

### M.Sc. (Botany) – Part II (SEMESTER III)

Session: 2021-2022, 2022-2023		Semester-III	
Paper Code	M-BOT-T-3.1		
Name of Course	Plant Anatomy and Reproduction		
	<b>Theory</b>	<b>Practical</b>	<b>Internal</b>
Maximum Marks	70	30	30
Pass Percentage	35%	35%	35%
Credits	4	1.5	-
Lectures per week (of one hour duration)	4	3	-

**Objective of the Paper** is to acquaint the students about the Growth and Differentiation of Shoot and Root Apical Meristem and Anatomy of Root, Stem and Leaf. The students will also learn about the methods of vegetative reproduction in plants as well as the process of sexual reproduction including the microsporogenesis, megasporogenesis, fertilization, structure and development of embryo and endosperm.

#### **Question Paper Format (Rules and Regulations)**

The paper will consist of three sections A, B and C. Section A and B will have four questions each from their respective units, the students are required to attempt any two questions from each section, and each question will carry 10 marks each (10×4). Section C is Compulsory and will consist of 10 Short answer questions covering the entire Syllabus with 3 Marks each (3×10).

#### **INSTRUCTIONS FOR THE CANDIDATES**

Candidates are required to attempt two questions each from section A and B and the entire section C which is compulsory.

#### **SECTION-A**

- 1) **Growth and Differentiation of Shoot:** Organization of Shoot Apex, Cytological and Molecular Analysis of SAM (Shoot Apical Meristem), Anatomy of the Meristem; Regulation of Cell Fate in the Meristem; Tissue Differentiation in the Shoot.
- 2) **Vascular Tissue and Cambium:** Cambium - Structure, Types and Functions; Vascular Tissues - Structure, Function and Differentiation; Secondary Growth in Gymnosperms and Angiosperms; Anomalous Stem Differentiation; Secretory Ducts and Laticifer.
- 3) **Root Anatomy:** Organization of RAM (Root Apical Meristem) in Vascular Plants, Differentiation of Root Tissues; Lateral Roots, Root Hairs, Concepts of Origin of Root Cap.
- 4) **Leaf Anatomy:** Leaf Determination and Development at the SAM- Regulation of Leaf Development and its formation at Apex; Differentiation of Leaf Cells - Epidermis with special reference to Stomata and Trichomes; Mesophyll Cell Differentiation.

#### **SECTION-B**

- 5) **Vegetative Reproduction:** Methods of vegetative reproduction, Significance of vegetative Reproduction in Plants of Horticultural, Floral and Agricultural crops.
- 6) **Sexual Reproduction:** Microsporogenesis and Megasporogenesis: Anther Differentiation, Pollen Development and Maturation, Male Gametogenesis; Ovule Determination and Development, Megasporogenesis, Organization of Embryo Sac, Structure of Embryo Sac Cells and Functions of Genes during Megagametogenesis.
- 7) **Pollination and Fertilization:** Floral Characteristics, Pollination Mechanisms and Vector; Structure of the Pistil; Pollen- Stigma Interactions, Sporophytic and Gametophytic Self-Incompatibility, Molecular Mechanisms of Self-Incompatibility, Methods to overcome self-incompatibility, Double Fertilization; *In vitro* Fertilization.
- 8) **Development of Endosperm and Embryo:** Introduction to Embryos and Seed, Endosperm Types and Development; Embryogeny in Dicot and Monocot, Physiological and Genetic Control of Embryogenesis, Ultra structural, Nuclear Cytology and Cell Lineage during Late Embryo Development, Nutrition and Growth of Embryos, Storage Proteins of the Endosperm and the Embryo, Polyembryony, Apomixis, Evolutionary Aspects of Plant Embryogenesis.

## **RECOMMENDED READINGS:**

1. Bhojwani, S.S. and Bhatnagar, S.P. (2000). The Embryology of Angiosperms 4<sup>th</sup> Edition, Vikas Publishing House, New Delhi.
2. Crang, R., Lyons- Sobaski, S. and Wise, R. (2018). Plant Anatomy: A Concept-Based Approach to the Structure of Seed Plants, Springer-Verlag, Berlin Heidelberg.
3. Dickison, W.C. (2000). Integrative Plant Anatomy, Academic Press, USA.
4. Esau, K. (2006). Anatomy of Seed Plants 2<sup>nd</sup> Edition, John Wiley and Sons, New York.
5. Fahn, A. (1995). Plant Anatomy, Butterworth-Heinemann Ltd., Oxford, UK.
6. Johri, B.M., Ambegaokar, K.B. and Srivastava, P.S. (1992). Comparative Embryology of Angiosperms, Springer-Verlag, Berlin Heidelberg.
7. Lersten N.R. (2004). Flowering Plant Embryology, Blackwell Publishing Ltd., UK
8. Marja C.P. and Timmermans (2010). Current Topics in Developmental Biology-Plant Development, Academic Press, USA.
9. Mauseth, J.D. (2008). Plant Anatomy, The Blackburn Press, USA.
10. Raghvan, V. (2000). Developmental Biology of Flowering Plants, Springer Science, New York.
11. Srivastava, L.M. (2002). Plant Growth and Development: Hormones and Environment, Academic Press, California.
12. Steeves, T.A. and Sussex, I.M. (1989). Patterns in Plant Development 2<sup>nd</sup> Edition, Cambridge University Press, Cambridge, UK.

## M.Sc. (Botany) – Part II (SEMESTER III)

Session: 2021-2022, 2022-2023		Semester-III	
Paper Code	M-BOT-T-3.2		
Name of Course	Ecology and Phytogeography		
	<b>Theory</b>	<b>Practical</b>	<b>Internal</b>
Maximum Marks	70	30	30
Pass Percentage	35%	35%	35%
Credits	4	1.5	-
Lectures per week (of one hour duration)	4	3	-

**Objective of the Paper** is to acquaint the students about the different types of Ecosystems, Energy Flow in Ecosystems, Biogeochemical Cycles, Studies of Population Community with relation to Ecosystem, Ecological Succession, Descriptive (World Floristic zones) and Interpretive Phytogeography, GIS (Geographical Information System) and GPS (Geographical Positioning System) and their applications.

### ***Question Paper Format (Rules and Regulations)***

The Question paper will consist of three sections A, B and C. Section A and B will have four questions each from their respective units, the students are required to attempt any two questions from each section, and each question will carry 10 marks each (10×4). Section C is Compulsory and will consist of 10 Short answer questions covering the entire Syllabus with 3 Marks each (3×10).

### **INSTRUCTIONS FOR THE CANDIDATES**

Candidates are required to attempt two questions each from section A and B and the entire section C which is compulsory.

### **SECTION-A**

- 1) **Ecosystem and Concept Related to Energy:** Structure and Function of Some Indian Ecosystems: Forest, Grassland, Freshwater, Marine and Estuarine; Brief idea of microcosms, Agro ecosystems, Spacecraft and City as ecosystems, Stability (Resistance and Resilience) of Ecosystems, Primary Productivity and its Measurements, Energy Flow Pathways, Ecological Pyramids, Energy Budgets.
- 2) **Biogeochemical Cycles and Concept of Limiting Factors:** Carbon, Nitrogen, Phosphorus and Sulphur Cycle; Cycling of Non-Essential Elements and Organic Nutrients; Nutrient Cycling in the Tropics, Recycle Pathways, Recycling Index; Liebig's Law of the Minimum, Shelford's Law of Tolerance, Factor Compensation, Combined Concept of Limiting Factors.
- 3) **Population and Community Ecology:** Population Characters, Population Growth, Carrying Capacity, Life History Strategies (r and k selection), Modes of Dispersal, Age Structured Populations. Population Regulation, Analysis of Communities (Analytic and Synthetic Characters), Continuum Concept, Species Diversity and its Measurements, Ecotypes and Ecads, Types of Interactions and Kinetics of Competition (Lotka-Volterra Model).
- 4) **Concept of Habitat, Ecological Niche and Ecological Succession;** Niche Width and Overlap; Fundamental and Realized Niche; Resource Partitioning; Ecological Equivalents, Character Displacement (Sympatry and Allopatry); Composition and Kinds of Ecological Succession, Succession Models, Causes, Changes in Ecosystem Properties during Succession, and Concept of Climax.

### **SECTION-B**

- 5) **Major Divisions of Phytogeography:** (i) Descriptive (World Floristic zones), (ii) Interpretive Phytogeography; Concept of Wides, Endemics (Palaeoendemics, Neoendemics, Pseudo endemics); Discontinuous Species (significant phytogeographical causes for discontinuous distribution).

