DAV UNIVERSITY JALANDHAR

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

1st TO 4th SEMESTER
Examinations 2018–2019 Session Onwards

Syllabi Applicable For Admissions in 2018

Total minimum credits required for M.Sc. (Hons.) Botany is 98

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

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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

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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
	Total						24
Departmental Elective-I(6Cr) (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

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

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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	Open Elective/Interdisciplinary Course II			4	0	0	4
5	Departmental Elective-II			4	1	2	6
6	Departmental Elective-III			4	0	0	4
	Total						25
Departmental Elective II (6Cr) (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
Departmental Elective III (4Cr) (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

M.Sc. Botany (Hons.) Semester I

Paper: Algae, Fungi and Phytopathology
Code: Theory: BOT521

L	T	P	Credits	Max. Marks	Minimum marks
4	0	0	4	100	40

Objective:

To acquaint the students with the origin, history, morphology, biology and importance of prokaryotic and eukaryotic algal and fungal organisms.

Teaching Methodology:

It will involve class room lectures, practicals and field visits etc.

Learning outcomes

This will enable the students to learn the evolutionary and recent trends in lower plants.

UNIT-I

Algae: Algal classification, Salient features of major divisions (Cyanophyta, Chlorophyta, Xanthophyta, Bacillariophyta; Phaeophyta and Rhodophyta).

Algal ecology:Ecological importance of Algae, Algal indicators, Algal blooms – damage and control, Carbon capture by algae, Algal biofouling, Symbiotic association.

Economic importance of Algae: Algae as food, fodder, biofertilizer, medicine, industrial uses and other useful products, algae as indicator of water pollution, biofuels 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).

Fungal associations and their significance: (a) Symbionts - Lichens, Mycorrhiza, Fungus-insect mutualism; (b) Parasites - Common fungal parasites of plants; (c) Saprophytes - Fungal decomposition of organic matter, coprophilous fungi, cellulolytic fungi, lignolytic fungi.

Agricultural significance of Fungi - Mycoparasite, 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)**

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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)**

DAV UNIVERSITY, JALANDHAR

Paper: Algae, Fungi and Phytopathology Laboratory
Paper code: BOT522

L	T	P	Credits	Max. Marks	Minimum marks
0	0	3	2	100	40

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.

Reference Books

1. Alexopoulos, Constantine John, and Meredith Blackwell. *Introductory Mycology*.4.th ed. New York [u.a.: Wiley, 1996. Print.
2. Bilgrami, K. S., andVerma, R. N. *Physiology of Fungi*. New Delhi: Vikas Pub. House, 1978. Print.
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.

DAV UNIVERSITY, JALANDHAR

M.Sc. Botany (Hons.) Semester I

Paper: Approaches for Crop Improvement
Paper code: BOT527

L	T	P	Credits	Max. Marks	Minimum marks
4	0	0	4	100	40

Objective:

To introduce the students about plant breeding, regeneration of plants and genetic variations under artificial conditions.

Teaching Methodology:

Class room lectures, practical, models, charts, filed visit, power point presentations.

Learning outcomes

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.

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)**

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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)

Gene Cloning and DNA Analysis in Agriculture

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)**

DAV UNIVERSITY, JALANDHAR

Paper: Approaches for Crop Improvement Laboratory

Paper code: BOT528

L	T	P	Credits	Max. Marks	Minimum marks
0	0	3	2	100	40

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 technique of encapsulation of shoot meristem/somatic embryos in calcium alginate beads.

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.

DAV UNIVERSITY, JALANDHAR

M.Sc. Botany (Hons.) Semester I

Paper: Genetics and Cytogenetics
Paper code: BOT529

L	T	P	Credits	Maximum Marks	Minimum marks
4	0	0	4	100	40

Objective:

To acquaint the students about the hereditary basis of life, prokaryotic and eukaryotic genome organization and its functions.

Teaching Methodology:

It will involve class room lectures, practicals, models, and topic related power point presentations.

Learning outcomes

To provide insight into structure and functions of chromosomes, chromosomemapping, polyploidy and cytogenetic aspects of crop 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.

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)**

DAV UNIVERSITY, JALANDHAR

Paper: Genetics and Cytogenetics Laboratory
Paper code: BOT530

L	T	P	Credits	Maximum Marks	Minimum marks
0	0	3	2	100	40

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, C-banding 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.

Reference 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.
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.
7. Karp G. *Cell and Molecular Biology*. USA: Wiley & Sons, 1999. Print.
8. Lewin B. *Genes VII*. UK: Oxford University Press, 2000. Print.
9. Lodish H., Berk, A., Zipursky, L., Matsudaira, P., Baltimore, D., and Darnell, J. *Molecular Cell Biology*. USA: W.H. Freeman & Co., 2005. Print.
10. Malacinski, J., and Friefelder, D. *Essentials of Molecular Biology*. USA: Jones and Bartlett Publ., 1999. Print.
11. Primrose S.B., Twyman, R.M., and Old, R.W. *Principles of Gene Manipulation*.UK: Blackwell Publisher, 2001. Print.
12. Russel, P.J. *Genetics*. California: Addison Wesley Longman, 2006. Print.
13. Snustad, D.P. and Simmons, M.J. *Principles of Genetics*. USA: Wiley and Sons, 2003. Print.
14. Stryr, L. *Biochemistry.* 5th ed. New York: W.H. Freeman and Co., 1995. Print.
15. Voet, D., and Voet, J.G. *Biochemistry.* New York: John Wiley and Sons Inc., 1995. Print.
16. Buchanan, B.B., Gruissem, W, and Jones, R. L. *Biochemistry and Molecular Biology of Plants.* India: IK Internationals 2005. Print.

