B.Sc BOTANY: Semester –V

Title of the Course: Plant Morphology and Taxonomy

Number of Theory Credits	Number of lecture hours/semester	Number of Practical Credits	Number of Practical hours/Semester
4	60	2	56

Course outcome:

1. Understanding the main features in Angiosperm evolution and ability to identify, classify and describe a plant in scientific terms, thereby, Identification of plants using dichotomous keys. Skill development in identification and classification offlowering plants.

2. Interpret the rules of ICN in Botanical nomenclature.

3. Classify Plants systematically and recognize the importance of Herbarium, Virtual Herbarium and Botanical gardens.

4. Recognition of locally available angiosperm families, plants and economically important plants. Appreciation of human activities in conservation of useful plants.

Content of Theory course **60 hrs**

Unit - 1 **15 hrs**

Morphology of Root – Tap root and Adventitious root modifications, Stem – Underground, Sub-aerial and Aerial and Leaf – parts, phyllotaxy, modifications for various functions. Inflorescence – Racemose, Cymose and Special types. Structure and variations of flower. Fruits- Simple, aggregrate and Multiple.

Introduction to Taxonomy: Brief History, objectives, scope and relevance of Taxonomy.

Taxonomic literatures: Floras, Monograph, Revisions, Journals and *Hortus Malabaricus*.

Herbaria and Botanical gardens: Important herbaria and botanical gardens of the world and India and their importance. Technique of Herbarium Preparation.

Unit - 2 **15 hrs**

Systems of classification: Artificial, Natural and Phylogenetic; brief account of Linnaeus', Bentham & Hooker's, Engler and Prantl's system and APG System (IV- 2016). Merits and demerits of classifications.

Taxonomic Hierarchy: Concept of taxa (family, genus, species); Categories and taxonomic hierarchy; Species concepts (biological, morphological, evolutionary). Modes of speciation. Problems with species concepts.

Botanical Nomenclature: Principles and Rules of ICN and its Significance; Latest code. Brief account of Ranks of taxa.

Plant Taxonomic Evidences: from Palynology, Embryology, Cytology, Phytochemistry and molecular data. Field inventory.

Unit - 3 **15hrs**

Biometrics, Numerical Taxonomy; Phenetics and Cladistics: Characters; Variations; OTUs, character weighting and coding; Cluster analysis; Phenograms, cladograms (definitions and differences).

Origin and evolution of angiosperms; Co-evolution of gymnosperms and angiosperms Methods of illustrating evolutionary relationship (phylogenetic tree, cladogram).

Plant identification: Taxonomic dichotomous keys; indented (yoked) and bracketed keys. (brief account only).

Ethnobotany and its Significance, Sacred grooves

Unit - 4

Plant descriptions: Common terminologies used for description of vegetative and reproductive parts of the following families:

Study of the diagnostic features of Angiosperm families:

Dicotyledonous: Magnoliaaceae, Brassicaceae, Malvaceae, Rutaceae, Fabaceae (with sub Families), Myrtaceae, Cucurbitaceae, Apiaceae, Asteraceae, Apocynaceae, Asclepiadaceae, Solanaceae, Lamiaceae, Amaranthaceae, Euphorbiaceae,
Monocotyledonous : Liliaceae, Arecaceae, Musaceae, Orchidaceae and Poaceae

Pedagogy: Teaching and learning, Seminar, Assignments, etc

Formative Assessment for Theory	
Assessment Occasion/ Type	**Marks**
Test	10
Assignment	10
Test	10
Seminar/Assignment	10
Total	**40 Marks**

