Indira Gandhi University, Meerpur (Rewari)

Scheme of Examination and Syllabi

for

M.Sc.(Botany) 3rd and 4th Semester

w.e.f. session 2018-19

as per

Choice Based Credit System (CBCS)

Indira Gandhi University, Meerpur (Rewari)
Scheme of Examination
M.Sc. Botany (Semester-III)
Under Choice Based Credit System
w.e.f. Session 2018-19

Core Courses

Course Code	Title of the Course	Theory Marks	Internal Marks	Practical Marks	Credits L:T:P
18BOT23CC1	Plant Physiology	80	20	-	4:0:0
18BOT23CC2	Plant Ecology	80	20	-	4:0:0

Discipline Centric Elective Courses
Group-A (Any one)

Course Code	Title of the Course	Theory Marks	Internal Marks	Practical Marks	Credits L:T:P
18BOT23DA1	Plant Reproduction	80	20	-	4:0:0
18BOT23DA2	Evolutionary and Economic Botany	80	20	-	4:0:0

Group-B (Any one)

Course Code	Title of the Course	Theory Marks	Internal Marks	Practical Marks	Credits L:T:P
18BOT23DB1	Recombinant DNA Technology	80	20	-	4:0:0
18BOT23DB2	Genetics of Medicinal Plants	80	20	-	4:0:0

Open Elective Course

To be chosen from the pool of open elective courses provided by the University (excluding the open elective course offered by the Department of Botany)	3

Open Elective Course offered by the Department of Botany

Course Code	Title of the Course	Theory Marks	Internal Marks	Practical Marks	Credits L:T:P
18BOT23OE	Plant Resource Utilization	80	20	-	3:0:0

Lab Courses

Course Code	Title of the Course	Theory Marks	Internal Marks	Practical Marks	Credits L:T:P
18BOT23LC1	Lab Course -1 (18BOT23CC1 to CC2)	-	-	100	0:0:4
18BOT23LC2	Lab Course -2 (18BOT23DA1/DA2 & DB1/DB2)	-	-	100	0:0:4

Total Credits : 27

Note: 1. The criteria for awarding internal assessment of 20 marks for each paper shall be as under :

(i) Sessional test	: 10 marks
(ii) Assignment/Presentation	: 5 marks
(iii) Attendance	: 5 marks
Less than 65%	: 0 marks
65% and above but upto 70%	: 2 marks
Above 70% but upto 75%	: 3 marks
Above 75% but upto 80%	: 4 marks
Above 80%	: 5 marks

2. Optional papers can be offered subject to the availability of requisite resources/faculty.

18BOT23CC1: Plant Physiology

Time : 3 hours **Max. Marks : 80**
Credits : 4:0:0

Note: The question paper will consist of five Units. Each of the units I to IV will contain two questions and the students shall be asked to attempt one question from each. Unit-V shall be compulsory and will contain eight short answer type questions without any internal choice covering the entire syllabus.

Unit-I

Water: Structure, properties and movement, osmosensors. Water absorption and conduction. Loss of water from plants, stomatal physiology. Beneficial nutrient elements, their functions and deficiency symptoms. Toxic effects of minerals. Antagonistic and synergistic relationship amongst ions. Nutrient uptake by roots. Root microbe interactions for nutrient uptake.
Comparison of xylem and phloem transport, molecular mechanism of phloem loading and unloading, passive or active solute transport.

Unit-II

Signal transduction: Overview, receptors and G-proteins, phospholipid signaling, role of cyclic nucleotides, Ca^{2+} - calmodulin cascade. Regulation of signaling pathways.

Diversity in protein kinases and phosphatases, specific signaling mechanisms-two component system in plants. Physiology of flowering: History, discovery, properties and molecular structure of phytochromes and cryptochromes. Photoperiodism, photoinduction and endogenous rhythms.

Unit-III

Promoters and inhibitors of plant growth. Structure, bioassay, transport, storage, physiological role and mechanism of action of auxins, gibberellins and cytokinins. Peptide hormones in plants. Structure and function of ABA, ethylene, ascorbic acid, brassinosteroids, polyamines (putrescine, spermidine, spermine and cadavarin), jasmonic acid and salicylic acid.