- 6) **Theories of Discontinuous Distribution:** Theory of Land Bridge, Theory of Continental drift, Factors affecting distribution of Species: Geological history and distribution, Migration and Ecological amplitude.
- 7) **Remote Sensing:** GIS (Geographical Information System) and GPS (Geographical Positioning System); Software, Hardware, Interpretation of spatial data.
- 8) **Applications of GIS and GPS:** Plant diversity distribution, Habitat shrinkage and Species loss, Mapping and monitoring of species, Habitats, Gaps in the exploration and conservation, Land use and landscape pattern, Species distribution and modeling, Delineation of ecological corridors and intact forest landscapes, Hotspot analysis, Forest cover change, Disaster Management.

#### **RECOMMENDED READINGS:**

1. Ambasht, R.S. and Ambasht, N.K. (2004). A Textbook of Plant Ecology, CBS Publishers and Distributors, New Delhi.
2. Crawley, M.J. (2009). Plant Ecology, John Wiley & Sons, USA.
3. Kormondy, E.J. (2013). Concepts of Ecology, 4<sup>th</sup> Edition. Prentice Hall, U.S.A., Pearson.
4. Odum, E.P. and Gary, W.B. (2015). Fundamentals of Ecology, 14<sup>th</sup> Edition, Cengage Learning India Pvt. Ltd.
5. Sharma, P.D. (2018). Ecology and Environment, 13<sup>th</sup> Edition, Rastogi Publications, Meerut, India.
6. Wegmann, M., Leutner, B. and Dech, S. (2016). Remote Sensing and GIS for Ecologists: Using Open-Source Software, Pelagic Publishing, UK.

## M.Sc. (Botany) – Part II (SEMESTER III)

Session: 2021-2022, 2022-2023		Semester-III	
Paper Code	M-BOT-T-3.3		
Name of Course	Biostatistics and Bioinformatics		
	<b>Theory</b>	<b>Practical</b>	<b>Internal</b>
Maximum Marks	70	30	30
Pass Percentage	35%	35%	35%
Credits	4	1.5	-
Lectures per week (of one hour duration)	4	3	-

**Objective of the Paper** is to acquaint the students with the Various Techniques related to Statistical Methods, Analysis of Variance and different tools; data mining procedures, software's used in bioinformatics along with its applications.

### ***Question Paper Format (Rules and Regulations)***

The Question paper will consist of three sections A, B and C. Section A and B will have four questions each from their respective units, the students are required to attempt any two questions from each section, and each question will carry 10 marks each (10×4). Section C is Compulsory and will consist of 10 Short answer questions covering the entire Syllabus with 3 Marks each (3×10).

### **INSTRUCTIONS FOR THE CANDIDATES**

Candidates are required to attempt two questions each from section A and B and the entire section C which is compulsory.

#### **SECTION-A**

- 1) **Statistical Methods:** Collection of Data, Distribution and Graphical Representation, Measurement of Central Tendency, Arithmetic Mean, Median, Mode and their Empirical Relationship.
- 2) **Measures of Dispersion:** Mean Deviation, Standard Deviation, Variance and Coefficient of Variation, Correlation and Regression.
- 3) **Statistics:** Sample Statistics and Parameters, Population and Null Hypothesis, Level of Significance,  $\chi^2$  Test, T-Test, Probability Distributions (Binomial, Poisson and Normal); Errors.
- 4) **Analysis of Variance:** ANOVA: One-Way and Two-Way.

#### **SECTION-B**

- 5) **Bioinformatics:** Definition, History, Application and Prospects, Limitations of Bioinformatics.
- 6) **Databases:** EMBL, DDBJ, GenBank, PIR, SWISS-PROT, PDB, NCBI, EXPASY, Data Mining and its limitations, Data Retrieval Systems: ENTREZ and SRS, Primer Designing.
- 7) **Sequence Analysis:** Sequence Alignment and its Types: Pairwise and Multiple Sequence Alignment, Local and Global Alignment, FASTA, BLAST, CLUSTALW, T-Coffee. Introduction to Database Search Engines: PubMed, OMIM and MEDLINE.
- 8) **Genomics and Proteomics:** Basic Concepts, Types of DNA Sequences, DNA and RNA Sequencing Methods, Protein Sequencing and Structure Determination Methods, Bioinformatics Institutes and Databanks.

### **RECOMMENDED READINGS:**

1. Attwood, T. (2007). An Introduction to Bioinformatics, Pearson Education, India.
2. Chainy, G.B.N., Mishra, G. and Mohanty, P.K. (2008). Biostatistics Theory and Applications, Kalyani Publishers, Ludhiana.
3. Gupta, S.C. and Kapoor, V.K. (2014). Fundamentals of Applied Statistics, Sultan Chand and

Sons, New Delhi.

4. Gurumani, N. (2008). An Introduction to Biostatistics, M.J.P. Publishers, Chennai.
5. Panse, V. G. and Sukhatme, P.V. (1995). Statistical Methods for Agricultural Workers, ICAR, New Delhi.
6. Rastogi, S.C., Mendiratta, N. and Rastogi, P. (2013). Bioinformatics Methods and Applications. PHI Learning Pvt. Ltd., Delhi.
7. Rastogi, V.B. (2011). Fundamentals of Biostatistics, Ane Books Pvt. Ltd., New Delhi.

### M.Sc. (Botany) – Part II (SEMESTER III)

Session: 2021-2022, 2022-2023		Semester-III		
Paper Code	M-BOT-T-3.4			
Name of Course	Systematics and Diversity of Angiosperms			
	<b>Theory</b>	<b>Practical</b>	<b>Internal</b>	
Maximum Marks	70	30	30	
Pass Percentage	35%	35%	35%	
Credits	4	1.5	-	
Lectures per week (of one hour duration)	4	3	-	

**Objective of the Paper** Objective of the paper is to acquaint the students about the Evolutionary trends in Angiosperm Systematics and Phylogeny of Angiosperms, Systems of Angiosperm Classification, International Nomenclature Code and socio-economic importance of angiosperms.

#### ***Question Paper Format (Rules and Regulations)***

The Question paper will consist of three sections A, B and C. Section A and B will have four questions each from their respective units, the students are required to attempt any two questions from each section, and each question will carry 10 marks each (10×4). Section C is Compulsory and will consist of 10 Short answer questions covering the entire Syllabus with 3 Marks each (3×10).

#### **INSTRUCTIONS FOR THE CANDIDATES**

Candidates are required to attempt two questions each from section A and B and the entire section C which is compulsory.

##### **Section A**

1. General evolutionary trends and criteria of primitive and advance taxa of flowering plants. Morphology of stamens and carpels- a brief account.
2. A brief account and theories related to the origin of Angiosperms.
3. Salient features of various systems of classification (Bentham & Hooker, Engler and Prantl, Hutchinson, Cronquist, Takhtajan).
4. Salient features of International code of Botanical Nomenclature (Principles, Ranks of taxa, typification, Principle of priority and citation of authors' names); Brief account of Angiosperm phylogeny group (APG) classification.

##### **SECTION-B**

5. A brief account on herbarium, Botanical gardens, floras, computer applications and GIS. Relevance of taxonomy to plant conservation.
6. Salient features and socio-economic importance of the following Dicots families: Nymphaeaceae, Magnoliaceae, Moraceae, Myrtaceae, Anacardiaceae, Sapindaceae, Meliaceae, Tiliaceae
7. Salient features and socio-economic importance of the following Dicots families: Amaranthaceae, Apocynaceae, Rubiaceae, Bignoniaceae, Polygonaceae, Sapotaceae, Scrophulariaceae, Lamiaceae.
8. Salient features and socio-economic importance of the following Monocot families: Orchidaceae, Amaryllidaceae, Araceae, Agavaceae, Cyperaceae and Poaceae.

## RECOMMENDED READINGS:

- 1) Dutta, S.C. (2015). Systematic Botany, New Age International (P) Ltd. Publications.
- 2) Grant, W.F. (1984). Plant Biosystematics, Academic Press, London.
- 3) Jones, S.B., Jr. and Luchsinger, A.E. (1986). Plant Systematics, (2<sup>nd</sup> Edition), Mc. Graw-Hill Book Co., New York.
- 4) Lawrence, G.H.M. (1951). Taxonomy of Vascular Plants, Oxford & IBH, New Delhi.
- 5) Panday, B.P. (2009). Taxonomy of Angiosperms, S. Chand and Company Pvt. Ltd, New Delhi.
- 6) Radford, A.E. (1986). Fundamentals of Plant Systematics, Harper and Row Publishing, U.S.A.
- 7) Simpson, M.G. (2010). Plant Systematics, (2<sup>nd</sup> Edition), Elsevier Academic Press.
- 8) Singh, G. (2019). Plant Systematics: An Integrated Approach. CRC Press, Taylor and Francis, Florida, USA.
- 9) Singh, V. and Jain D.K. (1997). Taxonomy of Angiosperms, (2<sup>nd</sup> Edition), Rastogi Publishers, Meerut, (UP).