References	
1	Baker. H.G. 1970. Plant and Civilization, Wadsworth Publishing Company.
2	Colton C.M. 1997. Ethnobotany – Principles and applications. John Wiley and sons –Chichester
3	Cotton, C.M. 1996. Ethnobotany – Principles and Applications. Wiley and Sons
4	Datta S C, *Systematic Botany*, 4th Ed, Wiley Estern Ltd., New Delhi, 1988.
5	Eames A. J. - *Morphology of Angiosperms* - Mc Graw Hill, New York.
6	Hall, B.G. (2011). *Phylogenetic Trees Made Easy: A How-To Manual*. Sinauer Associates,
7	Heywood - *Plant taxonomy* - Edward Arnold London.
8	Jeffrey C .J. and A. Churchil - *An introduction to taxonomy* – London.
9	Jeffrey, C. (1982). An Introduction to *Plant Taxonomy.* Cambridge University Press, Cambridge
10	Judd, W.S., Campbell, C.S., Kellogg, E.A., Stevens, P.F., Donogue, M.J., 2002. *Plant Systematics: A Phylogenetic approach*, 2nd edition. Sinauer Associates, Inc., USA.
11	Lawrence - *Taxonomy of Vascular Plants* - Oxford & I B H, New Delhi.
12	Manilal, K.S. and M.S. Muktesh Kumar 1998. *A Handbook on Taxonomy Training*. DST, NewDelhi.
13	Manilal, K.S. and A.K. Pandey, 1996. *Taxonomy and Plant Conservation*. C.B.S. Publishers &Distributors, New Delhi.
14	Manilal, K.S. 2003. *Van Rheede'sHortusMalabaricus. English Edition*, with Annotations and Modern Botanical Nomenclature. (12 Vols.) University of Kerala, Trivandrum.
15	Naik V.N., *Taxonomy of Angiosperms*, 1991. Tata Mcgraw-Hill Pub. Co. Ltd., New Delhi.
16	Pandey, S. N, and S.P. Misra (2008)-*Taxonomy of Angiosperms*- Ane Books India, New Delhi.
17	Radford A B, W C Dickison, J M Massey & C R Bell, *Vascular Plant Systematics*, 1974, Harper & Row Publishers, New York.
18	Singh G.2012. *Plant systematics: Theory and Practice*. Oxford and IBH, Pvt. Ltd., New Delhi.
19	Singh V. & Jain - *Taxonomy of Angiosperms* - Rastogi Publications, Meerut.
20	Sivarajan V. V - *Introduction to Principles of taxonomy* - Oxford &I B H New Delhi.

Content of Practical course: List of Experiments to be conducted

1. Study of root, stem and leaf modifications.
2. Study of Inflorescence and Fruits
3. Study of flower and its parts, Floral diagram and floral formula.

4-12. Study of Dicot families mentioned in theory with at least one example for each family and make suitable diagrams, describe them in technical terms (Description, V.S. flower, section of ovary, floral diagram/s, floral formula/e and systematic position according to Bentham & Hooker' system of classification) and identify up to species using the flora***

12-13. Identify plants/plant products of economic importance: Binomial name, Family and part used and uses.

- Oil yielding plants: Groundnut, Sunflower, Safflower, Coconut, Ricinus
- Fibre yielding plants: Cotton, jute and Coir
- Beverages: Tea, Coffee and Cocoa
- Pulses: Red gram, Green gram, Horse gram, Black gram and Bengal gram
- Cereals: Rice, Wheat and Ragi
- Sugar yielding plant: Sugar cane
- Rubber yielding plants: Rubber
- Dye yielding: Indigo
- Spices: Asafoetida, Cumin, Coriander, Ginger, Turmeric
- Starch yielding plant: Tapioca
- Narcotic Plants: Tobacco, cannabis and Opium
- Biodiesel Plants: Jatropha and Pongamia

14. Medicinal Plants: *Annona muricata, Catharanthus roseus, Rauwolfia serpentina, Justicia adhatoda, Vitex negundo, Withania somnifera* and *Leucas aspera*.

15. **Field visit***: Local or outside area/ Botanical garden/ tribal settlements minimum 3 to 5 days.
Submission: Record book, Tour report and Herbarium

(Preparation of 05 properly identified herbarium specimens; mounting of a properly dried and pressed specimen of any common plants from your locality with herbarium label).

Pedagogy: Teaching and learning, conducting experiments, field visits,

Formative Assessment for Practical	
Assessment Occasion/ Type	**Marks**
Continuous assesment	05
Test	05
Field visit/ Tour Report	05
Record	05
Submission (Herbarium)	05
Total	**25 Marks**

SCHEME OF PRACTICAL EXAMINATION

(Distribution of marks): 25 marks for the Semester end examination

1. Identify, classify and describe the specimen A, B & C taxonomically — 9 Marks
2. Describe the plant D using technical terms — 3 Marks
3. Write the floral diagram and floral formula of the given specimen E — 3 Marks
4. Identify the specimen F and G — 4 Marks
5. Comment on H, I and J — 6 Marks

Total: 25 Marks

General Instructions:

Q1. One each from Polypetalae, Gamopetalae and Monochlamydae/Monocotyledons

Q2. Specimen from family they studied.