Unit-IV

Stress physiology: Type of stresses. Plant responses and mechanism of tolerance of biotic and abiotic stress. Water, temperature, salt, heavy metal and oxidative stress. Effect of air pollutants SO_2 and O_3 and elevated CO_2 on plants. Hypersensitive reaction and systemic acquired resistance. Role of phytoalexins and phenyl propanoid pathway in plants. Secondary plant metabolites: role of terpenes, phenols and nitrogenous compounds, allelopathy.

Books recommended

1. Taiz, L. and Zeiger, E., 2006, Plant Physiology, 4th Edition, Sinauer Associates Inc. Publishers, Massachusetts, USA.
2. Hopkins, W.G. and Huner, P.A., 2008, Introduction to Plant Physiology, John Wiley and Sons.
3. Salisbury, F.B. and Ross, C.W., 1991, Plant Physiology, Wordsworth Publishing Co. Ltd.
4. Jain, V.K., 2013, Fundamentals of Plant physiology, (5th Edition), S. Chand & Company Ltd.
5. Verma, V., 2016, Plant Physiology, 2nd Edition, Athena Academic, London, UK.

18BOT23CC2: Plant Ecology

Time : 3 hours **Max. Marks : 80**
Credits : 4:0:0

Note: The question paper will consist of five Units. Each of the units I to IV will contain two questions and the students shall be asked to attempt one question from each. Unit-V shall be compulsory and will contain eight short answer type questions without any internal choice covering the entire syllabus.

Unit-I

Environment: Physical environment; biotic environment; biotic and abiotic interactions; climate and soil pattern of world.
Habitat ecology: Concept of habitat and niche; niche width and overlap; fundamental and realized niche; resource partitioning; character displacement and major habitat types of the subcontinent.

Unit-II

Population ecology: Characteristics of a population; population growth curves; population regulation; life history strategies (r and k selection); age structured populations.
Species interactions: Types of interactions, interspecific competition, herbivory, carnivory, pollination, symbiosis; Mechanisms of litter fall decomposition and climatic factors associated with decomposition.

Unit-III

Community ecology: Nature of communities; community structure and attributes; analysis of communities (analytical and synthetic characters); levels of species diversity and its measurement; edges and ecotones.
Ecological succession: Types; mechanisms; changes involved in succession; concept of climax; models of succession, Ecological adaptations.

Unit-IV

Ecosystem ecology: Structure and function; energy flow and biogeochemical cycles; primary production and methods of measurement, global pattern and controlling factors; ecosystem restoration.
Biomes: Distribution, climatic and edaphic, floral and faunal characteristics of major terrestrial biome.

Books recommended

1. Sharma, P.D., 2010, Ecology and environment, 8th Edition, Rastogi Pub. Meerut.
2. Odum, E.P., 1983, Basic Ecology, Sanders, Philadelphia.
3. Singh, J. S., Singh, S. P. and Gupta, S. R., 2006, Ecology, Environment and Resource Conservation, Anamaya Publishers, New Delhi.
4. Smith, R. L., 1996, Ecology & Field Biology, Harper Collins, New York.

18BOT23DA1: Plant Reproduction

Time : 3 hours **Max. Marks : 80**
Credits : 4:0:0

Note: The question paper will consist of five Units. Each of the units I to IV will contain two questions and the students shall be asked to attempt one question from each. Unit-V shall be compulsory and will contain eight short answer type questions without any internal choice covering the entire syllabus.

Unit-I

Male gametophyte: Structure of anther; microsporogenesis; role of tapetum; pollen development and gene expression; male sterility, sperm dimorphism; pollen germination; pollen tube growth and guidance, pollen storage; pollen allergy.

Unit-II

Female gametophyte: Ovule development; megasporogenesis; organization of embryo sac; structure and functions of embryo sac cells.
Pollination: Floral characteristics, mechanisms and vectors.
Pollen-pistil interaction and fertilization: structure of the pistil; pollen stigma interactions, Self incompatibility- SSI and GSI (cytological, biochemical and molecular aspects); Double fertilization; in-vitro fertilization.

Unit-III

Seed Development: Endosperm development during early maturation and desiccation stages; embryogenesis-ultrastructure and nuclear cytology. Storage proteins of endosperms and embryo; Polyembryony; Apomixis; Embryo culture.

Unit-IV

Fruit Growth: Dynamics of fruit growth; Biochemistry and molecular biology of fruit maturation. Dormancy: Importance and types of dormancy; seed dormancy; methods of overcoming seed dormancy.