17. Heldt, H.W. *Plant Biochemistry*, California: Elsevier, 2005. Print.

DAV UNIVERSITY, JALANDHAR

M.Sc. Botany (Hons.) Semester I

Paper: Plant Cell Biology and Biochemistry
Paper Code: BOT539

L	T	P	Credits	Max. Marks	Minimum marks
4	0	0	4	100	40

Objective:

The syllabus covered in the course will serve the following 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.

Teaching Methodology:

It will involve class room lectures, practicals, presentations, videos and assignments.

Learning outcomes

This will enable the students to learn the working of the cell.

UNIT I

Cell: First cell, prokaryotic and eukaryotic cell, evolution of metabolism.

Membrane Structure and Membranous Organelles: Introduction, The fluid-mosaic membrane model, Plasma membrane, Endoplasmic reticulum, Golgi apparatus, Exocytosis and endocytosis, Vacuoles, The nucleus, Peroxisomes, Plastids, Mitochondria. **(7 Lectures)**

The Cell Wall: Introduction, Sugars as building blocks of cell wall, Macromolecules of the cell wall, Cell wall architecture, Cell wall biosynthesis and assembly, Growth and cell walls, Cell differentiation. **(5 Lectures)**

UNIT II

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

Protein Sorting and Vesicle Traffic: Introduction, The cellular machinery of protein sorting, Targeting proteins to - plastids, mitochondria, peroxisomes and nucleus, Protein traffic and sorting in the secretory pathway: ER, Golgi apparatus and beyond, Endocytosis and endosomal compartments. (5 Lectures)

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

UNIT III

Cell Division: Plant cell cycle, Acentric mitosis, Mechanisms of cell cycle control, The logic of cell cycle control, Cell cycle control in multicellular organisms, 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, Phytohormone signal transduction with special reference to ABA and

ethylene, Signal transduction from phytochromes, Gibberellin signal transduction during seedling development, regulation of stomatal aperture. (8 Lectures)

UNIT IV

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

Amino Acids: Amino acid biosynthesis in plants, 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, Protein synthesis in plastids, Post- translational modification of proteins, Protein degradation, Enzymes and its kinetics. (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, Function of membrane lipids, extracellular lipids, Synthesis and catabolism of storage lipids.

(5 Lectures)

References:

1. Stryer, L. *Biochemistry*. 5thed. 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. Buchanan, B.B., Gruissem, W. and Jones, R.L. *Biochemistry and Molecular Biology of Plants*. India: I K Internationals, 2005. Print.

4. Heldt, H.W. *Plant Biochemistry*. California: Elsevier, 2005. Print.

DAV UNIVERSITY, JALANDHAR

M.Sc. Botany (Hons.) Semester II

Paper: Archegoniate Biology

Paper code: BOT531

L	T	P	Credits	Max. Marks	Minimum marks
4	0	0	4	100	40

Objective:

To expose the students to evolutionary history, morphology, biology and affinities of bryophytes and pteridophytes.

Teaching Methodology:

Class room lectures, practicals, models, charts, field visit, power point presentations.

Learning outcomes

The studies will be exposed to the evolutionary trends in cryptogams and phanerogams, development of vascular system in plants, ecological significance of bryophytes and pteridophytes.

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: Bryophyte endemisms; Indian bryodiversity with particular emphasis to Himalayas; Threatened bryophytes; strategies to conserve diversity at National and Global levels. **(3 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 hyperaccumulators of arsenic, mechanism of uptake, transfer and tolerance and use in phytoremediation

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

DAV UNIVERSITY, JALANDHAR

Paper: Archegoniate Biology Laboratory
Paper code: BOT532

L	T	P	Credits	Max. Marks	Minimum marks
0	0	3	2	100	40

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*.

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.

DAV UNIVERSITY, JALANDHAR

M.Sc. Botany (Hons.) Semester II

Paper: Plant Physiology
Code: BOT533

L	T	P	Credits	Max. Marks	Minimum marks
4	0	0	4	100	40

Objective:
To acquaint the students about various physiological processes at cellular and organ level in plants.

Teaching Methodology:
Class room lectures, practicals, models, charts, power point presentations.

Learning outcomes
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.

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; Transport proteins; Membrane transport process; 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; molecular basis of 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; CN- resistant respiration and metabolic inhibitors regulating the respiration. **(5 Lectures)**

DAV UNIVERSITY, JALANDHAR

UNIT-III

Sensory physiology: Phytochromes and cryptochromes; 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)**

DAV UNIVERSITY, JALANDHAR

Paper: Plant Physiology Laboratory
Code: BOT534

L	T	P	Credits	Max. Marks	Minimum marks
0	0	3	2	100	40

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.

Reference Books

1. Bonner, B., and Varner, J.E. *Plant Biochemistry*. London: Academic Press, 1976. Print.
2. Srivastava, L.M. *Plant Growth and Development*. NewYork: Associated Press, 2002. Print.
3. Stryer, L. *Biochemistry*. 5th ed. New York: W.H. Freeman and Co., 1995. Print.
4. Taiz, L., and Zeiger, E. *Plant Physiology*. California: The Benjamin/Cumming Publishing Company, 1998. Print.
5. Voet, D., and Voet, J.G. *Biochemistry*. New York: John Wiley and Sons Inc., 1995. Print.
6. Wilkins, M.B. *Advanced Plant Physiology*. New York: Pitman, 1984. Print.
7. Buchanan, B.B., Gruissem, W. and Jones, R.L. *Biochemistry and Molecular Biology of Plants*. India: I K Internationals, 2005. Print.