Q3. Flower from studied plants.

Q4. Materials from morphology

Q5. Materials from Economic botany.

Note: Same Scheme may be used for IA (Formative Assessment) examination

Title of the Course: Genetics and Plant Breeding

Number of Theory Credits	Number of lecture hours/semester	Number of Practical Credits	Number of Practical hours/Semester
4	60	2	56

Course outcome:

1. Understanding the basics of genetics, plant breeding and cell biology

2. Ability to identify, calculate and describe crossing over, allelic generations and frequencies ofrecombination.

3. Interpret the results of mating and pollinations.

4. Recognition of modes of inheritance of traits/ phenotypes and Phenotype-genotype correlation.

Content of Theory course **60 hrs**

Unit - 1 **15 hrs**

Mendelism: History; Principles of inheritance; Mendelian genetics and its extension; Chromosome theory of inheritance; Autosomes and sex chromosomes.
Incomplete dominance and codominance. Multiple alleles, Lethal alleles, Epistasis,Polygenic inheritance; Pleiotropy. Penetrance and Expressivity.
Extrachromosomal Inheritance- Chloroplast mutation: Variegation in Four O'clock plant; Mitochondrial mutations in yeast.

Unit - 2 **15 hrs**

Linkage, crossing over and chromosome mapping; Linkage and crossing over-Cytological basis of crossing over; Recombination frequency, two factor and three factor crosses; Interference and coincidence; Gene mapping; Sex Linkage.
Gene mutations- Types of mutations; Molecular basis of Mutations; Mutagens – physical and chemical (Base analogs, deaminating, alkylating and intercalating agents); Detection of mutations: ClB method.

Fine structure of gene (Intron, muton and Recon), Evolutionary Genetics: Darwinism, Lamarckism , Hardy-Weinberg's Law, Role of natural selection, mutation, genetic drift. Genetic variation and Speciation.

Unit - 3 **15 hrs**

Ultrastructure and functions of cell wall, cell membrane and cell organelles (nucleus, mitochondria, chloroplast, Golgi apparatus, vacuole, endoplasmic reticulum, ribosome, spherosome and lysosome).
Phases of eukaryotic cell cycle: mitosis and meiosis. Regulation of cell cycle and significance of mitosis and meiosis. Structure and function of Chromosome, DNA and RNAs
Chromosomal aberrations: Structural and numerical variations in chromosomes

Unit - 4 **15 hrs**

Plant Breeding: Introduction and objectives. Breeding systems: modes of reproduction in crop plants. Important achievements and undesirable consequences of plant breeding.
Centers of origin and domestication of crop plants, plant genetic resources; Acclimatization, Selection methods- for self-pollination, cross pollination.
Hybridization: For self, cross in plants – Procedure, advantages and limitations.
Inbreeding depression and Heterosis, Applications.
Crop improvement and breeding Role of mutations; Polyploidy; Distant hybridization and role of biotechnology in crop improvement.
Plant Breeding work in India: Paddy, Cotton and Sugarcane (Breeding centres should be mentioned)
Scientist: N E Borlaug, M S Swaminathan, M Mahadevappa, C H Lakshmanaiah and Janaki Ammal

Pedagogy: Teaching and learning, Seminar, Assignments, etc

Formative Assessment for Theory	
Assessment Occasion/ Type	**Marks**
Test	10
Assignment	10
Test	10
Seminar/Assignment	10
Total	**40 Marks**