### M.Sc. (Botany) – Part II (SEMESTER III)

Session: 2021-2022, 2022-2023		Semester-III	
Paper Code	M-BOT-T-3.5		
Name of Course	Principles of Plant Pathology (Optional i)		
	<b>Theory</b>	<b>Practical</b>	<b>Internal</b>
Maximum Marks	70	30	30
Pass Percentage	35%	35%	-
Credits	4	1.5	-
Lectures per week (of one hour duration)	4	3	-

**Objective of the Paper** is to give knowledge to the students about the Concept of Disease and Disease Management in plants, disease epidemiology, epiphytotics and disease appraisal. The students will also learn about Mechanism of Pathogen Attack and Defense Mechanisms adopted by Plants during Pathogen Attack.

#### ***Question Paper Format (Rules and Regulations)***

The Question paper will consist of three sections A, B and C. Section A and B will have four questions each from their respective units, the students are required to attempt any two questions from each section, and each question will carry 10 marks each (10×4). Section C is Compulsory and will consist of 10 Short answer questions covering the entire Syllabus with 3 Marks each (3×10).

#### **INSTRUCTIONS FOR THE CANDIDATES**

Candidates are required to attempt two questions each from section A and B and the entire section C which is compulsory.

##### **SECTION-A**

- 1) **Introduction:** A Brief Account of Scope and Objectives of Plant Pathology, Concept of Disease in Plants, Major Causes and Symptoms of Plant Diseases.
- 2) **Epidemiology:** The Seasonal Carry-Over of Plant Pathogens, their Dispersal and Factors Influencing Dispersal.
- 3) **Epiphytotics and Disease Forecasting:** Spread of Pathogens within Crop Areas; Pathogenesis and various Factors: Plant, Pathogenic, Biotic and Environmental Epiphytotics and its Types, Disease Forecasting and its Methods.
- 4) **Disease Appraisal:** Pathometry, The Assessment of Disease Incidence and Crop Loss, Various Methods (Statistical Methods excluded).

##### **SECTION-B**

- 5) **Mechanism of Pathogen Attack:** Pre-Penetration, Penetration and Post-Penetration; Host Range; Pathogenesis, Various Stages in the Development of Disease including Molecular Basis of Pathogenesis.
- 6) **Chemical Weapons:** Role of Enzymes, Microbial Toxins, Growth Regulators and Polysaccharides in Disease Development.
- 7) **Results of Infection:** Impact of Infection on Morphological, Anatomical and Physiological Aspects with Particular Reference to Translocation of Water and Nutrients, Respiration, Photosynthesis and Nitrogen Metabolism.
- 8) **Mechanism of Defense:** Pre- Infection and Post- Infection Defense Mechanisms including Signaling Pathway leading to Activation of Defense Responses. Role of Transgenic and RNA Silencing in Plant Defense, Genetics of Plant-Pathogen Interaction, Horizontal and Vertical Resistance, Gene for Gene Hypothesis.

## **RECOMMENDED READINGS:**

1. Agrios, G.N. (2005). Plant Pathology, Academic Press, New York.
2. Chandniwala, K.M. (1996). An Introduction to Plant Pathology, Anmol Publications, Pvt. Ltd., New Delhi.
3. Heald, F.D. (2016). Manual of Plant Diseases (Volume 1 & 2), Biotech Books, New Delhi.
4. Mehrotra, R.S. (2013). Fundamentals of Plant Pathology, Tata McGraw Hill Publishing Co., Pvt. Ltd., New Delhi.
5. Singh, R.S. (2009). Principles of Plant Pathology, Oxford and IBH Publishing Co., Pvt. Ltd., New Delhi.
6. Wheeler, H. (2012). Plant Pathogenesis, Springer-Verlag, Berlin Heidelberg.

### M.Sc. (Botany) – Part II (SEMESTER III)

Session: 2021-2022, 2022-2023		Semester-III	
Paper Code	M-BOT-T-3.6		
Name of Course	Evolutionary Biology (Optional ii)		
	<b>Theory</b>	<b>Practical</b>	<b>Internal</b>
Maximum Marks	70	30	30
Pass Percentage	35%	35%	35%
Credits	4	1.5	-
Lectures per week (of one hour duration)	4	3	-

**Objective of the Paper** is to acquaint the students with the different theories of evolution and the processes involved in the origin and evolution of prokaryotes and eukaryotes. The knowledge required to design, execute, and analyze the results of genetic experimentation in animals and plants model systems.

#### ***Question Paper Format (Rules and Regulations)***

The Question paper will consist of three sections A, B and C. Section A and B will have four questions each from their respective units, the students are required to attempt any two questions from each section, and each question will carry 10 marks each (10×4). Section C is Compulsory and will consist of 10 Short answer questions covering the entire Syllabus with 3 Marks each (3×10).

#### **INSTRUCTIONS FOR THE CANDIDATES**

Candidates are required to attempt two questions each from section A and B and the entire section C which is compulsory.

#### **SECTION-A**

- 1) **Emergence of Evolutionary Thoughts:** Darwinism and Lamarckism, spontaneous mutations, Evolutionary Synthesis.
- 2) **Unicellular evolution:** Origin of Biomolecules; Abiotic synthesis of organic monomers and polymers; Oparin-Haldane hypothesis, Coacervate, Prokaryotic and Eukaryotic cellular evolution, Photosynthesis and Aerobic metabolism. Origins of unicellular and multicellular organisms.
- 3) **Paleobotany:** Geological time scale, its stratification and evolution of major plant groups.
- 4) **Molecular Evolution:** Evolution and variation in Plant Chloroplast, Mitochondrial and Nuclear Genome, Rates of Genomic Evolution, Concepts of Neutral Evolution, Adaptive Radiation and Divergence evolution, Convergence (with special reference to tree growth habit), Molecular Clocks.

#### **SECTION-B**

- 5) **Speciation:** Allopatric and Sympatric modes, Anagenesis and Cladogenesis, Levels of Evolutionary Change (micro and macroevolution), Role of Polyploidy and Hybridization in Speciation, Convergent, Divergent and Co-evolution.
- 6) **Molecular Tools in Phylogeny:** Classification and identification, Protein and Nucleotide sequence analysis, origin of new genes and proteins, Gene duplication and Divergence.
- 7) **Population Genetics:** Genetic structure of population –Gene pool, Genotype Frequency, Allelic frequency, Hardy-Weinberg Principle, Factors affecting Gene Frequency, Kinds of selection.
- 8) Fisher's Genetic Variance, Genetic load, Genetic death, Genetic variation in natural populations at Protein and DNA level.

## RECOMMENDED READINGS:

1. Avise, J.C. (2004). *Molecular Markers, Natural History and Evolution* (2<sup>nd</sup> Edition) Sinauer Associates, Inc., Sunderland, Massachusetts
2. Coyne, J.A. and Orr, A.H. (2004). *Speciation* Sinauer Associates, Inc., Sunderland, Massachusetts
3. Douglas, J.F. (2005). *Evolutionary Biology* (3<sup>rd</sup> Edition) Sinauer Associates, Inc., Sunderland, Massachusetts
4. Freeman, S. and Harron, C.J. (2006). *Evolutionary Analysis* (4<sup>th</sup> Edition) Prentice Hall, Inc. Pearson, NJ
5. Gould, S.J. (1997). *Ever Since Darwin, Reflections in Natural History*. W.W. Norton and company Net work
6. Gould, S.J. (2002). *The Structure of Evolutionary Theory*. Harvard University Press, Cambridge, Massachusetts
7. Gottlieb, L.D. and Jain, S.K. (2012). *Plant Evolutionary Biology*, Chapman and Hall, NewYork.
8. Niklas, K.J. (1997). *The Evolutionary Biology of Plants*,The University of Chicago Press, Chicago and London.

### M.Sc. (Botany) – Part II (SEMESTER III)

Session: 2021-2022, 2022-2023		Semester-III
Paper Code	M-BOT-L-3.1	
Practical Paper	Pertaining to M-BOT-T-3.1 and M-BOT-T-3.2	
Maximum Marks	60	
Pass Percentage	35%	
Credits	3	

#### **M-BOT-T-3.1 Plant Anatomy and Reproduction (List of Practicals)**

1. To Study RAM and SAM from Slides/ Diagrams.
2. To Study the Anatomy of Dicot and Monocot Root, Stem and Leaf.
3. To Study the Anomalous Structure in T.S. Stem of *Boerhaavia*, *Nyctanthes*, *Mirabilis*, *Bougainvillea* and *Pyrostegia*.
4. To Study Types of Stomata.
5. To Compare the C<sub>3</sub> and C<sub>4</sub> Leaf Anatomy.
6. To Study the details of Reproductive Parts of Flower: *Hibiscus*, *Tabernaemontana*, *Solanum*, *Lathyrus*, *Helianthus*, *Thevetia*, *Cassia*, *Jasminum*, *Jatropha* and *Clerodendron*.
7. Structure of Young and Mature Anthers.
8. Study of Various Types of Ovules.
9. Study of Various Types of Embryo Sacs and Endosperms
10. Study of Various Artificial Methods of Vegetative Reproduction: Cutting, Budding, Grafting, Layering, Micropropagation.
11. To Test the Viability of Different Types of Seeds with help of Tetrazolium Test.
12. Isolation of Zygotic, Globular, Heart shaped, Torpedo shaped and Mature Embryo from suitable Seeds.
13. *In Vitro* Pollen Germination using Hanging Drop, Sitting Drop, Suspension and Surface Cultures.
14. Study of Microsporogenesis and Gametogenesis using Anthers of *Allium*, *Zea*, *Ipomea* and *Hibiscus*.