DAV UNIVERSITY, JALANDHAR

M.Sc. Botany (Hons.) Semester II

Paper: Conservation of Natural Resources

Paper code: BOT535

L	T	P	Credits	Max. Marks	Minimum marks
4	0	0	4	100	40

Objective:

To make the students learn about the significance of different natural resources and their conservation strategies.

Teaching Methodology:

Class room lectures, practicals, models, charts, power point presentations.

Learning outcomes

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

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. **(4 Lectures)**

Pesticides and herbicides: role in crop protection; Organic, inorganic and hormonal pesticides and herbicides. Environmental hazards of pesticides and insecticides - their impact on life and life support system. **(6 Lectures)**

Role of botanicals in crop protection; Biological management of pests; Integrated weed management. **(4 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. **(5 Lectures)**

Conservation of Forests: Joint Forest Management, Plantation Programmes in India – Social and Urban Forestry; Forest Conservation Act. **(2 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. **(5 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 biodiversity conservation: *In-situ* conservation: protected areas sanctuaries, biosphere reserves, national parks. *Ex-situ* conservation: botanical gardens, herbarium; *In-vitro* Conservation: germplasm and gene Bank; tissue culture: pollen and spore bank, DNA bank. **(6 Lectures)**

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

DAV UNIVERSITY, JALANDHAR

Paper: Conservation of Natural Resources Laboratory
Paper code: BOT536

L	T	P	Credits	Max. Marks	Minimum marks
0	0	3	2	100	40

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.

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. James, P. and Lodge, J. R. *Methods of Air sampling and Analysis.* ISc Lewis Pub. Inc, 1971.Print.
11. Klaassen, C.D. andAlkinsJ.B.W.*Essentials of Toxicology*. McGraw-Hill Professional, 2003.Print.
12. Lutgens, F.K. andTarbuek, J.E.*The Atmosphere*. Prentice Hall, 1992.Print.
13. Michael, L., McKinney andSchoch, R.M.*Environmental science: Systems and Solutions*. West publishing company, 2002.Print.
14. Oehme, W.F. *Toxicity of Heavy Metals in Environment.* Marcel DakkarInc, 1989.Print.

DAV UNIVERSITY, JALANDHAR

M.Sc. Botany (Hons.) Semester III

Paper: Evolutionary Biology of Plants
Code: BOT540

L	T	P	Credits	Max. Marks	Minimum marks
4	0	0	4	100	40

Objective: 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.

Teaching Methodology:

Class room lectures, practicals, models, charts, power point presentations.

Learning outcomes:

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.

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)**

References

1. Douglas, J. Futuyma. *Evolutionary Biology*. Sinauer Publications.
2. Smith, J.M. *Evolutionary Genetics*. Oxford University Press. 1998. Print
3. Minkoff, J.C. 1983. *Evolutionary Biology*. Addison Wesley Publishing Company. 1983. Print.
4. Dobzhansky, T. *Evolutionary Biology*. Appleton – Century – Crofts, Educational Division/Meredith Corporation, New York.
5. Ayala, F.J. & Valentine, J.W. *Evolving the theory of organic evolution*. The Benjamin Cumming Publishing Company, Melno Park, California. Lull. 1979. Print.
6. R.S. *Organic Evolution*. Light and Life Publishers, New Delhi. 1976. Print.
7. Kathy Willis, Jennifer McElwain. The Evolution of Plants, Oxford University Press.2016. Print.
8. Kenrick, Paul, and Peter R. Crane. "The origin and early evolution of plants on land." *Nature* 389.6646 (1997): 33-39.

DAV UNIVERSITY, JALANDHAR

L	T	P	Credits	Max. Marks	Minimum marks
0	0	0	1	100	40

Paper: Seminar
Paper code: BOT538

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.

DAV UNIVERSITY, JALANDHAR

M.Sc. Botany (Hons.) Semester III

Paper: Scientific Writing and Research Methodology
Code: BOT621

L	T	P	Credits	Max. Marks	Minimum marks
3	1	0	4	100	40

Objective:

To make the students learn how to design an experiment and what are the various research strategies.

Teaching Methodology:

Class room Lectures, practicals, models, charts, power point presentations.

Learning outcomes

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.

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)**

Reference Books

1. Kothari, C.R. *Research Methodology – Methods and Techniques*. 2nd revised ed. New Delhi: New Age International (P) Ltd. Publishers, 2007. Print.
2. McKillup, S. *Statistics Explained. An Introductory Guide for Life Scientists*. Cambridge, UK: Cambridge University Press, 2006. Print.
3. Selvin, S. *Biostatistics – How it Works.* First Impression. New Delhi: Pearson Education Inc., 2007. Print.
4. Agarwal, B.L. *Basic Statistics*. New Delhi: New Age International, 2006. Print.

DAV UNIVERSITY, JALANDHAR

M.Sc. Botany (Hons.) Semester III

Paper: Advanced Plant Systematics
Paper code: BOT622

L	T	P	Credits	Max. Marks	Minimum marks
4	0	0	4	100	40

Objective:
To familiarize the students about the origin, evolution and taxonomy of angiosperms.