References	
1	Acquaah, G. (2007). Principles of Plant Genetics & Breeding. NewJearsey, U.S.: Blackwell Publishing.
2	Singh, B.D. (2005). Plant Breeding: Principles and Methods, 7th edition. New Delhi, Delhi: Kalyani Publishers.
3	Chaudhari, H.K. (1984). Elementary Principles of Plant Breeding, 2nd edition. New Delhi, Delhi: Oxford – IBH.
4	Gardner, E.J., Simmons, M.J., Snustad, D.P. (1991). Principles of Genetics, 8th edition. New Delhi, Delhi: John Wiley & sons
5	Griffiths, A.J.F., Wessler, S.R., Carroll, S.B., Doebley, J. (2010). Introduction to Genetic Analysis, 10thedition. New York, NY: W.H. Freeman and Co.
6	Klug, W.S., Cummings, M.R., Spencer, C.A. (2012). Concepts of Genetics, 10th edition. San Francisco, California: Benjamin Cummings
7	Raven, F.H., Evert, R. F., Eichhorn, S.E. (1992).Biology of Plants. New York, NY: W.H. Freeman and Co.
8	Welsh, J. R. (1981). Fundamentals of Plant Genetics and Breeding. John Wiley and Sons, New York.
9	Poehlman, J.M. (1987). Breeding Field Crops, 3rd Ed. AVI Publishing Co. Inc., Westport, Connecticut
10	Chopra, V.L. (2000). Plant Breeding: Theory and Practice 2nd Ed. Oxford & IBH, New Delhi.
11	Cooper, G.M., Hausman, R.E. (2009). The Cell: A Molecular Approach, 5th edition. Washington, D.C.: ASM Press & Sunderland, Sinauer Associates, MA
12	Karp, G. (2010). Cell Biology, 6th edition. New Jersey, U.S.A.: John Wiley & Sons.
13	De Robertis, E. D. P. and De Robertis R. E. 2009. Cell and Molecular Biology, 8th edition. Lippincott Williams and Wilkins, Philadelphia.
14	Becker W. M., Kleinsmith L.J. and Bertni G. P. 2009. The World of the Cell. 7th edition. Pearson Benjamin Cummings Publishing, San fransisco.
15	Reven, F.H., Evert, R.F., Eichhorn, S.E. (1992). Biology of Plants. New York, NY: W.H.Freeman and Company
16	Alberts, B., Bray, D., Hopkin, K., Johnson, A. D., Lewis, J., Raff, M., Roberts, K., & Walter, P. (2013). Essential cell biology (4th ed.). Garland Publishing.
17	Raven, F.H., Evert, R. F., Eichhorn, S.E. (1992). Biology of Plants. New York, NY: W.H. Freeman and Co.
18	Verma, P. S. (2004). Cell Biology, Genetics, Molecular Biology: Evolution and Ecology. India: S. Chand Limited.

Content of Practical course: List of Experiments to be conducted

1. Hybridization: Emasculation, bagging

2. Pollen viability test- Hanging drop and Histochemical test

3. Seed viability- TTC/Paper towel method/Standard Blotter method

4-5. Origin, distribution and centre of diversity of crop plants: Wheat, sorghum, rice, chilli, sugarcane, cotton, potato, coffee, sunflower and groundnut.

6. Charts related to plant breeding - N E Borlaug, M S Swaminathan, M Mahadevappa, C H Lakshmanaiah and Janaki Ammal

7-9. Genetic problems: 2 each from monohybrid, dihybrid, incomplete dominance and interaction of genes.

10.Study of aneuploidy: Down's, Klinefelter's and Turner's syndrome.

11. Study of Mitosis in onion root tips

12. Study of Meiosis in onion/ Chlorophytum flower buds.

13. Study of Micrometry

14. Karyotype (Onion)

Pedagogy: Teaching and learning, conducting experiments, field visits

Formative Assessment for Practical	
Assessment Occasion/ Type	**Marks**
Continuous assessment	05
Test	05
Submission and Report	10
Record	05
Total	**25 Marks**

SCHEME OF PRACTICAL EXAMINATION
(Distribution of marks): 25 marks for the Semester end examination

1. Solve the genetic problem A and B	8 Marks
2. Perform the experiment C	4 Marks
3. Comment on D	3 Marks
4. Perform or Comment on E	3 Marks
5. Make micropreparation of F	5 Marks
5. Identify Slide G	2 Marks

Total: 25 Marks

General Instructions:

