MSE** | Q.1 Will Comprise of 5 parts having 1 mark each<br>Q.2 to Q.6 will carry 4 marks each out of which 3 questions are to be attempted.<br>Q.7 and Q.8 will carry 8 marks each out of which 1 question is to be |

attempted

**Model Question Paper: ESE**

Q.1 Will Comprise of 10 parts having 1 mark each

Q.2 to Q.9 will carry 4 marks each out of which 6 questions are to be attempted.

Q.10 to Q.13 will carry 8 marks each out of which 2 question are to be attempted

**Text Books:**


1. Batish, D.R., Kohli, R.K., Jose, S., and Singh, H.P. *Ecological Basis of Agroforestry*. NewYork: CRC Press, 2008. Print.
2. Chaturvedi, A.N. *Forest Mensuration*. Dehradun: International Book Distributors, 1982. Print.
3. Dwivedi, A.P. *A Text Book of Silviculture*. Dehradun: International Book Distributors, 2006. Print.
4. Gopikumar, K.,Gopakumar, S., and Anoop, E.V. *Forest Nursery and Tree Husbandry*. Dehradun: International Book Distributors, 2003. Print.


**Reference Books:**


5. Jha, L.K. *Forestry for Rural Development*. New Delhi: APH Publishing Corporation, 1996. Print.
6. Khosla, P. K., and Kohli, R.K. *Social Forestry for Rural Development*. Solan: Indian Society of Tree Scientists;, 1988. Print.
7. Kohli, R.K., Arya, K.S., Singh, H.P. and Dhillon, H.S. *Tree Directory of Chandigarh*. New Delhi: Lovedale Educational, 1994. Print.
8. Negi, S.S. *Elements of General Silviculture*. Dehradun: International Book Distributors, pp. 269, 2003. Print.
9. Negi S.S. *Hand Book of Forest Ecology and Biology*. Dehradun: International Book Distributors, 2004. Print.
10. Puri, G.S., Mehr-Homji, V.M., Gupta, R. K., and Puri, S. *Forest Ecology Vol. 2*. New Delhi: Oxford & IBH, 1989. Print.
11. Sahni, K.C. *The Book of Indian Trees.* 2nded. Mumbai: Oxford University Press, 2000. Print.
12. Stoddard, C.H. *Essentials of Forestry Practice*. New York: Wiley, 1959. Print.

**Programme Name:** **M.Sc. (Hons) Botany**
**Course Name:** **Advances in Plant Breeding**
**Course Code:** **BOT637**
**Total Credits:** **4**
**Credit Components:** **L-4; T-0; P-0**
**Learning Objectives:** To make the students learn about various breeding techniques that is used to develop new genotypes of important crop plants.

**Unit I**

**An introduction to Quantitative and Qualitative Characters:** Dominance, Segregation, Pleiotropy, Penetrance and Expressivity, Modified Genes, Gene interaction and Linkage. Multiple Factor Hypothesis, Polygenic Inheritance and Continuous variation, Normal distribution, Components of Genetic variance. **(7 Lectures)**

**Heritability:** Definitions; Methods of estimation; Factors influencing heritability.

**Genotype × Environment interaction:** Models; implications in testing programme; stability of genotype performance. **(4 Lectures)**

**Parent selection in Breeding Programme:** Choice of Parents; Type of crosses and strategies; Sources of parent germplasm. **(2 Lectures)**

**Unit II**

**Breeding methodology:** breeding methods in self pollinated crops – selection, progeny selection, pure line concept and selection, mass selection; Hardy-Weinberg's Law. Breeding methods in cross pollinated crops: mass selection (without progeny selection), with progeny selection – Eanto row method, recurrent selection – recurrent selection of general combining ability, recurrent selection of specific combining ability, reciprocal recurrent selection – selection scheme and brief description. **(15 Lectures)**

**Unit III**

**Hetrosis and plant breeding:** inbreeding – inbreeding depression, effects of inbreeding; C-degrees of inbreeding depression, homozygous and heterozygous balance, over dominance hypothesis. Hetrosis, luxuriance (different hetrosis, manifestation of hetrosis).

**Genetic basis of hetrosis and inbreeding depression**: dominanace hypothesis, mechanism involved in hybrid seed production, hetrosis breeding steps, use of cytoplasmic male sterility in production of hybrid chemically induced male sterile lines, self incompatibility. **(12 Lectures)**

**Unit IV**

**Hybridization**: objectives (combining breeding, transgressive breeding), types of hybridization, procedure of hybridization, pedigree, bulk and back cross selection.

**Breeding for stress resistance**: stress, single seed decent method, back cross method, hybrid and synthetic variety, clonal selection, hybridization in clonal crops. **(13 Lectures)**

**Learning Strategies:** Class room Lectures, models, charts, power point presentations. Cultivated land and crops visits.

**Learning Outcome:** This course will impart the knowledge of plant reproductive processes and these processes can be used for the creation of new and improved genotypes.

**Assessment:**
Mid Semester Exam (MSE) – 25 Marks
Written Quiz (MCQs) – 10 Marks
Assignment (written) – 10 Marks
End Semester Examination (ESE) – 50 Marks

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|---|---|
| | Attendance – 5 Marks |
| **Model Question Paper: MSE** | Q.1 Will Comprise of 5 parts having 1 mark each<br>Q.2 to Q.6 will carry 4 marks each out of which 3 questions are to be attempted.<br>Q.7 and Q.8 will carry 8 marks each out of which 1 question is to be attempted |
| **Model Question Paper: ESE** | Q.1 Will Comprise of 10 parts having 1 mark each<br>Q.2 to Q.9 will carry 4 marks each out of which 6 questions are to be attempted.<br>Q.10 to Q.13 will carry 8 marks each out of which 2 question are to be attempted |
| **Text Books:** | 1. Singh, B.D. *Plant Breeding: Principles and Methods*. New Delhi: Kalyni Publishers, 2013. Print.<br>2. Chahal, G. S., and S. S. Gosal. *Principles and Procedures of Plant Breeding: Biotechnological and Conventional Approaches*. Boca Raton, Fla.: CRC, 2002. Print.<br>3. Poehlman, John Milton, and Dhirendranath Borthakur. *Breeding Asian Field Crops, with Special Reference to Crops of India*. Calcutta: Oxford & IBH Pub., 1969. Print. |
| **Reference Books:** | 4. Roy, Darbeshwar. *Plant Breeding: A Biometrical Approach*. Oxford: Alpha Science International, 2012. Print.<br>5. Allard, R.W. *Principles of Plant Breeding*. New York: Wiley India Pvt. Ltd., 2010. Print.<br>6. Chopra, V. L. *Breeding Field Crops.* New Delhi: Oxford and IBH Pub., 2001. Print.<br>7. Chopra, V. L. *Breeding Field Crops.* New Delhi: Oxford and IBH Pub., 2004. Print.<br>8. Gupta, S. K. *Practical Plant Breeding*. 2nd ed. Jodhpur: Agrobios (India), 2010. Print. |