Books recommended

1. Bhojwani, S. S. and Bhatnagar, S. P., 2004, The Embryology of Angiosperms, Vikas Publishing House Pvt. Ltd.. New Delhi.
2. Johri, B. M., 1984, Embryology of Angiosperms, Springer, Netherlands.
3. Takhtajan, A. L., 1997, Diversity and Classification of Flowering Plants, Columbia University Press, New York.

18BOT23DA2: Evolutionary and Economic Botany

Time : 3 hours **Max. Marks : 80**
Credits : 4:0:0

Note: The question paper will consist of five Units. Each of the units I to IV will contain two questions and the students shall be asked to attempt one question from each. Unit-V shall be compulsory and will contain eight short answer type questions without any internal choice covering the entire syllabus.

Unit-I

Evolutionary Biology: Origin of life (including aspects of prebiotic environment and molecular evolution); Concept of evolution; Theories of organic evolution; Mechanisms of speciation.
Hardyweinberg genetic equilibrium, genetic polymorphism and selection; origin and evolution of economically important microbes and plants.

Unit-II

Origin of agriculture: World centers of primary diversity of domesticated plants; Plant introduction; Secondary centers of origin.
Plant as a source of renewable energy; Innovations for meeting world food demands.

Unit-III

Botany, cultivation and uses of

a. Food, forage and fodder crops (cereals, pulses, vegetables and fruits)

b. Fiber yielding plants

c. Medicinal plants

d. Aromatic plants

e. Oil yielding plants

Unit-IV

Important fire-wood, timber-yielding plants and Non-wood forest products (NWFPs) such as-Bamboos, rattans, raw materials for paper-making, gums, tannins, dyes and resins.
Plants used as avenue trees for shade, pollution control and aesthetics.

Books recommended

1. Rastogi, V. B., 2009, Organic Evolution, Kedar Nath Ram Nath, New Delhi.

2. Darwin, C., 1995, Origin of Species, The Harvard Classics, New York.

3. Kochhar, S. L., 2009. Economic Botany in Tropic, Macmillan and Co., New Delhi.

4. Swaminathan, M. and Kochhar, S. L., 1989. Plants and Society, Macmillan Publishers Ltd.

5. Wickens, G. E., 2004, Economic Botany: Principles and Practices, Springer, Kuwer Publishers, Dordrecht, Netherlands

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18BOT23DB1: Recombinant DNA Technology

Time : 3 hours **Max. Marks : 80**
Credits : 4:0:0

Note: The question paper will consist of five Units. Each of the units I to IV will contain two questions and the students shall be asked to attempt one question from each. Unit-V shall be compulsory and will contain eight short answer type questions without any internal choice covering the entire syllabus.

Unit-I

Principles of Genetic Engineering: Historical account, Components Nucleic acids, DNA modifying enzymes, Cloning vectors and Cloning hosts, Gene transfer and cloning methods, Gene Screening and isolation -Strategies, DNA libraries, Probe Selection and gene screening.

Unit-II

PCR and DNA sequencing: PCR Principle, Methodology, Types - RT-PCR, RAPD, AFLP, ISSR, inverse PCR and Real time PCR and their applications, DNA sequencing methods - Maxam and Gilbert's method, Sanger's method, Automated DNA sequencing method, Capillary gel electrophoresis for DNA sequencing.

Unit-III

Molecular markers: Type of molecular markers; Application of molecular markers in discerning polymorphism, germplasm characterisation, Gene tagging; Disease diagnostics; Marker aided selection in crop improvement.
DNA Engineering techniques: Gel electrophoresis of nucleic acids, Methods of labelling of DNA, Blotting of macromolecules and hybridization, Oligonucleotide synthesis, Promoter characterization, DNA fingerprinting, Microarray technology, In-vitro translation.

Unit-IV

Application r-DNA technology: (Production of recombinant protein, Vaccine and pharmaceutical compounds; application in agriculture, Fluorescence in situ hybridization (FISH).
Proteomics: Tools techniques, study of protein- protein interaction, protein analysis for gene identification, post translation modification.

Books recommended

1. Wilson, K. and Walker, J., 2010, Biochemistry and Molecular Biology, 6th Edition, Cambridge University Press, New York.
2. Debnath, M., 2005, Tools & Techniques of Biotechnology, Pointer Publishers.
3. Cooper, T. G., 1977, The Tools of Biochemistry, Wiley-Interscience publication.
4. Chawla, H. S., 2004, Introduction to Plant Biotechnology 2nd Edition, Oxford & IBH Publishing Co. Pvt. Ltd. New. Delhi.
5. Singh, B. D., 2007, Biotechnology, Kalyani Publishers, New Delhi.
6. Morris, M. D., 2016, Molecular Biotechnology, 1st Edition, CBS Publishers and Distributors, New Delhi.