Teaching Methodology:
Class room lectures, practicals, models, charts, power point presentations.

Learning outcomes
The students will acquire the knowledge of evolution, their systematic position, nomenclature of an organism/species.

UNIT I

Taxonomic History: Brief introduction to systems of classification: Artificial, natural and phylogenetic systems; taxonomy in ancient India: contribution of Parashara, Charaka. **(4 Lectures)**

Systematics: Keys for identification of plants: single and multiple access keys; Evidences from morphology, palyonology, cytotaxonomy, chemotaxonomy, serology, computers and GIS; molecular systematics. **(4 Lectures)**

UNIT II

Botanical Nomenclature: Kinds of names; International Code of Nomenclature for algae, fungi and plants. Major changes adopted in last two IBC, Names according to rank; Author citation; Principle of Priority; Typification; Naming a new species; Legitimacy; Synonyms. **(8 Lectures)**

Molecular Systematics: Principles of molecular systematics, multiple sequence alignment, distance based methods and discrete methods for phylogenetic reconstruction. **(6 Lectures)**

UNIT III

Classification: The components of classification; Characters and their states; Sources of characters; Evaluation of characters. **(4 Lectures)**

Phylogenetics: The nature of phylogeny; How we depict phylogeny?; The importance of homology, Polarizing characters of homology; The problem of homoplasy. **(4 Lectures)**

Introduction to the angiosperms: General characteristics; Evolutionary history; Basal angiosperms and Magnoliids; Basal monocots; Petaloid monocots; Commelinids; Basal eudicots and Caryophyllids; Rosids; Asterids. **(8 Lectures)**

UNIT IV

Salient Features and Economic Importance of Dicot Families: Apocyanaceae; Verbenaceae; Chenopodiaceae; Capparidaceae; Caryophyllaceae; Myrtaceae; Apiaceae; Acanthaceae; Moraceae; Rubiaceae. **(10 Lectures)**

Salient Features and Economic Importance of Monocot Families: Amaranthaceae; Musaceae; Cannaceae; Commelinaceae. **(4 Lectures)**

References

1.Schierwater, Bernd, et al., eds. *Molecular ecology and evolution: approaches and applications*. Vol. 69. Birkhäuser, 2013.

2. Singh, Gurcharan. *Plant Systematics, 3/ed.: An Integrated Approach*. CRC Press, 2016.

3. Judd, Walter S., et al. "Plant systematics: a phylogenetic approach." *ecologiamediterranea* 25.2 (1999): 215.

4. Simpson, Michael G. *Plant systematics*. Academic press, 2010.

5. Radford, Albert E. *Fundamentals of plant systematics*. Harper & Row, 1986.

6. Farnsworth, Elizabeth. "Plant Systematics: A Phylogenetic Approach." *Rhodora* 118.976 (2016): 418-420.

7. Pellens, Roseli, and Philippe Grandcolas. *Biodiversity Conservation and Phylogenetic Systematics*. Springer,, 2016.

DAV UNIVERSITY, JALANDHAR

Paper: Advanced Plant Systematics Laboratory
Paper code: BOT623

L	T	P	Credits	Max. Marks	Minimum marks
0	0	3	2	100	40

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

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. 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.
5. Maheshwari, J.K. *The Flora of Delhi*. New Delhi: CSIR, 1963. Print.
6. Nei, M., and Kumar, S. *Molecular Evolution and Phylogenetics*. New York: Oxford University Press, 2000. Print.
7. Radford, A.E., Dickison, W.C., Massey, J.R., and Bell, C.R. *Vascular Plant Systematics*. New York: Harper and Row, 1974. Print.
8. Semple, C., and Steel, M.A. *Phylogenetics*. Oxford: Oxford University Press, 2003. Print.
9. Simpson, M.G. *Plant Systematics*. Amsterdam: Elsevier, 2006. Print.
10. Stuessy T.F. *Plant Taxonomy: The systematic Evaluation of Comparative Data*. New York: Columbia University Press, 2009. Print.
11. Bierhorst, D.W. *Morphology of Vascular Plants*. New York: The Macmillan and Co., 1971. Print.
12. Cronquist, A. *The Evolution and Classification of Flowering Plants*. Boston: Houghton Miffin, 1968. Print.
13. Naik, V.N. *Taxonomy of Angiosperms*. New Delhi: Tata McGraw Hill, 1984. Print.
14. Pandey, S.N., and S.P. Misra. *Taxonomy of Angiosperms*. India: Ane Reference Books, 2008. Print.

DAV UNIVERSITY, JALANDHAR

M.Sc. Botany (Hons.) Semester III

Paper: Plant Molecular Biology

Paper code: BOT629

L	T	P	Credits	Max. Marks	Minimum marks
4	0	0	4	100	40

Objective: To acquaint the students with the basic machinery governing the maintenance of life as it is in the living world.

Teaching Methodology: It will involve class room lectures, practicals, models, and topic related power point presentations.

Learning Outcomes: 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.