#### **M-BOT-T-3.2 Ecology and Phytogeography (List of Practicals)**

1. To Draw Ecological Pyramids based on Number, Biomass and Energy Utilization.
2. To Study World Soil Map based Bioclimatic Zones.
3. To Determine the Biomass in terms of Fresh Mass, Dry Mass, Moisture Content of the given Plant sample by Harvest Method.
4. To Determine Minimum Area required for Quadrats to Study Plant Community in an assigned Locality by Species Area Curve Method.
5. To Study Frequency, Density and Abundance of an assigned Protected and Unprotected Grassland Plant Community.
6. To Study Species Diversity (Richness and Evenness), Index of Dominance, Similarity Index, Dissimilarity Index and Species Diversity Index in Grazed and Protected Grassland.
7. To Determine the Basal Area of Herbs in an Assigned Grassland Locality.
8. To Study the Phytogeographical Regions of the World on the basis of the Map provided to you.
9. To demarcate different Biomes on the World map.
10. To Study World Soil Map based on Bioclimatic Zones.
11. Introduction to Digital Image Processing Software – ENVI.
12. Importing Satellite Data and Familiarization with Basic functions of ENVI.

### M.Sc. (Botany) – Part II (SEMESTER III)

Session: 2021-2022, 2022-2023		Semester-III
Paper Code	M-BOT-L-3.2	
Practical Paper	Pertaining to M-BOT-T-3.3 and M-BOT-T-3.4	
Maximum Marks	60	
Pass Percentage	35%	
Credits	3	

#### **M-BOT-T-3.3 Plant Resource and Utilization (List of Practicals)**

1. To Study the Different Types of Starch Grains: Wheat, Rice, Maize, Bean, and Potato.
2. To Study the Morphological and Anatomical Features of the following plants:
  - a) Spices and Condiments: Ginger, Haldi, Black pepper, Cardamon, Cinnamon, Clove, Fennel, Coriander, Cumin.
  - b) Medical plants: *Aconitum*, *Allium sativum*, *Adhatoda vasaka*, *Aloe*, *Artemisia*, *Azadirachta indica*, *Belladonna*, *Cinchona*, *Digitalis*, *Ferula asfoetida*, *Ginkgo biloba*, *Ginseng*, *Glycyrrhiza*, *Ocimum sanctum*, *Papaver*, *Rauwolfia*, *Nux-vomica*.
  - c) Fibers: *Saccharum munja*, Cotton, *Cannabis*.
  - d) Oil Seeds: Cotton seed, Groundnut, Castor, Mustard, Coconut, Sunflower, Soyabean.
3. To Study the Raphides in *Eichhorina*.
4. To Study the Calcium Carbonate Crystals (Cystolith) in *Ficus*.
5. To Study Different Types of Woods for Texture and Density.

#### **M-BOT-T-3.4 Systematics and Diversity of Angiosperms (List of Practicals)**

1. General description of flower in technical terms.
2. Description of different types of inflorescences and fruits in angiosperms.
3. Description of leaf type on the basis of shape of lamina, margins, base, tips, phyllotaxy, venation, leaf modification and placentation.
4. Description of following flowers in technical terms and their derivation up to the family level on basis of key:  
*Anagalis arvensis*, *Stellaria media*/*Spergula*, *Majus japonicus*/*Antirrhinum*, *Solanum nigrum*, *Vicia/Lathyrus*, *Calotropis procera*, *Cassia fistula*, *Oxalis corniculata*, *Acacia*, *Convolvulus microphylla*, *Boerhaavia/Bougainvillea*, *Salvia/Ocimum*, *Bidens/Tridax*, *Allium/Asparagus*, *Hamelia/Gardenia*, *Jasminum*, *Clerodendron*, *Tabernaemontana*, *Thevetia*, *Tecoma*, *Euphorbia/Jatropha*, *Quisqualis*, *Fumaria*, *Coriander/Foeniculum*, *Polygonum*, *Triticum aestivum*, *Abutilon* and *Malvastrum*.

### M.Sc. (Botany) – Part II (SEMESTER III)

Session: 2021-2022, 2022-2023		Semester-III
Paper Code	M-BOT-L-3.3	
Practical Paper	Pertaining to M-BOT-3.5 or M-BOT-3.6	
Maximum Marks	30	
Pass Percentage	35%	
Credits	1.5	

#### Optional Papers

##### **M-BOT-T-3.5: Principles of Plant Pathology (Optional i)**

1. Acquaintance with Techniques and Stains used in Plant Disease Study.
2. Study of the Disease Symptoms and Histopathological Details of the following:
  - I. Oomycota: White Rust of Crucifers (*Albugo candida*), Late Blight of Potato (*Phytophthora infestans*) and Downy Mildew of Brassica (*Peronospora parasitica*).
  - II. Blastocladiomycota: Brown Spot of Maize (*Physoderma maydis*).
  - III. Ascomycota: Stem Galls of Coriander (*Protomyces microsporus*), Powdery Mildew of *Dalbergia* (*Phyllactinia dalbergiae*), Apple Scab (*Venturia inaequalis*), Coal Tar Disease (*Rhytisma acerinum*), Blotch of Turmeric (*Taphrina maculans*), Black Spot of Rose (*Diplocarpon rosae*) and False Smut of Rice (*Ustilago virens*).
  - IV. Basidiomycota: Corn Smut (*Ustilago maydis*) and Leaf Smut of Rice (*Entyloma oryzae*),
  - V. Mitosporic Fungi: Early Blight of Potato (*Alternaria solani*), Tikka Disease of Groundnut (*Cercospora arachidicola*), Leaf Spot of Spinach/Lufa (*Cercospora*), Anthracnose of Chillies (*Colletotrichum capsici*)

##### **M-BOT-T-3.6: Evolutionary Biology (Optional ii)**

1. Study of plants with reference to their evolutionary significance (adaptations, connecting links, modifications, living fossils (*Equisetum*, *Ginkgo biloba*).
2. Study of Fusion, reduction and symmetry in plants as an evolutionary evidence
3. Study of Remoration and Elaboration in suitable plants.
4. Hardy-Weinberg Principle-Numerical Problems.

## M.Sc. (Botany) – Part II (SEMESTER IV)

Session: 2021-2022, 2022-2023		Semester-IV	
Paper Code	M-BOT-T-4.1		
Name of Course	Crop Genetics and Plant Breeding		
	<b>Theory</b>	<b>Practical</b>	<b>Internal</b>
Maximum Marks	70	30	30
Pass Percentage	35%	35%	35%
Credits	4	1.5	-
Lectures per week (of one hour duration)	4	3	-

**Objective of the Paper** is to acquaint the students about the basic principle of crop genetics, role of qualitative and quantitative traits in determining the genetic variance, reproduction in plants in the role of selection methods and procedure to release new varieties. The details of hybridization, mutation breeding, importance of quality seeds and types & importance of molecular markers is also taught to students.

### ***Question Paper Format (Rules and Regulations)***

The Question paper will consist of three sections A, B and C. Section A and B will have four questions each from their respective units, the students are required to attempt any two questions from each section, and each question will carry 10 marks each (10×4). Section C is Compulsory and will consist of 10 Short answer questions covering the entire Syllabus with 3 Marks each (3×10).

### **INSTRUCTIONS FOR THE CANDIDATES**

Candidates are required to attempt two questions each from section A and B and the entire section C which is compulsory.

#### **SECTION – A**

- 1) **Historical Perspectives:** Past Progress and Future needs, Green Revolution, Plant Genetic Resources, Centres of Origin, Gene Pool Concept, Primary, Secondary and Tertiary Gene Pool; Germplasm Evaluation and Conservation, Gene Banks.
- 2) **Qualitative and Quantitative Traits:** Qualitative and Quantitative Traits and their Genetic Behaviour in Segregating Populations, Significance of Polygenic Traits, Component of Genetic Variance, Heritability and Genetic Advance.
- 3) **Reproduction in Plants:** Mode of Reproduction, Genetic Consequences of Self and Cross Fertilization, Mating Systems in Plants, Types, Mechanism and Utility of Self-Incompatibility, Apomixis and Male Sterility in Plant Breeding.
- 4) **Selection Methods and Release of New Varieties:** Plant Introduction and Selection (Pure line Selection, Mass Selection, Recurrent Selection and Clonal Selection) as Methods of Plant Breeding, Release of New Varieties: Evaluation Trials, Tests, Agencies, Registration of New Varieties; Institutions involved in the Release of New Varieties, Ideotype Concept in Plant Breeding; Breeder's Rights.