18BOT23DB2: Genetics of Medicinal Plants

Time : 3 hours **Max. Marks : 80**
Credits : 4:0:0

Note: The question paper will consist of five Units. Each of the units I to IV will contain two questions and the students shall be asked to attempt one question from each. Unit-V shall be compulsory and will contain eight short answer type questions without any internal choice covering the entire syllabus.

Unit-I

History & philosophics of herbal medicine (Ayurveda, Unani), Importance and need of cultivation of medicinal and aromatic plants; Harvesting, drying, grading and storage of medicinal plants; Organic cultivation of medicinal plants; Good agricultural practices in medicinal plants.

Unit-II

Active constituents and uses of important medicinal and aromatic plants:

Asparagus racemosus, Stevia rebaudiana, Aloevera, Withania somnifera, Solanum nigrum Cassia angustifolia, Rosa damascena, Tagetes minuta, Salvadora species, Cassia tora, Cassia occidentalis, Boerhavia diffusa, Achyranthes aspera, Ncytanthus arbor-tristis, Balanites aegyptiaca, Tridex procumbens or any other species specific to the region.

Unit-III

Molecular biology of plant natural products: Genes involved in biosynthetic pathways of plants, Families of metabolic genes and their evolution (Gene families & their evolution, cytochrome, P450 genes):Expression of metabolism genes; Molecular biology tools used in natural products research; Application of molecular biology approaches to natural products.

Unit-IV

Separation and purification of phytopharmaceuticals through thin layer chromatography and column chromatographic techniques; Extraction of essential oils and their evaluation for quality parameters; Natural products and plant biodiversity; Plant cell biotechnology for the production of secondary metabolities, Metabolic engineering of plant secondary metabolism; Molecular farming, Transferring genes from plants to rhizophere microbes and vice-versa.

Books recommended

1. Farooqi, A. A. and Sreeramu, B. S., 2004, Cultivation of Medicinal and Aromatic Crops. Universities Press (India) Private Ltd.
2. Handa, S. S., 1996, Supplement to Cultivation and Utilization of Medicinal Plants, Regional Research Laboratory, CISR.
3. N. Kumar, J. B. M. Md. Abdul Khadar, P. Rangaswami, and I. Irulappan, Introduction to Spices, Plantation Crops, Medicinal and Aromatic Plants, 1997, South Asia Books.
4. Cseke L. J., Kirkasyan A., Kaufman P. B., Warber S. L., Duke J. A. and Brielmann H. L., Natural Products from Plants, 2006, Taylor and Francis group, CRC Press.

18BOT23OE: Plant Resource Utilization

Time : 3 hours **Max. Marks : 80**
Credits : 3:0:0

Note: The question paper will consist of five Units. Each of the units I to IV will contain two questions and the students shall be asked to attempt one question from each. Unit-V shall be compulsory and will contain eight short answer type questions without any internal choice covering the entire syllabus.

Unit-I

Origin of Agriculture, World Centres of Primary diversity of domesticated plants: The Indo- Burma Centre, Plant Introductions and Secondary Centres. Origin, Distribution, Types, Botany, Cultivation, Harvesting and uses of Wheat and Rice. History, Botany, Breeding, Cultivation and uses of following fruits and vegetables: Mango, Apple, Banana, Potato, Alliums, Cabbage, Spinach and Tomato

Unit-II

General Account of the Spices: Ginger, Turmeric, Cinnamon, Clove, Umbelliferous spices and Peppers.
Beverage Plants: Source and general account of Tea and Coffee.
Legumes: Origin, Botany, Cultivation and uses of Pigeon pea, Chick pea, Cluster bean, French bean etc.
Medicinal Plants: Plants as sources of drugs, parts used, composition and uses.

Unit-III

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

Unit-IV

Wood and its Uses: Soft woods and hard woods, wood as fuel, construction material Unexploited plants of potential economic value; plants as a source of renewable energy. Genetic Resources and their conservation.