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. (**6 Lectures)**

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, Rolling circle mechanism of replication. (**9 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. 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. (**9 Lectures)**

UNIT III

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)**

Techniques in molecular biology: Agarose gel electrophoresis for DNA and RNA, DNA hybridization, hybridization probes, PCR, DNA sequencing, model organisms, gene engineering through cutting and joining of DNA molecules, enzymes for DNA modification. **(6 Lectures)**

DAV UNIVERSITY, JALANDHAR

UNIT IV

Genomics and Proteomics:

Genomics: Genome, genomics. Structural genomics - genome sequencing strategies, genome projects with special mention to human genome project, rice and *Arabidopsis* genome projects. Functional genomics – genome annotation, gene expression study using microarrays,metagenomics,genomics in crop improvement. **(6 Lectures)**

Proteomics: Proteome, proteomics, Separation and identification of cellular proteins by 2D gel electrophoresis and mass spectrometry, Protein expression analysis using Protein microarray, protein localization using GFP, proteomics in crop improvement.**(6 Lectures)**

DAV UNIVERSITY, JALANDHAR

Paper: Plant Molecular Biology Laboratory

Paper code: BOT630

L	T	P	Credits	Max. Marks	Minimum marks
0	0	3	2	100	40

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.
7. Multiple sequence alignment using CLUSTAL X (give DNA or protein sequence).

Subject to the availability of lab facilities, teacher may demonstrate with the help ofimages/powerpoint presentation.

References

1. Becker,W.M.,Kleinsmith,L.J. and Hardin, J. *The world of the cell* (VI Edn). Pearson.,2007.Print.
2. Cooper, G.M., and Hausman, R.E.*The Cell: A molecular approach* (V Edn). Sinaeur, 2009.Print.
3. Karp, G.*Cell and Molecular biology: Concepts and experiments* (V Edn). John Wiley & Sons, 2008.Print.
4. Lodish, H., Berk, A., Zipursky, L., Matsudaira, P., Baltimore, D. and Darnell, J.*Molecular cell biology* (IV Edn). W H Freeman & Company, 2000.Print.
5. 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.
6. Brooker, R.J.*Genetics: analysis and principles* (III Edn). McGraw Hill, 2009.Print.
7. Krebs, J.E., Goldstein, E.S. and Kilpatrick, S.T.*Lewin's Genes X*. Jones and Bartlett Publishers, 2011.Print.
8. Buchanan, B.B., Gruissem, W. and Jones, R.L.*Biochemistry and Molecular biology ofplants*.I K International Pvt. Ltd, 2000.Print.
9. Hartl, D.L. and Jones, E.W. *Genetics: Analysis of genes and genomes* (VII Edn). Jonesand Bartlett publishers, 2012.Print.
10. 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.
11. Klug, W.S. and Cummings, M.R.*Concepts of Genetics* (VII Edn). Pearson, 2004.Print.
12. Weaver, R.F.*Molecular biology* (II Edn).McGraw Hill, 2002.Print.
13. Alberts, B., Bray, D., Hopkin, K., Johnson, A., Lewis, J., Raff, M., Roberts, K. and Walter, P.*Essential Cell Biology*. Garland Science, 2010.Print.

DAV UNIVERSITY, JALANDHAR

Paper: Project-I
Paper code: BOT624

L	T	P	Credits	Max. Marks	Minimum marks
0	0	2	2	50	20

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.

DAV UNIVERSITY, JALANDHAR

M.Sc. Botany (Hons.)-Departmental Elective-I

Paper: Plant Resource Utilization
Paper code: BOT641

L	T	P	Credits	Max. Marks	Minimum marks
4	0	0	4	100	40

Objective:
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.

Learning outcomes
The students will learn the origin, cultivation, high yielding varieties, part used, active principles etc. of some food, oil, drugs, spice, rubber etc yielding plants.

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 themanufacuring 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., *Shorearobusta*, *Tectonagrandis, Cedrusdeodara*, 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 andIntellectual 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)**

DAV UNIVERSITY, JALANDHAR

Paper: Plant Resource Utilization Laboratory
Paper code: BOT642

L	T	P	Credits	Max. Marks	Minimum marks
0	0	3	2	100	40

The practical course is divided into three units; (1) Laboratory Work; and (2) Field Survey and Scientific Visits.

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.)

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.

Reference Books

1. Bole, P.V., and Vaghani, Y. *Field Guide to Common Indian Trees*. Mumbai: Oxford University Press, 1986. Print.
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.
3. Cristi, B.R. *Handbook of Plant Science and Agriculture*, Vol. I. *In-situ Conservation*, Florida, U.S.A: CRC Press, Boca Raton, 1999.Print.
4. Council for Scientific & Industrial Research. *The Useful Plants of India*, New Delhi: Publications and Information Directorate, CSIR, 1986.Print.
5. Kocchar, S.L. *Economic Botany of the Tropics*, 2nd ed., New Delhi Macmillan India Ltd., 1998.Print.
6. Swaminathan, M.S., and Kocchar, S.L., (eds.). *Plants and Society*. London: MacMillan Publications Ltd., 1989.Print.
7. Thakur, R.S., Puri, H.S. and Husain, A.*Major Medicinal Plants of India*. Lucknow: Central Institute of Medicinal and Aromatic Plants, 1989.Print.
8. 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.

DAV UNIVERSITY, JALANDHAR

M.Sc. Botany (Hons.)-Departmental Elective-I

Paper: Agricultural ecology –principles and application
Code: BOT627

L	T	P	Credits	Max. Marks	Minimum marks
4	0	0	4	100	40

Objective:

To provide an understanding of the basic theories and principles of ecology and to help study various aspects related to ecology

Teaching Methodology:

Class room lectures, practicals, models, charts, power point presentations.

Learning outcomes

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.