#### **SECTION-B**

- 5) **Hybridization:** Procedure, Choice of Parents, Pedigree and Bulk Methods, Back Cross Methods, Composite Crosses, Wide Crosses: Significance, Crossability, Barriers and Methods to overcome. Heterosis Breeding, Hybrid varieties, Synthetic Varieties.
- 6) **Mutation Breeding:** Procedure and Achievements, Haploidy and Polyploidy in Plant Breeding, Mutant Variety Data (MVD)-IAEA.
- 7) **Quality Seeds:** Practices for Quality Seed Production, Seed Certification Procedure, Seed Tests, Maintenance of Improved Seeds.
- 8) **Molecular Markers:** Types of Molecular Markers, Mapping of Molecular markers, Marker Assisted Selection (MAS) for Disease Resistance and Qualitative Trait Loci (QTLs) and Application of MAS in Breeding.



## RECOMMENDED READINGS:

1. Allard, R.W. (1998). Principles of Plant Breeding, John Wiley and Sons, Inc., Singapore.
2. Brown, J., Caligari, P.D.S. and Campos H.A. (2014). Introduction to Plant Breeding, 2nd Edition, Wiley Blackwell, USA.
3. Chaudhury, R.C. (2017). Introductory Principles of Plant Breeding, Oxford and IBH Pub. Co. Pvt. Ltd., New Delhi.
4. Heyward, M.D., Bosemark, N.O. and Romagosa, I. (1993). Plant Breeding: Principles and Prospects, Chapman and Hall, Madras.
5. Poehlman, J.M. (2006). Breeding Field Crops, Van Nostrand Reinhold, New York.
6. Principles of Plant Breeding <http://krishikosh.egranth.ac.in/handle/1/5810048999> (practical manual)
7. Rastogi, V.B. (2007). Fundamentals of Biostatistics, Ane Books India, New Delhi, India.
8. Singh, B.D. (2013). Plant Breeding: Principles and Methods, Kalyani Publishers, New Delhi.
9. Singh, R.K. and Singh, P.K. (1994). A Manual on Genetics and Plant Breeding, Experimental Techniques, Kalyani Publishers, New Delhi.

## M.Sc. (Botany) – Part II (SEMESTER IV)

Session: 2021-2022, 2022-2023		Semester-IV	
Paper Code	M-BOT-T-4.2		
Name of Course	Biodiversity and Global Climate Change		
	<b>Theory</b>	<b>Practical</b>	<b>Internal</b>
Maximum Marks	70	30	30
Pass Percentage	35%	35%	35%
Credits	4	1.5	-
Lectures per week (of one hour duration)	4	3	-

**Objective of the Paper** is to acquaint the students about the Concept of Biodiversity and Sustainable development, Factors affecting Biodiversity loss and Strategies for Biodiversity Conservation and Management around the World and in India. The students are made well versed with the phenomenon of climate change, Principal Challenges and Opportunities for Climate Change Action and International efforts and legal instruments to mitigate climate change.

### ***Question Paper Format (Rules and Regulations)***

The Question paper will consist of three sections A, B and C. Section A and B will have four questions each from their respective units, the students are required to attempt any two questions from each section, and each question will carry 10 marks each (10×4). Section C is Compulsory and will consist of 10 Short answer questions covering the entire Syllabus with 3 Marks each (3×10).

### **INSTRUCTIONS FOR THE CANDIDATES**

Candidates are required to attempt two questions each from section A and B and the entire section C which is compulsory.

#### **SECTION-A**

- 1) **Biodiversity and Sustainable Management:** Types and Levels of Biodiversity, Convention on Biological Diversity (CBD). Basic Concepts of Sustainable Development, Sustainability Indicators.
- 2) **Biodiversity Loss:** Threats and Causes, Extinctions, Mechanism of Extinction, Rate of Extinction, Prediction of Extinction Rates, Rarity of Species, Threat Value, Categories of Existence, Blue/Red Data Categories.
- 3) **Biodiversity Management:** Managing Biodiversity in Agriculture and Forestry, Role of International Union for Conservation of Nature (IUCN), United Nations Environment Programme (UNEP), World Resources Institute (WRI), World Wildlife Fund (WWF), National Biodiversity Authority (NBA), State Biodiversity Boards (SBSs) and National Biodiversity Fund (NBF) in Managing Biodiversity; Various Acts with particular reference to Indian Biodiversity, People's Biodiversity Registers (PBRs).
- 4) **Strategies for Conservation:** *In Situ* Conservation: International Efforts and Indian Initiatives; Protected areas in India – Sanctuaries, National Park, Biosphere Reserves, Wetlands, Mangroves and Coral Reefs, *Ex Situ* Conservation: Principles and Practices, Botanical Gardens, Field Gene Banks, Seed Banks, *In Vitro* Repositories, Cryobanks.

#### **SECTION-B**

- 5) **Introduction to Earth's Climate System:** CO<sub>2</sub> emission, Greenhouse Effect, Earth's Carbon Reservoirs, Climate and Weather, Global Wind Systems, Clouds, Storms and Climates, Global Ocean Circulation, *El Nino* and the Southern Oscillation.

- 6) **Science of Climate Change:** Fundamentals of climate change science, Climate Change Adaptation, Impact of Climate Change, Community Response and Government Policies, Ecological Footprint, Clean Development Mechanism (CDM).
- 7) **Climate Change Finance:** Climate Investment Funds (CIFs), Green Climate Fund (GCF), Adaptation Fund (AF) and Global Environment Facility (GEF), Analysis of Principal Challenges and Opportunities for Climate Change Action.
- 8) **International Efforts to Mitigate Climate Change:** The UN Intergovernmental Panel on Climate Change (IPCC), Fifth Assessment Report, Global Warming of 1.5°C, Kyoto Protocol, Paris Agreement, Climate Action Summit and National and International Awards in lieu of Natural Environment Protection.

#### **RECOMMENDED READINGS:**

1. Adeleke, B.O. and Leong, G.C. (1981). Certificate Physical and Human Geography, University Press.
2. Barry, R.G. and Hall-McKim, E.A. (2014). Essentials of the Earth's Climate System, Cambridge University Press.
3. Bolin, B. (2007). A History of the Science and Politics of Climate Change: the Role of the Intergovernmental Panel on Climate Change, Cambridge University Press, UK.
4. Dubash, N. (Ed.). (2012). Handbook of climate change and India: Development, Politics and Governance, Oxford University Press, UK.
5. Kato, M. (Ed.). (2000). The Biology of Biodiversity, Springer, UK.
6. Krishnamurthy, K. V. (2018). Advanced Textbook on Biodiversity: Principles and Practice. CBS Publishers and Distributors Pvt. Limited, India.
7. Kumar, U. and Asija, M.J. (2006). Biodiversity: Principles and Conservation. Agrobios (India).
8. Luterbacher, U. and Sprinz, D.F. (Eds.). (2001). International Relations and Global Climate Change, MIT Press, UK.
9. McKibben, B. (2006). The end of Nature. Random House Incorporated.
10. Parker, C., Brown, J., Pickering, J., Roynestad, E., Mardas, N. and Mitchell, A.W. (2009). The Little Climate Finance Book. Global Canopy Programme, UK.
11. Parry, M. and Carter, T. (1998). Climate impact and Adaptation assessment: a guide to the IPCC approach, Earthscan Publications Ltd. London.
12. Petersen, J., Sack, D. and Gabler, R.E. (2010). Fundamentals of Physical Geography, Cengage Learning, Boston.
13. Rodgers, C. (2013). The Law of Nature Conservation, Oxford University Press, Oxford, UK.
14. Saltzman, B. (2001). Dynamical Paleoclimatology: Generalized Theory of Global Climate Change, Elsevier.
15. Solomon, S., Qin, D., Manning, M., Chen, Z., Marquis, M., Averyt, K.B., and Miller, H. L. (2007). Climate Change 2007: The Physical Science Basis, Intergovernmental Panel on Climate Change (IPCC), Cambridge University Press, Cambridge.
16. Stewart, R. B., Kingsbury, B. and Rudyk, B. (Eds.). (2009). Climate finance: Regulatory and Funding Strategies for Climate Change and Global Development, New York University Press, USA.

## M.Sc. (Botany) – Part II (SEMESTER IV)

Session: 2021-2022, 2022-2023		Semester-IV	
Paper Code	M-BOT-T-4.3		
Name of Course	Plant Tissue Culture and Biotechnology		
	<b>Theory</b>	<b>Practical</b>	<b>Internal</b>
Maximum Marks	70	30	30
Pass Percentage	35%	35%	35%
Credits	4	1.5	-
Lectures per week (of one hour duration)	4	3	-

**Objective of the paper** is to give knowledge to the students about different tissue culture techniques and methods of recombinant DNA technology, production of transgenic plants and application of microbes in biotechnology.