Books recommended

1. Anonymous. National Gene Bank: Indian Heritage on Plant Genetic resources (Booklet). National Bureau of Plant Genetic Resource, New Delhi. 1997.
2. Cobley, L.S. and W.M. Steels. An Introduction to the Botany of Tropical Crop Plants.3rd Ed. The English Language Book Society and Longman, London. 1979.
3. Bole, P.V. and Y. Vaghani. Filed Guide to Common Indian Trees. Oxford University Press, Mumbai. 1991.

4. Chandel, K.P.S., G. Shukla and N. Sharma. Biodiversity in Medicinal and Aromatic Plants in India: Conservation and Utilization. National Bureau of Plant Genetic Resources, New Delhi. 1996.

5. Conway, G. and V.W.Rattan. The Doubly Green Revolution. Food for all in the 21st Century. Cornell Univ. Press. 1999.

6. Dastur, J.F., Medicinal Plants of India and Pakistan, 3rd Edition, Meyerbooks, 1985.

7. Hill, A.F. Economic Botany. McGraw Hill Book Co. Inc., New York. 1986.

8. Kirtikar, K.R. & D.D. Basu. Indian Medicinal Plants. Vols. I & II. 2nd Ed. Lalit Mohan Basu, Allahabad. 1953.

9. Kochhar, S.L. Economic Botany of the Tropics.2nd Ed. MacMillan India Ltd., Delhi.

10. Leonard, W.H. & J.H. Martin. Cereal Crops. MacMillan Co., New York, USA. 824 pp. 1963.

18BOT23LC1: Lab Course -1

Time : 6 hours **Max. Marks : 100**

Suggested Laboratory Exercises

1. Demonstration of stomatal activity from suitable plant material.
2. To study plant responses to red and far-red light.
3. Bioassay of auxin, cytokinin and gibberellins.
4. Effect of plant hormones on growth.
5. To study the effect of plant hormones on enzymatic activity.
6. To study the effect of salt and water stress on seed germination and plant growth in terms of metabolites.
7. To study the physical characteristics (temperature, colour and texture) of soil.
8. To determine water holding capacity of soils collected from different locations.
9. To determine pH and conductivity of soils collected from different locations.
10. Chemical testing of soil for phosphorus, potassium and nitrate.
11. To determine percentage organic carbon and organic matter in the soils of crop land, grassland and forest.
12. To determine the pH and conductivity of water samples collected from different locations.
13. To estimate the dissolved oxygen content in eutrophic and oligotrophic water samples.
14. To record the abiotic components i.e. pH, temperature, turbidity and light intensity of water in a pond ecosystem.
15. To determine the minimum size of the quadrat by species- area curve.
16. To study the community by quadrat method by determining frequency, density and abundance of different species present in the community.
17. Determination of species diversity index and importance value index of local vegetation.
18. To compare protected and unprotected grasslands using community coefficients (similarity index).
19. To study the species composition of an area for analyzing biological spectrum and comparison with Raunkiaers normal biological spectrum.
20. To survey and study the ecological adaptations of locally available hydrophytes and xerophytes.
21. Field visit of any protected area and to discuss causes and impacts of biodiversity loss.

18BOT23LC2: Lab Course -2

Time : 6 hours **Max. Marks : 100**

Suggested Laboratory Exercises based on 18BOT23DA1

1. Study of microsporogenesis and gametogenesis in sections of anthers.
2. Examination of modes of anther dehiscence and collection of pollen grains for microscopic examination (maize, grasses, *Cannabis sativa, Tradescantia, Crotolaria, Brassica, Petunia, Solanum melongena,* etc.).
3. Tests for pollen viability using stains and in vitro germination. Pollen germination using hanging drop and sitting drop cultures, suspension culture and surface cultures.
4. Estimating percentage and average pollen tube length in vitro.
5. Role of transcription and translation inhibitors on pollen germination and pollen tube growth.
6. Pollen storage, pollen pistil interaction, self incompatibility, in vitro pollination.
7. Study of ovules in cleared peparations; study of monosporic, bisporic and tetrasporic type of embryosac development through examination of permanent, stained serial sections.
8. Field study of several types of flowers with different pollination mechanisms (wind pollination, thrips pollination, bee/butterfly pollination, bird pollination).
9. Emasculation, bagging and hand pollination to study pollen germination, seed set and fruit development using self compatible and obligate out crossing systems. Study of cleistogamous flowers and their adaptations.
10. Study of nuclear and cellular endosperm through permanent slides.
11. Isolation of zygotic globular, heart shaped, torpedo stage and mature embryos from suitable seeds and polyembryony in citrus, jamun, etc.by dissections.
12. Study of seed dormancy and methods to break dormancy.