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 optional density. Exponential growth, limits of population growth, population dynamics, life history pattern, fertility rate and age structure. Ecological consequence of overpopulation. **(9 lectures)**

UNIT III

Genecology - ecological amplitude, ecads, ecotypes, ecospecies, coenospecies, k-selection and r-selection populations. **(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 criteria of classification, dynamic system of classification by 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)**

DAV UNIVERSITY, JALANDHAR

Paper: Agricultural Ecology-Principles and Applications Laboratory
Paper code: BOT628

L	T	P	Credits	Max. Marks	Minimum marks
0	0	3	2	100	40

1. Quantitative and qualitative community analysis. Carry out a project on species structure and the frequency, abundance, density of different species and similarity index of different communities in a natural system. Students must be able to explain the structure of vegetation from the given data on the above 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, plant diversity (species and community).

Reference 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.
3. Conklin, Alfred R., and Rolf Meinholtz. *Field Sampling: Principles and Practices in Environmental Analysis*. New York: Marcel Dekker, 2004. Print.
4. Fahey, Timothy J. *Principles and Standards for Measuring Primary Production*. Oxford: Oxford UP, 2007. Print.
5. Grant, William E., and Todd M. Swannack. *Ecological Modeling: A Common-sense Approach to Theory and Practice*. Malden, MA: Blackwell Pub., 2008. Print.
6. Wilkinson, D.M. *Fundamental Processes in Ecology: An Earth system Approach*. Oxford: Oxford Scholarship Online. 2007. Print.
7. Briggs, D. and Walters, S.M. *Plant Variation and Evolution*. Cambridge: Cambridge University Press. 1997. Print.
8. Futuyma, Douglas J. *Evolutionary Biology*. 3rd ed. Sunderland, Mass.: Sinauer Associates, 1998. Print.
9. Ridley, M. *Evolution*. New York: Blackwell. 2003. Print.

DAV UNIVERSITY, JALANDHAR

M.Sc. Botany (Hons.) Semester IV

Paper: Techniques in Plant Analysis
Paper code: BOT647

L	T	P	Credits	Max. Marks	Minimum marks
4	0	0	4	100	40

Objective:
To acquaint the students about the various techniques used to analyze a biological system.
Teaching Methodology:
Class room lectures, practicals, models, charts, power point presentations.
Learning outcomes
This course will make the students learn the principles, procedures and uses of various bioanalytical techniques used for plant/animal analysis.

UNIT I

pH metery – Principles and applications. **(2 Lecture)**
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, 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. **(2 Lectures)**
Electrophoresis and Isoelectric focusing: Principle, working and applications of Electrophoresis; one and two dimensional gel electrophoresis, Isoelectric focusing gels; Analysis of RNA, DNA and proteins electrophoresis. **(2 Lectures)**
Sequencing: Protein sequencing methods, detection of post translation modification of proteins.DNA sequencing methods, strategies for genome sequencing; Methods for analysis of gene expression at RNA and protein level, large scale expression, such as micro array based techniques. **(5 Lecture)**

DAV UNIVERSITY, JALANDHAR

UNIT IV

Radiolabeling techniques: Detection and measurement of radioisotopes normally used in biology; incorporation of radioisotopes in biological tissues and cells, 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)**

DAV UNIVERSITY, JALANDHAR

Paper: Techniques in Plant Analysis Laboratory
Paper code: BOT648

L	T	P	Credits	Max. Marks	Minimum marks
0	0	3	2	100	40

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.

Reference Books

1. Plummer, D.T. *An Introduction to Practical Biochemistry*. New Delhi: Tata McGraw Hill Publishing Ltd., 1994. Print.
3. Potter, G.W.H. *Analysis of Biomolecules: An introduction to Principles, Instrumentation and Techniques*. London: Chapman and Hall, 1995. Print.
4. Primrose, S.B., Twyman, R.M., and Old, R.W. *Principles of Gene Manipulation.* UK: Blackwell Publishers, 2001. Print.
5. Sawhney, S.K., and Singh, R. *Introductory Practical Biochemistry.* New Delhi: Narosa Publishing House, 2002.
6. Wilson, K., and Walker, J. *Principles and Techniques of Practical Biochemistry.* Cambridge: Cambridge University Press. 2000. Print.

DAV UNIVERSITY, JALANDHAR

Paper: Project-II
Paper code: BOT631
Project Report

L	T	P	Credits	Max. Marks	Minimum marks
0	0	8	8	100	40

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.

DAV UNIVERSITY, JALANDHAR

M.Sc. Botany (Hons.)-Departmental Elective II

Paper: Plant Ecology and Phytogeography
Code: BOT645

L	T	P	Credits	Max. Marks	Minimum marks
2	0	0	2	100	40

Objective:
To inspire the students about ecological importance of the environment, natural resources, various problems related to environment and its protection.

Teaching Methodology:
Class room Lectures, practicals, models, charts, field visit, power point presentations.

Learning outcomes
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.

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

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

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

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 in

vegetation classification, understanding the key environmental issues and ecosystem management. **(3 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)**

DAV UNIVERSITY, JALANDHAR

Paper: Plant Ecology and Phytogeography Laboratory
Code: BOT646

L	T	P	Credits	Max. Marks	Minimum marks
0	0	2	1	100	40

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.