### ***Question Paper Format (Rules and Regulations)***

The Question paper will consist of three sections A, B and C. Section A and B will have four questions each from their respective units, the students are required to attempt any two questions from each section, and each question will carry 10 marks each (10×4). Section C is Compulsory and will consist of 10 Short answer questions covering the entire Syllabus with 3 Marks each (3×10).

### **INSTRUCTIONS FOR THE CANDIDATES**

Candidates are required to attempt two questions each from section A and B and the entire section C which is compulsory.

#### **SECTION-A**

- 1) **Basic Techniques:** Nutrition Medium, Sterilization Techniques, Principles (Cyto-differentiations, Organogenic differentiation). Types of culture: Embryo culture, Callus culture and Organ culture, Micropropagation: Axillary bud Proliferation approach, Meristem & shoot tip culture, Bud culture, Organogenesis & Embryogenesis & their applications.
- 2) **Cell suspension culture:** Types of suspension cultures, Production of secondary metabolites and their applications, Somaclonal Variation: Selection of somaclonal variants, mechanism & their applications, Cryopreservation.
- 3) **Haploid Production:** Androgenic Methods, Gynogenic Haploids, Chromosome elimination techniques, distant hybridization, Embryo rescue.
- 4) **Somatic Hybridization:** Protoplast isolation, fusion. Section of hybrid cells, regeneration of hybrid plants, Applications & limitation, cybrids Hybrids, somatic hybrids.

#### **SECTION-B**

- 5) **Recombinant DNA Technology:** Isolation, cloning vectors and amplification of genes (PCR and Non-PCR based approaches) and their applications.
- 6) **Molecular markers and Marker assisted selection:** Morphological, Biochemical and Molecular markers: Random Amplified Polymorphic DNA (RAPD), Restriction Fragment Length Polymorphism (RFLP), and Amplified Fragment Length Polymorphism AFLP), DNA Fingerprinting.
- 7) **Transgenics in Crop improvement:** Gene Transfer Methods (Chemical, Physical and Biological), Production of Transgenic Plants with respect to Herbicide Resistance, Resistance against Biotic (Insects, Fungal, Viral) and Abiotic (Salinity, Drought, Cold, Heat) Factors.
- 8) **Biotechnology for Human Welfare:** Food Adjuncts, Molecular Farming, Role of Microbial Fermentation Technology in Food Industry, *in situ* and *ex situ* Bioremediation and its applications.

## RECOMMENDED READINGS:

1. Bhojwani, S.S. and Razadan, M.K. (1996). Plant Tissue Culture: Theory and Practice (A revised Edition), Elsevier Science Publication, New York, U.S.A.
2. Chawla H.S. (2005). Introduction to Plant Biotechnology, Oxford and IBH Pub., New Delhi, India.
3. Clark, D.P. and Pazdernik N. J. (2015). Biotechnology, 2nd Edition. Academic Cell, London, U.K.
4. Collins, H.A., and Edwards, S. (1998). Plant Cell Culture, Bios Scientific Pub., Oxford, U.K.
5. Hammond, J., Mc Garvey, P. and Yusibov, V. (Eds.) (1999). Plant Biotechnology – New Products and Applications, Springer Publications, New York, USA.
6. Kartha, K.K. (1985). Cryopreservation of Plant Cells and Organs, CRC press, Boca Raton, Florida, U.S.A.
7. Malacinski, G.M. and Freifelder, D. (1998). Essentials of Molecular Biology, 3<sup>rd</sup> Edition, Jones and Bartlett Pub., London, UK
8. Narayanaswamy, S. (2004). Plant Cell and Tissue Culture, Tata McGraw-Hill Publication, New Delhi India.
9. Razadan, M.K. (2018). An Introduction to Plant Culture, Oxford and IBH Pub., New Delhi, India.
10. Thieman, W.J. and Palladino, M.A. (2014). Introduction to Biotechnology, Pearson Education India, Pvt. Ltd., Noida, India.
11. Trigiano, R.N. and Gray D.J. (2011). Plant Tissue Culture, Development, and Biotechnology, Special Indian Edition, CRC Press, Taylor and Francis Group.
12. Vasil, I.K. and Thorpe, T.A. (1998). Plant Cell and Tissue Culture, Kluwer Academic Publication, Dordrecht, Boston, London.

## M.Sc. (Botany) – Part II (SEMESTER IV)

Session: 2021-2022, 2022-2023		Semester-IV	
Paper Code	M-BOT- T-4.4		
Name of Course	Plant Resource and Utilization		
	<b>Theory</b>	<b>Practical</b>	<b>Internal</b>
Maximum Marks	70	30	30
Pass Percentage	35%	35%	35%
Credits	4	1.5	-
Lectures per week (of one hour duration)	4	3	-

**Objective of the Paper** is to acquaint the students about the Economic Importance of Cereals, Sugar Crops, Fibre Crops, Oil Seed Crops, Beverage Crops, Medicinal and Aromatic Plants and Spices and Condiments. The students will also learn about Processing and Usage of Cocoa and Rubber.

### *Question Paper Format (Rules and Regulations)*

The Question paper will consist of three sections A, B and C. Section A and B will have four questions each from their respective units, the students are required to attempt any two questions from each section, and each question will carry 10 marks each (10×4). Section C is Compulsory and will consist of 10 Short answer questions covering the entire Syllabus with 3 Marks each (3×10).

### **INSTRUCTIONS FOR THE CANDIDATES**

Candidates are required to attempt two questions each from section A and B and the entire section C which is compulsory.

#### **SECTION-A**

- 1) A Brief Account of the Origin, Botany, Cultivation and Uses of Food Crops.  
Cereal Crops - Wheat, Rice, Maize  
Sugar Crops - Sugarcane  
Tuber Crops - Potato
- 2) A Brief Account of the Origin, Botany, Cultivation and Uses of the following Fibre Crops: (Cotton, flax, Hemp, Sisal) and Fodder Crops (Sorghum, Barseem, Guar).
- 3) A Brief Account of the Origin, Botany, Cultivation and Uses of following Vegetable Oil Yielding Plants. (i) Mustard (ii) Coconut (iii) Groundnut (iv) Sunflower.
- 4) A Brief Account of the Origin, History, Botany, Cultivation, Processing, Chemical Composition and Uses of the following Beverages Crops. (i) Tea (ii) Coffee.

#### **SECTION-B**

- 5) A Brief Account of the Origin, History, Botany, Cultivation, Processing and Uses of *Cannabis*, Cocoa and Para rubber.
- 6) Name, Family, Plant Part, Active Principle and Uses of the following:  
**Medicinal Plants:** *Aconitum, Adhatodavasaka, Alliumsativum, Aloe, Artemisia, Azadirachtaindica, Belladonna, Cinchona, Digitalis, Ferula asafoetida, Ginkgo biloba, Ginseng, Glycyrrhiza, Ocimum sanctum, Papaver, Rauwolfia, Nux-vomica.*  
**Aromatic Plants:** Mint, Rose, Jasmine, Lemon grass, Lavender, Hops, Camphor.  
**Spices and Condiment:** Ginger, Turmeric, Cinnamon, Clove, Cardamom, Chillies, Pepper, Fennel, Coriander, Cumin, Nutmeg, Mace and Saffron.
- 7) Name, Family, Distribution and Uses of Important Commercial Timbers of India (Teak, Sal, Chir, Kail, Deodar, Shisham, Kikar). List of Important Fuel Woods, Trees for Avenues, Pollution Control and Aesthetics.
- 8) A Brief Account of the Following: (i) Gums (ii) Resin (iii) Tannins (iv) Dyes (v) Raw materials for Paper Industry (vi) Bamboos (vii) Wild Fruits.

## RECOMMENDED READINGS:

1. Chovatia, V.P., Dhaduk, H.L. and Nakar, R.N. (2016). Medicinal Plants, Cultivation and Uses, Daya Publishing House, New Delhi.
2. Gupta, R.D., Gupta, S.K. and Bhardwaj, S.D. (2016). Agrotechniques and Uses of Medicinal Plants, Associated Publishing Company, New Delhi.
3. Kochhar, S.L. (2012). Economic Botany in the Tropics, MacMillan Indian Ltd., New Delhi.
4. Nair, M.N.B., Sahri, M.H. and Ashaari, Z. (Eds.) (1998). Sustainable Management of Non-Wood Forest Products. Faculty of Forestry, University Putra Malaysia, Selangor, Malaysia.
5. Pimentel, D. and Hall, C.W. (Eds.) (1995). Food and Natural Resources, Academic Press, London- New York.
6. Sambamurty, A.V.S.S. and Subrahmanyam, N.S. (2016). A Textbook of Modern Economic Botany, Wiley Eastern Limited, New Delhi.
7. Sharma, O.P. (1998). Hill's Economic Botany (Late Dr. A.F. Hill, adapted by O.P. Sharma), Tata McGraw Hill Co., Ltd., New Delhi.
8. Simpson, B.B. and Ogorzaly, M.C. (1986). Economic Botany: Plant in our World, McGraw Hill Book Company, New Delhi.