Suggested Laboratory Exercises based on 18BOT23DA2

The practical course is divided into three units:

(i) Laboratory Work

(ii) Field Survey

(iii) Scientific Visits

(i) Laboratory Work

Food Crops: Wheat, Rice, Maize, Potato, Chickpea(Bengal gram), Sugarcane.

Morphology, anatomy, microchemical tests for stored food materials.

Fodder Crops:Sorghum, Bajra, Berseem, Guar, Oat.

Plant Fibres: Cotton, Jute, Sun hemp, Coir.

Medicinal and Aromatic Plants: Study of live or herbarium specimens or other visual materials to become familiar with following plants:
Papaver somniferum, Atropa belladona, Catharanthus roseus, Adhatoda zeylanica, Allium sativum, Rauwolfia serpentine, Withania somnifera, Phyllanthus niruri, Andrographis paniculata, Aloe barbadensis, Mentha arvensis, Ricinus communis, Abutilon indicum, Datura sp., Artemisia sp., Pedalium murex, Ocimum sanctum, Vetiveria zizanoides, Cymbopogon maritini. Gums, Resins, Tannins, Dyes: Acacia, Terminalia, Tea, Turmeric, Bixa orellana, Indigo, Butea monosperma, Lawsonia inermis.

(ii) Field Survey

Prepare a list of important sourses of firewood and timber in your locality. Give their local names, scientific names and families to which they belong.

(iii) Scientific visits
Students should be taken to any protected area, a recognized botanical garden or museum (such as FRI, BSI, NBRI), to a CSIR laboratory doing research on plants and their utilization and an ICAR research institute or a field station dealing with crops.

Suggested Laboratory Exercises based on 18BOT23DB1

1. Extraction of total nucleic acid DNA from plant tissues.
2. Extraction of total nucleic acid RNA from plant tissues
3. Determination of RNA concentration by orcinol method.
4. Quantitative determination of DNA and RNA by Spectrophotometric method.
5. Sodium Dodecyl Sulfate-Polyacrylamide Gel Electrophoresis (SDS-PAGE) for protein profiling.
6. Protein quantification by Bradford method.
7. To determine the Tm of given sample DNA.
8. To study PCR (Polymerase Chain Reaction).

Suggested Laboratory Exercises based on 18BOT23DB2

1. Identification and preparation of herbaria of locally available medicinal plants
2. Preparation of aqueous extracts of medicinal plants by using Soxhlet apparatus

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Under Choice Based Credit System
w.e.f. Session 2018-19

Semester-IV

Core Courses

Course Code	Title of the Course	Theory Marks	Internal Marks	Practical Marks	Credits L:T:P
18BOT24CC1	Plant Genetics	80	20	-	4:0:0
18BOT24CC2	Biodiversity Conservation	80	20	-	4:0:0
18BOT24CC3	Tools and Techniques	80	20	-	4:0:0

Lab Course

Course Code	Title of the Course	Theory Marks	Internal Marks	Practical Marks	Credits L:T:P
18BOT24LC	Lab Course (18BOT24CC1 to CC3)	-	-	150	0:0:6

Project/Field Work/Dissertation/Group Seminars

Course Code	Title of the Course	Theory Marks	Internal Marks	Practical Marks	Credits L:T:P
18BOT24CC4	Project Report based on Field Excursion on Industrial training/visit	-	-	100	0:0:4

Total Credits : 22

Total Credits of the Programme : 30 + 26 + 27 + 22 = 105

Note: The criteria for awarding internal assessment of 20 marks for each paper shall be as under :

(i) Sessional test : 10 marks

(ii) Assignment/Presentation : 5 marks

(iii) Attendance : 5 marks

Less than 65% : 0 marks

65% and above but upto 70% : 2 marks

Above 70% but upto 75% : 3 marks

Above 75% but upto 80% : 4 marks

Above 80% : 5 marks

18BOT24CC1: Plant Genetics

Time : 3 hours **Max. Marks : 80**
Credits : 4:0:0

Note: The question paper will consist of five Units. Each of the units I to IV will contain two questions and the students shall be asked to attempt one question from each. Unit-V shall be compulsory and will contain eight short answer type questions without any internal choice covering the entire syllabus.