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. Odum, E.P. *Fundamentals of Ecology*. USA: Saunders Toppan, 1971. Print.
7. Ramakrishanan, P.S. *Ecology of Biological Invasion in the Tropics*. New Delhi: International Scientific Publications, 1991. Print.
8. Raven, P.H., Berg, L.R., and Hassenzahl, D.M. *Environment*. 7thed. USA: Wiley, Hoboken, 2010. Print.
9. 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.
10. Singh, H.P., Batish, D.R., and Kohli, R.K. *Handbook of Sustainable Weed management*. New York, USA: Food Products Press, 2006. Print.
11. Singh, J.S., Singh, S.P., and Gupta, S.R. *Ecology, Environment and Resource Conservation*. New Delhi: Anamaya Publishers, 2006. Print.

DAV UNIVERSITY, JALANDHAR

M.Sc. Botany (Hons.)-Departmental Elective II

Paper: Advanced Plant Physiology and Metabolism
Code: BOT649

L	T	P	Credits	Max. Marks	Minimum marks
4	1	0	4	100	40

Objective:
To acquaint the students about molecular regulation of various physiological processes in plants.

Teaching Methodology:
Class room lectures, practical, models, charts, power point presentations.

Learning outcomes
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.

UNIT-I

Energetics: Primary charge separation events in reaction centres; regulatory action of uncoupling agents of photophosphorylation; energy loss during vectorial electron transfer in light reaction; genetics of RUBISCO subunit assembly and organization in plants; physiological and ecological aspects of photosynthesis; efficiency of carbohydrate synthesis. **(5 Lectures)**

Respiration – regulation of key respiratory enzymes with particular emphasis on phosphofructo kinase, glyceraldehydes-3-phosphate dehydrogenase and pyruvate dehydrogenase; mechanism of action of inhibitors of oxidative phosphorylation; arrangement and organization of protein complexes in mitochondrial electron transport chain. **(4 Lectures)**

UNIT-II

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-III

Metabolism: Lipid catabolism and membrane generation *de novo*; function of glycerolipids as membrane constituents and carbon stores. **(6 Lectures)**

Blue-light responses: Stomatal movement; morphogenesis; circadian rythms; regulation of plant movements. **(2 Lectures)**

Plant genomes: Organization and importance of chloroplast and mitochondrial genomes; retrograde signalling. **(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)**

DAV UNIVERSITY, JALANDHAR

Paper: Advanced Plant Physiology and Metabolism Laboratory
Code: BOT650

L	T	P	Credits	Max. Marks	Minimum marks
0	0	3	2	100	40

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.

Reference Books

1. Srivastava, L.M.*Plant Growth and Development*. NewYork: Associated Press, 2002. Print.
2. Stryer, L. *Biochemistry*. 5thed. New York: W.H. Freeman and Co., 1995. Print.
3. Taiz, L., and Zeiger, E. *Plant Physiology*. California: The Benjamin/Cumming Publishing Company, 1998. Print.
4. Voet, D., and Voet, J.G. *Biochemistry*. New York: John Wiley and Sons Inc., 1995. Print.
5. Wilkins, M.B. *Advanced Plant Physiology*. New York: Pitman, 1984. Print.
6. Buchanan, B.B., Gruissem, W. and Jones, R.L. *Biochemistry and Molecular Biology of Plants*. India: I K Internationals, 2005. Print.
7. Heldt, H.W. *Plant Biochemistry*. California: Elsevier, 2005. Print.

DAV UNIVERSITY, JALANDHAR

M.Sc. Botany (Hons.)
Departmental Elective II

M.Sc. Botany (Hons.)
Paper: Plant Developmental Biology
Code: BOT643

L	T	P	Credits	Max. Marks	Minimum marks
4	0	0	4	100	40

Objective:
To acquaint the students about the anatomy and mechanism of reproduction in the angiosperms.

Learning Outcome
The course will enable students to know about the different tissue systems and reproductive structures of angiosperms and their mechanism of action.

UNIT I

Introduction to Plant Anatomy: Primary and secondary tissues in plants; Anatomy of root, stem, leaf of monocot and dicot plants; differentiation of vascular tissue in higher plants; Secondary growth in stem and root. **(9 Lectures)**

Shoot Development: organization of shoot Apical meristem and types of vegetative shoot apex **(2 Lectures)**

Root Development: organization of root apex and significance of Quiscentcenter **(2 Lectures)**

Leaf: Structure with reference to C3 and C4 plants – Kranz and CAM Syndrome **(2 Lectures)**

UNIT II

Structural Response of Plants to Diseases and other stresses: Abscission, Tissue regeneration, Grafting; Cytological reaction to invasion of parasites; Structural basis of Resistance: Trichomes, Laticifers, Dutch Elm Disease and Tylosis; Virus movement in Plants; Anatomical responses to mineral deficiency **(9 Lectures)**

Morphological and structural adaptations in different ecological groups - hydrophytes, xerophytes, epiphytes and halophytes. **(4 Lectures)**

The composition and structure of plant primary cell walls: Hemicellulose, Xyloglucan, Xylans, Mannose containing hemicellulose; Pectic Polysaccharides: Homogalacturonan, Rhamnogalacturonans. **(4 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-palynology in relation to taxonomy. 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.Photomorphogenesis, Photoreceptors. Photoresponses and molecular mechanism. **(6 Lectures)**