**M.Sc. (Botany) – Part II (SEMESTER IV)**

Session: 2021-2022, 2022-2023		Semester-IV		
Paper Code	M-BOT-T-4.5			
Name of Course	Plant Diseases and Management (Optional i) (Pre-requisite is M-BOT-T-3.5)			
	<b>Theory</b>	<b>Practical</b>	<b>Internal</b>	
Maximum Marks	70	30	30	
Pass Percentage	35%	35%	35%	
Credits	4	1.5	-	
Lectures per week (of one hour duration)	4	3	-	

**Objective of the paper** is to give knowledge to students about the Symptoms, Disease Cycle, and Control Measures of diseases caused by different types of Pathogens.

***Question Paper Format (Rules and Regulations)***

The Question paper will consist of three sections A, B and C. Section A and B will have four questions each from their respective units, the students are required to attempt any two questions from each section, and each question will carry 10 marks each (10×4). Section C is Compulsory and will consist of 10 Short answer questions covering the entire Syllabus with 3 Marks each (3×10).

**INSTRUCTIONS FOR THE CANDIDATES**

Candidates are required to attempt two questions each from section A and B and the entire section C which is compulsory.

**SECTION-A**

- 1) Symptoms, Disease Cycle and Control Measures of diseases caused by Protozoic and Oomycetous fungi with particular reference to Club Root of Crucifers, Damping off of Seedlings, Downy Mildew of Bajra, Late Blight of Potato.
- 2) Symptoms, Disease Cycle and Control Measures of Diseases caused by Chytridiomycetous, Zygomycetous and Ascomycetous Fungi with particular reference to Black Wart of Potato, Brown Spot of Maize and Soft Rot of Fruits and Vegetables, Stem Galls of Coriander, Peach Leaf Curl, Powdery Mildew of Cereals, Ergot of Grains, Apple Scab.
- 3) Symptoms, Disease Cycle and Control Measures of Disease caused by Basidiomycetous Fungi: Smuts and Bunt Fungi with particular reference to Corn Smut, Loose Smut of Wheat, Smut of Sugarcane, Smut of Bajra, Smut of Sorghum, Flag Smut of Wheat, Leaf Smut of Rice, Karnal Bunt of Wheat.
- 4) Symptoms, Disease Cycle and Control Measures of Disease caused by Basidiomycetous Fungi: Rusts with particular reference to Black Stem Rust of Wheat, Brown Rust of Wheat, Yellow Stripe Rust of Wheat, Rust of *Linum*; Re-occurrence of Cereal Rust Diseases in India-A General Account.

**SECTION-B**

- 5) Symptoms, Disease Cycle and Control Measures of Disease caused by Mitosporic Fungi with particular reference to *Alternaria*, Leaf Spot of Crucifers, Early Blight of Potato, Tikka Disease of Groundnut, Blast of Rice, *Fusarium* Wilt of Tomato, Red Rot of Sugarcane, Gram Blight, Anthracnose of Chillies.
- 6) Symptoms, Disease Cycle and Control Measures of Disease caused by Bacteria with particular reference to Angular Leaf Spot of Cotton, Crown Gall Disease of Plants, Blight of Rice, Common Scab of Potato. Symptoms, Disease Cycle and Control Measures of Diseases caused by Viruses with particular reference to Tobacco Mosaic, Leaf Roll of Potato, Leaf Curl of Papaya, Tristeza of Citrus.



- 7) Symptoms, Disease Cycle and Control Measures of Diseases caused by Mollicutes with particular reference to Grassy Shoot of Sugarcane, Sandal Spike, *Sesamum* Phyllody, Little Leaf Disease of Brinjal, Symptoms, Disease Cycle and Control Measures of Diseases caused by Nematodes with particular reference to Root Knot of Plants, Ear Cockle of Wheat, Molya Disease of Barley and Golden Nematode of Potato.
- 8) Plant Diseases Management: Basic Principles of Plant Disease Management with particular reference to Quarantine, Cultural, Biological, Physical and Chemical Methods, Integrated Pest Management (IPM), Application of Biotechnology in Plant Disease Management.

#### **RECOMMENDED READINGS:**

1. Agrios, G.N. (2005). Plant Pathology, Academic Press, New York.
2. Chandniwala, K.M. (1996). An Introduction to Plant Pathology, Anmol Publications, Pvt. Ltd., New Delhi.
3. Heald, F.D. (2016). Manual of Plant Diseases (Volume 1 & 2), Biotech Books, New Delhi.
4. Mehrotra, R.S. and Aggarwal, A. (2013). Plant Pathology, Tata McGraw Hill Publishing Co., Pvt. Ltd., New Delhi.
5. Nagarajan, S. 1990. Plant Disease Epidemiology, Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
6. Singh, R.S. (2009). Plant Diseases, Oxford and IBH Publishing Co., Pvt. Ltd., New Delhi.
7. Singh, R.S. (2009). Principles of Plant Pathology, Oxford and IBH Publishing Co., Pvt. Ltd., New Delhi.
8. Tar, S.A.J. (1972). Principles of Plant Pathology, MacMilan Press, London.
9. Wheeler, H. (2012). Plant Pathogenesis, Springer-Verlag, Berlin Heidelberg.

## M.Sc. (Botany) – Part II (SEMESTER IV)

Session: 2021-2022, 2022-2023		Semester-IV	
Paper Code	M-BOT-T-4.6		
Name of Course	Agricultural Botany (Optional ii)		
	<b>Theory</b>	<b>Practical</b>	<b>Internal</b>
Maximum Marks	70	30	30
Pass Percentage	35%	35%	-
Credits	4	1.5	-
Lectures per week (of one hour duration)	4	3	-

**Objective of the paper** is to acquaint the students Centres of Origin, cytology and genomic analysis of different field crops and morphology and reproductive biology of important field crops. The students are made well versed with the concept of diseases affecting different field crops, their causes and management by taking the example of diseases of important field crops of Punjab.

### ***Question Paper Format (Rules and Regulations)***

The Question paper will consist of three sections A, B and C. Section A and B will have four questions each from their respective units, the students are required to attempt any two questions from each section, and each question will carry 10 marks each (10×4). Section C is Compulsory and will consist of 10 Short answer questions covering the entire Syllabus with 3 Marks each (3×10).

### **INSTRUCTIONS FOR THE CANDIDATES**

Candidates are required to attempt two questions each from section A and B and the entire section C which is compulsory.

#### **SECTION-A**

- 1) Centre of origin of crops; Plant Genetic Resources- a general account.
- 2) Morphology and Reproductive Biology of Wheat, Maize, Cotton and *Brassica*.
- 3) Cultivation practices and improved varieties of important crops of Punjab (Wheat, Rice, Cotton, Potato, Brassica and Sugarcane).
- 4) Methods of breeding for self-pollinated (Wheat), cross pollinated (Maize) and vegetatively propagated (Sugarcane) crops; Objectives for breeding the major crops of Punjab with particular reference to Wheat, Rice, Maize, Cotton, Sugarcane, Potato and *Brassica*.

#### **SECTION-B**

- 5) Role of Biotechnology in breeding of crop - a brief account.
- 6) General idea about the concept of diseases affecting cultivated crops, major causes, symptoms and management.
- 7) Cytology and Genomic analysis of important crops of Punjab (Wheat, Rice, Potato and *Brassica*). Genetics of disease resistance in Wheat and Rice.
- 8) Diseases of following crops with particular reference to Punjab with emphasis on Causal organism, Epidemiology, Symptoms, Disease cycle and Management:
  - a) **Wheat:** Powdery mildew, rust diseases, loose smut of wheat, karnal bunt of wheat, Yellow ear rot and ear cockle of wheat.
  - b) **Rice:** Brown leaf spot, blast diseases, false smut, bacterial blight.
  - c) **Maize:** Downy mildew, brown spot and Head smut.
  - d) **Sugarcane:** Red rot, smut disease, ratoon stunting, grassy shoot.
  - e) **Brassica:** Club root of crucifers, white rust, leaf spot.
  - f) **Potato:** Potato wart, late blight, early blight, common scab of potato, golden nematode.