Unit-I

Cytology: Chromosome structure and packaging of DNA; molecular organization of centromere and telomere; euchromatin and heterochromatin.
Karyotype analysis; banding patterns; karyotype evolution; specialized types of chromosomes: polytene, lampbrush, B-chromosomes and sex chromosomes.

Unit-II

Structural and numerical alterations in chromosomes: Mutations, mutagens and their molecular mechanisms of occurrence; Site directed mutagenesis; DNA repair mechanisms; Transposable elements; DNA methylation.
Origin, meiosis and breeding behavior of deficiency, duplication, inversion and translocations in chromosomes; Robertsonian and B-A translocations.

Unit-III

Mapping of bacteriophage genome; genetic recombination in phage; genetic transformation, conjugation and transduction in bacteria.
Genetic fine structure; cis-trans test; Heterochromatization; Dosage compensation and mechanism of sex determination.

Unit-IV

Genetic recombination and mapping: Recombination; independent assortment and crossing over; molecular mechanisms of recombination; role of RecA and RecBCD enzymes; site-specific recombination.
Chromosome mapping; linkage groups; physical mapping; construction of molecular maps; correlation of genetic and physical maps; somatic cell genetics- an alternative approach to gene mapping.

Books recommended

1. Singh, B.D. 2014. Genetics, Kalyani Publishers, New Delhi.
2. Gardner, E.J., Simmons, M.J. and Snustad, D.P. 2006. Principles of Genetics, John Wiley and Sons.
3. Snustad, D.P. and Simmons, M.J. 2015. Principles of Genetics, John Wiley and Sons.
4. Campbell, N.A. and Reece, J.B. 2016. Biology, 8th Edition, Pearson Benjamin Cummings, SanFrancisco.

5. Pierce, Benjamin, A. 2013. Genetics: A Conceptual Approach, 4th Edition, W.H. Freeman Palgrave Macmillan International Edition.

6. Karp, G. 2013. Cell and Molecular Biology; Concepts and Experiments, 6th Edition, John Wiley and Sons Inc.

7. Lodish, H., Berk, A., Zipursky, S.L., Matsudaira, P., Baltimore, D. and Darnell, J. 2007. Molecules Cell Biology, 4th Edition, W.H. Freeman Co. New York.

18BOT24CC2: Biodiversity Conservation

Time : 3 hours **Max. Marks : 80**
Credits : 4:0:0

Note: The question paper will consist of five Units. Each of the units I to IV will contain two questions and the students shall be asked to attempt one question from each. Unit-V shall be compulsory and will contain eight short answer type questions without any internal choice covering the entire syllabus.

Unit-I

Biodiversity: concept; national & global status; endemism, speciation and extinction; levels of biodiversity, hotspots and hottest hotspots; study of Indian biodiversity hot spot, significance of biodiversity; local plant diversity and its socio-economic importance, causes of biodiversity depletion, ICUN categories of threat; Red Data Books.

Unit-II

Principles of conservation, major approaches to management, Biodiversity Conservation strategies, Protected areas in India - Wildlife sanctuaries; National parks; Biosphere reserves; Wetlands and Ramsar convention, Role of botanical gardens, seed banks, in- vitro repositories and cryobanks in biodiversity conservation.

Unit-III

Plant explorations; invasions and introductions; National Bureau of Plant Genetic Resources (NBPGR), Convention of Biological Diversity (CBD), Indian initiatives in biodiversity conservation, National Biodiversity Authority (NBA), Importance of Ethnobotany in Indian context; Farmers Rights and Intellectual Property Rights.

Unit-IV

Phytogeography and forest types of India - Ecological and economic importance of forests, afforestation, deforestation and social forestry; endangered plants, endemism, invasive species; desertification and wasteland reclamation, energy plantations; Effects of global warming, climatic change and stratospheric ozone depletion on plant diversity.

Books recommended

1. Odum, E.P. 1983. Basic Ecology, Sanders, Philadelphia.
2. Singh, J.S., Singh, S.P. and Gupta, S.R.2006. Ecology, Environment and Resource Conservation, Anamaya Publishers, New Delhi.
3. Smith, R.L. 1996. Ecology & Field Biology, Harper Collins, New York.

18BOT24CC3: Tools & Techniques

Time : 3 hours **Max. Marks : 80**
Credits : 4:0:0

Note: The question paper will consist of five Units. Each of the units I to IV will contain two questions and the students shall be asked to attempt one question from each. Unit-V shall be compulsory and will contain eight short answer type questions without any internal choice covering the entire syllabus.