Q1. One each from monohybrid/dihybrid and interaction of genes/linkage

Q2. Pollen/ seed viability and micrometry

Q3. Chart from Karyotype/Klinefelter syndrome/Turner's syndrome/Down's Syndrome

Q4. Perform emasculation and bagging/Vavilov's centres chart/Plant breeding charts

Q5. Mitosis/Meiosis

Q6. Permanent slide – Mitosis/Meiosis

GENETIC PROBLEMS

PROBLEMS ON MONOHYBRID CROSS

1. In Tomatoes Red fruit color (R) is dominant over yellow (r). A pure red fruited plant is crossed to a yellow fruited one. What will be the appearance of F1? The F1 are interbred and produce 320 off springs in the F2. Howmany of them will be red and how many yellow? What will be the genotypes of F2 and in what numbers ?

2. In pea plant, Tallness (T) is dominant over dwarfness (t). A tall pea crossed with dwarf produces offerings ofwhich 50% are tall and 50% are dwarf. What are the genotypes of the parents ?

PROBLEMS ON DIHYBRID CROSS

1. In garden pea, yellow seed color (Y) is dominant over green (y) and round seed shape (R) is dominant over wrinkled (r). The character pair segregate separately. A pure yellow wrinkled variety is crossed to a pure greenround. Give the phenotypes and genotypes of F1 and phenoypic ratio of F2 generation.

2. A tall red when crossed with dwarf red produces a dwarf white. Give the genotypes of the parents.

PROBLEMS ON INTERACTIN OF FACTORS

1. Two white flowered strains of the sweet pea (*Lathyrus odoratus*) were crossed, producing an F1 with onlypurple flowers. Random crossing among the F1 produced 96 progeny plants, 53 exhibiting purple flowers and43 with white flowers.

a) What phenotypic ratio is approximated by the F2?

b) What type of interaction is involved?

What were the probable genotype of the parental strains ?

PROBLEMS ON 2 POINT TEST CROSSES

1. In tomato, red fruit (R) is dominant over yellow fruit (r) and yellow flowers (W) are dominant over white flowers (w). A cross is made between true breeding plants with red fruit and yellow flowers and plants with yellow fruit and white flowers. The F1 generation plants are then test crossed to plants with yellow fruits andwhite flowers. The following results are obtained.

333 red fruits/ yellow flowers

64 red fruits/ white flowers

58 yellow fruits/ yellow flowers
350 yellow fruits/ white flowers
Calculate the map distance between the two genes.

2. Two different traits affecting pod characteristics in garden pea plants are enclosed by genes found on chromosome 5. Narrow pod is recessive to normal pod, yellow pod recessive to green pod. A true breeding plant with narrow, green pods was crossed to a true breeding plant with normal yellow pods. The F1 were then test crossed to plants with narrow, yellow pods. The following results were obtained.
144 normal green pods
150 narrow yellow pods
11 normal yellow pods
9 narrow green pods
How far apart are these two genes?

B.Sc BOTANY: Semester –VI

Title of the Course: Plant Physiology and Plant Biochemistry

Number of Theory Credits	Number of lecture hours/semester	Number of Practical Credits	Number of Practical hours/Semester
4	60	2	56

Course Outcome:

1. Importance of water and the mechanism of transport.
2. To understand biosynthesis and breakdown of biomolecules.
3. Role of plant hormones in plant development and about secondary metabolites.
4. Preliminary understanding of the basic functions and metabolism in a plant body.
5. To understand the importance of nutrients in plant metabolism and crop yield.

Unit -1 **15 hrs**

Plant water relations: Importance of Water as a solvent, Diffusion, osmosis, imbibition, osmotic pressure, osmotic potential, turgor pressure, wall pressure, water potential and its components. Mechanism of water absorption, Factors affecting water absorption.

Transpiration. Types and process. Mechanism of guard cell movement. K+ ion mechanism. Antitranspirants.

Mechanism of a**scent of sap:** Vital and physical force theories (TCT).