## **RECOMMENDED READINGS:**

1. Agrios, G.N. (2005). Plant Pathology, Academic Press, New York.
2. Brown, J., Caligari P.D.S. and Campos H.A. (2014). Introduction to Plant Breeding, 2<sup>nd</sup> Edition, Wiley Blackwell, USA.
3. Chaudhury, R.C. (2017). Introductory Principles of Plant Breeding, Oxford and IBH Pub. Co. Pvt. Ltd., New Delhi.
4. Heald, F.D. (2016). Manual of Plant Diseases (Volume 1 & 2), Biotech Books, New Delhi.
5. Mehrotra, R.S. and Aggarwal, A. (2013). Plant Pathology, Tata McGraw Hill Publishing Co., Pvt. Ltd., New Delhi.
6. Singh, B.D. (2013). Plant Breeding, Kalyani Publishers, New Delhi.
7. Singh, R.S. (2009). Plant Diseases, Oxford & IBH Publishing Co., Pvt. Ltd., New Delhi.
8. Vijendra Das, L.D. (1998). Plant Breeding, New Age International Publishers, New Delhi.

### M.Sc. (Botany) – Part II (SEMESTER IV)

<b>Session: 2021-2022, 2022-2023</b>		<b>Semester-IV</b>
<b>Paper Code</b>	M-BOT-L-4.1	
<b>Practical Paper</b>	Pertaining to M-BOT-T- 4.1 and M-BOT- T-4.2	
<b>Maximum Marks</b>	60	
<b>Pass Percentage</b>	35%	
<b>Credits</b>	3	

#### **M-BOT-T-4.1 Crop Genetics and Plant Breeding (List of Practicals)**

1. To Study about Plant Breeder's kit and Floral Biology.
2. Study of Botanical Description and Reproductive Biology of Crops (Wheat, Maize, Sugarcane, Potato, Mustard).
3. To Study the Effect of selfing in Self Pollinated and Cross Pollinated Crops.
4. To Study about Field layouts of experiments, Field Trials and Maintenance of Records.
5. Hybrid Seed Production by Emasculation and Hand Pollination.
6. Estimation of Heterosis and Inbreeding Depression.
7. Estimation of Variability Pattern including Genotypic Coefficient of Variation, Phenotypic Coefficient of Variation and Heritability.
8. To Work out the Type and Level of Ploidy of the available Plant material with the given Base Number.
9. Study of Effect of Chemical Mutagens (EMS, MH) in *Allium* system.
10. Induction of Autopolyploidy using Colchicine.
11. Numerical problems related to Quantitative Inheritance and Self-Incompatibility.
12. Seed Tests: Seed Purity, Seed Germination, Seed Viability and Seed Health Test.

#### **M-BOT-T-4.2 Biodiversity and Global Climate Change (List of Practicals)**

1. To study the distribution of different types of forest in the world from the map.
2. To study the botanical zones of India from a map.
3. To study national parks, biosphere reserves, wetlands and sanctuaries of India from map.
4. Visit various Conserved areas of Punjab and make Project report.
5. To prepare a project report based on the study of endemic flora of lower Shivalik hills.
6. To study Climate Trends: Create temperature graphs for your hometown using secondary data, ground station and satellite sources.
7. Case study of Climate Changes in terms of Emission of CO<sub>2</sub>, NO<sub>(x)</sub>, SO<sub>2</sub> Emission, Smog level, Temperature and Rainfall parameters in major cities of Punjab during the last two decades.
8. Create CO<sub>2</sub> graphs (World and India).

### M.Sc. (Botany) – Part II (SEMESTER IV)

Session: 2021-2022, 2022-2023		Semester-IV
Paper Code	M-BOT-L-4.2	
Practical Paper	Pertaining to M-BOT-T-4.3 and M-BOT-T-4.4	
Maximum Marks	60	
Pass Percentage	35%	
Credits	3	

#### **M-BOT-T-4.3 Plant Tissue Culture and Biotechnology (List of Practicals)**

1. To Prepare different Media used for Tissue Culture Techniques.
2. To Prepare Cell Culture after mechanical Isolation of Mesophyll cells from the Leaves.
3. To Induce Somatic Embryogenesis in Carrot/ Citrus.
4. To Prepare Anther and Pollen Culture for Haploid Production.
5. To Study Cell Suspension Cultures.
6. To Demonstrate Embryo Culture/ Embryo Rescue Method.
7. To Perform Meristem Tip Culture for Virus Free Plant Production in Sugarcane.
8. To Write and Perform Steps of Micropropagation for Potato, Gladiolus, Banana.
9. To Write Requirement used for Cryopreservation of Plant Material.
10. To Prepare Synthetic Seeds of given Material.
11. Isolation of DNA from Plants.
12. Quantification of DNA from Plants.
13. Separation of DNA by Horizontal Gel Electrophoresis
14. Immobilization Techniques employing Microorganisms.
15. Removal of Chromium/ Nitrate/ Ammonia by Immobilized Cyanobacterial cells.
16. Demonstration of DNA Amplification by PCR.
17. To Determine the Specific Growth Rate and Generations time of a Bacterium/Yeast during Submerged Fermentation.
18. To Study the Effect of Temperature and pH on the Growth of Microorganisms.
19. To Study the Role of Plants in the Removal of Contaminants/Metals from the Soil

#### **M-BOT-T-4.4 Plant Resource and Utilization (List of Practicals)**

1. To Study the Different Types of Starch Grains: Wheat, Rice, Maize, Bean, and Potato.
2. To Study the Morphological and Anatomical Features of the following plants:
  - a) Spices and Condiments: Ginger, Haldi, Black pepper, Cardamon, Cinnamon, Clove, Fennel, Coriander, Cumin.
  - b) Medical plants: *Aconitum*, *Allium sativum*, *Adhatoda vasaka*, *Aloe*, *Artemisia*, *Azadirachta indica*, *Belladonna*, *Cinchona*, *Digitalis*, *Ferula asfoetida*, *Ginkgo biloba*, *Ginseng*, *Glycyrrhiza*, *Ocimum sanctum*, *Papaver*, *Rauwolfia*, *Nux-vomica*.
  - c) Fibers: *Saccharum munja*, Cotton, *Cannabis*.
  - d) Oil Seeds: Cotton seed, Groundnut, Castor, Mustard, Coconut, Sunflower, Soyabean.
3. To Study the Raphides in *Eichhorina*.
4. To Study the Calcium Carbonate Crystals (Cystolith) in *Ficus*.
5. To Study texture and density of Different Types of Woods.

## M.Sc. (Botany) – Part II (SEMESTER IV)

Session: 2021-2022, 2022-2023		Semester-IV
Paper Code	M-BOT-L-4.3	
Practical Paper	Pertaining to M-BOT-T-4.5(i) or M-BOT-T-4.5(ii)	
Maximum Marks	30	
Pass Percentage	35%	
Credits	1.5	

### Optional Papers

#### M-BOT-T-4.5: Plant Diseases and Management (Optional i)

1. Preparation of Culture Medium (PDA) and Culturing of Fungi.
2. Study of the Disease Symptoms and Histopathological details of the following:
  - A. *Oomycota*: Downy Mildew of Bajra/*Trifolium*.
  - B. *Chytridiomycota*: Symptoms of Black Wart of Potato (*Synchytrium endobioticum*).
  - C. *Ascomycota*: Powdery Mildew of Wheat (*Blumeria graminis tritici*), Dalbergia and Poplar, Ergot of Grains, Apple Scab, Peach Leaf Curl (*Taphrina deformans*), Leaf Spot of Grass.
  - D. *Basidiomycota*: **Smuts and Bunts**: Loose Smut of Wheat. Smut of Sugarcane, Flag Smut of Wheat, Smut of Bajra, Smut of Sorghum, Karnal Bunt, Hill Bunt (symptoms); **Rusts**: Stages of *Puccinia* on *Berberis*, Stages of *Puccinia* on wheat, Stages of *Melampsora* on linseed.
  - E. Mitosporic Fungi: Red rot of Sugarcane (*Colletotrichum falcatum*), Leaf Spot of *Trifolium*
  - F. Bacteria: Citrus Canker
  - G. Viruses: Leaf Curl of Papaya, Leaf Roll of Potato and Yellow Vein Mosaic of Bhindi.
  - H. Mycoplasma: Little Leaf Disease of Brinjal.
  - I. Nematode: Root Knot of Vegetable (Study of different Stages in the life cycle), Ear Cockle of Wheat.

#### M-BOT-T-4.6: Agricultural Botany (Optional ii)

1. Study of botany, floral biology and meiosis of Wheat.
2. Study of botany, floral biology and meiosis of Maize.
3. Study of botany, floral biology and meiosis of Rice.
4. Study of botany, floral biology and meiosis of Brassica.
5. Study of botany, floral biology and meiosis of Cotton.
6. Study of pathogen and disease symptoms of Rust, Smut, Karnal bunt and Ear cockle of Wheat.
7. Study of pathogen and disease symptoms of Brown leaf spot, Blast diseases, False smut and Bacterial blight of Rice.
8. Study of pathogen and disease symptoms of Red rot of Sugarcane, White rust of Brassica, Late blight and Early blight of Potato.
9. Study of symptoms of various diseases caused by Nematode infection.