Unit-I

Microscopy: Light Microscopy-Introduction, Geometrical optics, Image formation, Magnification and Resolution, Lens aberrations, Distortion of image and curvature of field; Types of microscopes-Compound, Comparison, Fluorescence, Polarized, Stereo, Their basic principles, working and applications; Electron Microscopy- Introduction, Historical review, Scanning electron microscopy (SEM), Transmission electron microscopy (TEM), Theory and basic principles, Instrumentation, applications.

Unit-II

Principles and techniques of nucleic acid hybridization and cot curves; Sequencing of nucleic acids; Southern, Northern and Western blotting techniques; Protein sequencing, Polymerase chain reaction (PCR), Real Time-PCR, Methods for measuring nucleic acid and protein interaction. Electrophoresis: Principle, procedure and application of- Agarose, PAGE, SDS-PAGE, Pulse field electrophoresis, Paper cellulose acetate and High voltage electrophoresis; Isoelectric focusing (IEF).

Unit-III

Biophysical methods: Analysis of biomolecules using UV/visible, fluorescence, circular dichroism, NMR and ESR spectroscopy; Structure determination using X-ray diffraction and NMR analysis using light scattering; Different types of mass spectrometry and surface plasma resonance methods; Computation methods; Nucleic method and protein sequence databases, data mining method for sequence searches, motif analysis and prediction.

Unit-IV

Principle and applications of gel filtration, ion exchange & affinity chromatography; Thin layer chromatography; Gas chromatography; GLC; High pressure liquid chromatography (HPLC), Fast protein liquid chromatography (FPLC); Ultracentrifugation (Velocity and buoyant density).
Nature Radioactivity, detection and measurement, construction and use of scintillation counters, Autoradiography, preparation of labelled compounds. Applications in biological sciences, use of non radioactive compounds.

Books recommended

1. Wilson, K. and Walker, J. 2010. Principles and Techniques of Biochemistry and Molecular Biotechnology, 7th Edition, Cambridge University Press, New York.

2. Cooper, T.G. 2011. Electrophoresis. In: The Tools of Biochemistry, John Wiley & Sons, New York.

3. Debnath, M. 2011. Tools and Techniques of Biotechnology, Aavishkar Publishers, Jaipur.

4. Brown, T.A. 2015. Gene Cloning and DNA Analysis: An Introduction, 7th Edition, Blackwell Publication.

5. Singh, B.D. 2007. Biotechnology, Kalyani Publishers, New Delhi.

6. Morris, M.D. 2016. Molecular Biotechnology, 1st Edition, CBS Publishers and Distributors, New Delhi.

18BOT24LC: Lab Course

Time : 6 hours **Max. Marks : 150**

Suggested Laboratory Exercises

1. Study the mitotic complement of chromosomes in *Allium cepa*.
2. Karyotyping of mitotic metaphase chromosomes complements for cytological characterization of chromosomes in the genome.
3. Preparation of slides to study of meiosis in plant pollen mother cells recording structural changes in chromosomes during reduction division cycle.
4. Study chromosome associations' consequent to structural changes (*Tradescantia*).
5. Study meiotic chromosomes configurations in polyploid plants.
6. To study chromosomal banding pattern.
7. Development of physical linkage maps.
8. To demonstrate the results of genetic crosses for the linkage and crossing over.
9. Numericals on gene mapping.
10. Determination of molecular weight of a given protein by gel filtration chromatography
11. To demonstrate Gram-staining of bacteria
12. Separation of pigments from leaves or flowers by adsorption chromatography.
13. Separation and identification of amino acids by thin layer chromatography.
14. Demonstration of working of different types of microscopes.
15. Demonstration of Chromatography i.e. TLC, HPLC, GC.
16. To demonstrate the separation of proteins with the help of electrophoresis.
17. To study various molecular biology techniques i.e. PCR, ELISA.
18. To demonstrate the use of spectrophotometer.
19. Purification of protein by column chromatography.
20. Visit of various laboratories in the institutes/universities.

18BOT24CC4: Project Report based on Field Excursion on Industrial training/visit

Time : 6 hours **Max. Marks : 100**

Suggested Laboratory Exercises

1. Project Report based on Field Excursion on Industrial training/visit etc as per requirement of the curriculum.
2. Report + Viva voce by external examiner = 50 + 50 marks