Phloem Transport: Transport of organic solutes. Path of transport, vein loading and unloading. Transcellular hypothesis, mass flow hypothesis.

ineral nutrition: A brief account of Micro and macro nutrients (N, P, K, Mg, Na; B, Cu, Zn, Mn, Mo)**.**

Unit - 2 **15 hrs**

Photosynthesis: Structure of Chloroplast, Photosynthetic Pigments (Chl a, b, xanthophylls, carotene); Photosystem I and II, reaction center, antenna molecules; Electron transport and mechanism of ATP synthesis; C3, C4 and CAM pathways of carbon fixation reactions; Photorespiration.

Respiration: Structure of Mitochondria, Aerobic and Anaerobic respiration: SGlycolysis, anaerobic respiration, TCA cycle; Oxidative phosphorylation, Glyoxylate, Oxidative Pentose Phosphate Pathway.

Unit - 3 **15 hrs**

Definition and classification of plant growth regulators- Hormones. influence on plant growth development of individual group of hormone- Auxins, Gibberlins, cytokinins, ABA, ethylene and its application.

Synthetic growth regulators- classification, their effect on plant growth and development. Practical utility of hormones in agriculture and horticulture**.**

Sensory Photobiology: Biological clocks, photoperiodism and vernalisation, function & structure of phytochromes, phototropin & cryptochromes. Senescence, Aging & Cell Death (PCD and Autophagosis). Plant Movements.

Unit - 4 **15 hrs**

Nitrogen metabolism: Biological nitrogen fixation; Nitrate and ammonia assimilation.
Proteins and amino acids: classification, structure - primary, secondary, tertiary and quaternary.
Enzymes- Properties, classification and mechanism of action (Lock and Key and Induced fit).
Vitamins - classification, distribution, function and effect on deficiency.
Lipid Metabolism: classification, structure, biosynthesis of fatty acids and functions.
Secondary plant products: Account on terpenes, phenolics and nitrogen containing compounds and their distribution.

References	
1	Fundamentals of Biochemistry 2nd Ed, John Wiley and Sons Inc. Wilson, K. and Walker, J. 1994
2	JainV K, 2008. Fundamentals of Plant Physiology.S Chand andCo.
3	Kochhar P L, Krishnamoorthy H N. Plant Physiology. Atmaram and sons, Delhi.
4	Kumar and Purohit. Plant Physiology: Fundementals and Applications.Agrobotanical Publishers.
5	Malik CP, 2002. Plant Physiology. Kalyani publishers.
6	Mukherjii S, Ghosh AK, 2005. Plant Physiology. New Central Book Agency, Culcutta.
7	Noggle GR, Fritz GJ, Introductory Plant Physiology.Prentice Hall of India.
8	Pandey SN, Sinha BK, 2006. Plant physiology.Vikas Publishing House, NewDelhi.
9	Salisbury F B, Ross C W, 1992. Plant Physiology. CBS publishers and Distributers, NewDelhi.
10	Sinha A K, 2004. Modern Plant Physiology. Narosa publishing House, NewDelhi.
11	Srivastava H S, 2004. Plant physiology and Biochemistry. Rasthogi publications.
12	Verma V, 2007.Text Book of Plant Physiology. Ane Books Pvt. Ltd.

Content of Practical course: List of Experiments to be conducted
1-6. Major experiment

To demonstrate root pressure / transpiration pull in plants.

To determine the osmotic pressure of the cell sap by plasmolytic method.

To demonstrate that oxygen is liberated in the process of photosynthesis. i. Effect of light intensity ii. Quality of light

Separation of photosynthetic pigments by paper chromatography and measure their Rf values.

Demonstration of Starch in the leaf.

Determination of stomatal index, Area of stomatal aperture and stomatal frequency

To demonstrate suction force due to transpiration pull

Estimation of diurnal fluctuation using CAM plants.

6-12. Minor Experiments

Experiment to demonstrate the phenomenon of exosmosis and endosmosis.

To demonstrate root pressure plants.

To compare the rate of transpiration from dorsiventral leaf by cobalt chloride paper method.

To demonstrate that CO2 is evolved during anaerobic respiration by gas flow method.