DAV UNIVERSITY, JALANDHAR

Paper: Plant Developmental Biology Laboratory
Code: BOT644

L	T	P	Credits	Max. Marks	Minimum marks
0	0	3	2	100	40

1. Study of angiosperm leaf epidermis in the following taxa:
Crotalaria, Portulaca or *Talinium, Tridax, Petunia* or *Datura, Rheodiscolo*r or *Commelina, Brassica, Cyperus* and Grass.
2. Estimation of stomatal frequency and stomatal index in the materials studied.
3. Maceration of wood and identification of various elements in *Michelia, Bombax, Tectona,*Terminalia and *Azadirathta*
*4.*Study of wood structure with the help of T.S., R.L.S. in the following: *Tectona, Bombax, Michelia, Pongamia* and *Azadiratha*
5. 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 sledges.
6. Study of shoot apex in suitable locally available materials to understand cytohistological zonation (*Coleus, Kalanchoe*)
7. Study of roots in Monocots and Dicots.
8. Anomalous secondary growth in the following examples: Stems of *Aristolochia, Nyctanthes, Pyrostegia, Peperomia, Tinospora, Achyranthes,*
9. Ecological anatomy.
10. Study of the pollen grains of *Hibiscus, Tribulus, Ocimum*and Grass.
11. 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 pollen fertility.
12. Study of embryos and Haustoria in locally available.

Reference 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.
3. Dickison, W.C. *Integrative Plant Anatomy*.USA: Academic Press, 2000. Print.
4. Fahn, A. *Plant Anatomy*. Sydeny: Pergamon Press. Print.
5. Beck, Charles B. *An introduction to plant structure and development: plant anatomy for the twenty-first century*. Cambridge University Press, 2010.Print.
6. Johansen, Donald Alexander. *Plant embryology*.ChroniceBotanica Company; Waltham, Mass,1950.Print.
7. Johri, Brij M., Kunda B. Ambegaokar, and Prem S. Srivastava. *Comparative embryology of angiosperms*.Vol. 1.Springer Science & Business Media, 2013.Print.
8. Bhojwani, Sant Saran, and Woong-Young Soh, eds. *Current trends in the embryology of angiosperms*. Springer Science & Business Media, 2013.Print.
9. 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.

DAV UNIVERSITY, JALANDHAR

M.Sc. Botany (Hons.)-Departmental Elective III

Paper: Forestry
Paper code: BOT636

L	T	P	Credits	Max. Marks	Minimum marks
4	0	0	4	100	40

Objective:
To expose the students about the practice of growing trees, their legal and social protection, plantation of trees for different purposes etc.

Teaching Methodology:
Traditional method of class room lectures, forest visits, and performing practicals related forestry.

Learning outcomes
The studies will provide students with the knowledge of importance and conservation of forests.

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)**

Reference 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.
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.

DAV UNIVERSITY, JALANDHAR

M.Sc. Botany (Hons.)-Departmental Elective III

Paper: Advances in Plant Breeding
Code: BOT637

L	T	P	Credits	Max. Marks	Minimum marks
4	0	0	4	100	40

Objective:
To make the students learn about various breeding techniques that are used to develop new genotypes of important crop plants.

Teaching Methodology:
Class room Lectures, models, charts, power point presentations.

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

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

Selection theory; Hardy-Weinberg law; Genetic advance under selection

Breeding Methodology: Pedigree method; Bulk method; Single-seed descent method; Backcross method; Production of doubled haploids

Mixture, Blends, and Composites; Early Generation Testing; Selection Index - Multiple Trait Selection; Linkage and Plant Breeding **(15 Lectures)**

UNIT-III

Intrapopualtion Improvement: Mass selection-Genetic gain theory; Gardner's Grid system; Half-sib family selection; Ear-to-row selection; Modified ear-to-row selection; Genetic gain theory; Half-sib recurrent selection (or test cross); Testers; S1 progeny recurrent selection; S2 family selection; Full-sib family recurrent selection. **(12 Lectures)**

UNIT-IV

Interpopulation Improvement: Reciprocal recurrent selection; Reciprocal recurrent selection based on test cross of half-sib families; Reciprocal recurrent selection based on half-sib progenies of prolific plants; Reciprocal full-sib recurrent selection **(7 Lectures)**

Hybrid Development: Inbreeding; Methods of inbreeding; Inbreeding depression; Types of hybrid; Factors in comparing hybrid types; Calculating number of possible hybrids; Prediction of double and 3-way hybrid yields from single cross data; Topcross testers for inbred line development; Type of testers; Stage of testing **(6 Lectures)**

Reference Books

1. Singh, B.D. *Plant Breeding: Principles and Methods*. New Delhi: Kalyni Publishers, 2013. Print.
2. Chahal, G. S., and S. S. Gosal. *Principles and Procedures of Plant Breeding: Biotechnological and Conventional Approaches*. Boca Raton, Fla.: CRC, 2002. Print.
3. Roy, Darbeshwar. *Plant Breeding: A Biometrical Approach*. Oxford: Alpha Science International, 2012. Print.
4. Allard, R.W. *Principles of Plant Breeding*. New York: Wiley India Pvt. Ltd., 2010. Print.
5. Chopra, V. L. *Breeding Field Crops.* New Delhi: Oxford and IBH Pub., 2001. Print.
6. Chopra, V. L. *Breeding Field Crops.* New Delhi: Oxford and IBH Pub., 2004. Print.
7. Gupta, S. K. *Practical Plant Breeding*. 2nd ed. Jodhpur: Agrobios (India), 2010. Print.
8. Poehlman, John Milton, and Dhirendranath Borthakur. *Breeding Asian Field Crops, with Special Reference to Crops of India*. Calcutta: Oxford & IBH Pub., 1969. Print.