Experiment to demonstrate Geotrophism, Phototropism and Hydrotropism and Arc Auxonometer experiment

Determination of transpiration by Ganong's Potometer

Ganong's light screen experiment

Effect of Auxins

Instruments: Spectrophotometer, Centrifuge, Calorimeter

Mineral nutrition deficiency symptoms, Photoperiodism - Photographs

13. Biochemical test for Starch, Protein, Reducing Sugars and Lipids.

14. Industrial visit. **Pedagogy:**

Formative Assessment for Practical	
Assessment	**Marks**
C_1 = Test I	15 Marks
C_2 = Assignment + Project report / Industrial visit	5 + 5 =10 Marks
Total	**25 Marks**

SCHEME OF PRACTICAL EXAMINATION
(Distribution of marks): 25 marks for the Semester end examination

1. Conduct major experiment A	8 Marks
2. Comment on the experiment B, C and D	9 Marks
3. Micro chemical test of material E	4 Marks
4. Comment on Instrument and photograph F and G	4 Marks

Total: 25 Marks

B.Sc BOTANY: Semester –VI

Title of the Course: Plant Biotechnology

Number of Theory Credits	Number of lecture hours/semester	Number of Practical Credits	Number of Practical hours/Semester
4	60	2	56

Course outcome:

1. Explain the basics of the physiological and molecular processes that occur during plant growth and development and during environmental adaptations.
2. Understand how biotechnology has been used to develop knowledge of complex processes that occur in the plant.
3. Use basic biotechnological techniques to explore molecular biology of plants
4. Understand the processes involved in the planning, conduct and execution of plant biotechnology experiments
5. Explain how biotechnology is used for plant improvement and discuss the ethical implications of that use

Content of Theory course **60 hrs**

Unit - 1 **15 hrs**

Historical perspective; Composition of media; Nutrient and hormone requirements (role of vitamins and hormones); Totipotency; Organogenesis; Embryogenesis (somatic and zygotic); Protoplast isolation, culture and fusion; Tissue culture applications (micropropagation, androgenesis, virus elimination, secondary metabolite production, haploids, triploids and cybrids; Cryopreservation; Germplasm Conservation).

Unit - 2 **15 hrs**

Restriction Endonucleases (History, Types I-IV, biological role and application); Restriction Mapping (Linear and Circular); Cloning Vectors: Prokaryotic (pUC 18, pBR322, Ti plasmid, BAC); Lambda phage, M13 phagemid, Cosmid, Shuttle vector; Eukaryotic Vectors (YAC and briefly PAC, HAC).Gene Cloning (Recombinant DNA technology), Gene Construct; construction of genomic and cDNA libraries, screening DNA libraries to obtain gene of interest by genetic selection; complementation, colony hybridization; Probes-oligonucleotide, heterologous (Definitions), PCR, HGP and its significance

Unit - 3 **15 hrs**

Methods of gene transfer- Agrobacterium-mediated, Direct gene transfer by Electroporation, Microinjection, Micro projectile bombardment; Selection of transgenics– selectable marker and reporter genes (Luciferase, GUS, GFP).
Pest resistant (Bt-cotton); herbicide resistant plants (RoundUp Ready soybean); Transgenic crops with improved quality traits (FlavrSavr tomato, Golden rice); Improved horticultural varieties (Moondust carnations); Role of transgenics in bioremediation (Superbug); edible vaccines; Industrial enzymes (Aspergillase, Protease, Lipase); Biosafety concerns.

Unit - 4 **15 hrs**

Introduction to Bioinformatics- Definition, history, scope and applications.
Opportunities in Bioinformatics.
Introduction to Genomics, Proteomics, Metabolomics and Pharmacogenomics.Biological databases: Nucleotide databases, Protein databases. Genome databases.
Organization of data in NCBI, DDBJ, EBI, PDB, SwissPROT and software used.

Pedagogy: Teaching and learning, Seminar, Assignments, etc

Formative Assessment for Theory	
AssessmentOccasion/type	**Marks**
Test	10
Assignment	10
Test	10
Seminar/Assignment	10
Total	**40 Marks**

References	
1	Arthur M. Lesk. (2003). Introduction to Bioinformatics, Oxford University Press,Indian edition.
2	Des Higgins and Willie Taylor. (2000). Bioinformatics, Sequence, structure and databanks. A practical approach. Oxford University Press, Indian edition, Second impression, New Delhi.
3	ImtiazAlam Khan. (2005). Elementary bioinformatics. Pharma Book Syndicate, Hyderabad.
4	Krane Dan, E. and Raymer M.L. (2004). Fundamental concepts of Bioinformatics. Pearson education. New Delhi. Second Indian reprint.
5	Rastogi, S.C., Mediratta, N. and Rastogi. P. (2004). Bioinformatics, methods and applications, genomics, proteomics and drug discovery, Prentice hall of India, pvt. Ltd., New Delhi.

6	Baxevanis, A. D. and Ouellettee, B. F. F. (2002). Bioinformatics: A Practical Guide to the analysis of Genes and Proteins. (2nd Ed.), New York, John Wiley & Sons, Inc. Publications.
7	Attwood, T. K. and Parry-Smith, D. J. (2001). Introduction to Bioinformatics Delhi. Pearson Education (Singapore) Ptd. Ltd.
8	Bhojwani, S.S. and Razdan, M.K., (1996). Plant Tissue Culture: Theory and Practice. Elsevier Science Amsterdam. The Netherlands.
9	Glick, B.R., Pasternak, J.J. (2003). Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington
10	Bhojwani, S.S. and Bhatnagar, S.P. (2011). The Embryology of Angiosperms. Vikas Publication House Pvt. Ltd., New Delhi. 5th edition
11	Snustad, D.P. and Simmons, M.J. (2010). Principles of Genetics. John Wiley and Sons, U.K. 5th edition
12	Stewart, C.N. Jr. (2008). Plant Biotechnology & Genetics: Principles, Techniques and Applications. John Wiley & Sons Inc. U.S.A.

Content of Practical course: List of Experiments to be conducted

1. (a) Preparation of MS medium.
   (b) Demonstration of in vitro sterilization and inoculation methods using leaf and nodal explants of Tobacco/Datura/Brassica etc.
2. Study of anther, embryo and endosperm culture, micropropagation, and somatic embryogenesis
3. Preparation of Artificial/Synthetic seeds.
4. Isolation of protoplasts (Mechanical isolation)
5. Study and description of binary vectors by using photographs.
6. Study of methods of gene transfer through photographs: Agrobacterium-mediated, direct gene transfer by electroporation, microinjection, micro projectile bombardment.
7. Study of steps of genetic engineering for production of Bt cotton, Golden rice, FlavrSavr tomato through photographs.
8. Isolation of DNA from Onion/Coconut Endosperm.
9. Charts/ Photographs related to Biotechnology.
10. Separation of DNA using agarose gel electrophoresis and gel documentation.
11-12. Study of databases of NCBI, DDBJ, EMBL, PDB
13. Charts/ Photographs related to Biotechnology.
14. Visit to Biotech Labs in nearby places.

Formative Assessment for Practical	
AssessmentOccasion/type	**Marks**
Continuous assessment	05
Test	05
Submission and Report	10
Record	05
Total	**25 Marks**

SCHEME OF PRACTICAL EXAMINATION

(Distribution of marks): 25 marks for the Semester end examination

Time =03 hrs **Marks =25**

1. Isolation of plant DNA/ spectrophotometric quantification of DNA(A) 05 marks
2. Preparation of Artificial/SyntheticSeed/ Inoculation using leaf and nodal explants (B) 04 marks
3. Comment on Bt cotton, Golden rice, FlavrSavr tomato, microinjection, micro projectile bombardment, Agarose /PAGE electrophoresis, Transilluminator, PCR (C&D) 06 marks
4. Comment on E (Bioinformatics) 05 marks
5. Viva-voce 05 marks

GENERAL PATTERN OF THEORY QUESTION PAPER

(60 Marks for semester end Examination with 2 hrs. and 30 min. duration)

Part-A

1. Question Number 1-06 carries 2 Marks each. Answer any 05 questions. 10 Marks

Part-B

2. Question Number 07-11 carries 5 Marks each. Answer any 04 questions. 20 Marks

Part-C

3. Question Number 12-15 carries 10 Marks each. Answer any 03 questions. 30 Marks

(Minimum 1 Question from each unit and 10 marks question may have sub-question for 7+3 or 6+4 or 5+5 if necessary) **Total: 60 Mark**