M.Sc. (Botany) – Part I (SEMESTER I)

Session: 2021-22, 2022-2023			Semester-I
Paper Code	M-BOT-T-1.1		
Name of Course	Phycology and Bryology		
	Theory	**Practical**	**Internal**
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 Principles and Systems of Algal Classification, different Characteristic Features of Algae, Life Cycles and Interrelationships of important groups of Algae as well as Economic importance of Algae. The students are also well versed about the Origin, Classification, General Characteristics and Alternation of Generations of Hepaticopsida, Anthocerotopsida and Bryopsida.

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) **Classification and General Characteristics of Algae:** General Characteristics, Important systems of classification, Habitat, Thallus Organization, Nutrition, Algal Pigments and their comparative account, Food Reserves, Cell wall Composition, Flagellation, Chloroplasts, Reproduction, Life Cycle Patterns.
2) **Cyanophyta, Chlorophyta, Charophyta and Xanthophyta: Cyanophyta:** Cell Structure, Thallus organization, Heterocyst and Akinete development and their role; Reproduction; Paddy soil cyanophytes and their role; **Chlorophyta, Charophyta and Xanthophyta:** Salient Features, Comparative account of Range of Thallus Organization, Methods of Reproduction, Life Cycles and Alternation of Generation, Interrelationship between Chlorophyta, Charophyta and Xanthophyta.
3) **Bacillariophyta, Cryptophyta, Phaeophyta and Rhodophyta:** Salient Features, Range of Thallus Organization, Methods of Reproduction, Life Cycles and Alternation of Generation of Bacillariophyta, Cryptophyta, Phaeophyta and Rhodophyta.
4) **Economic, Ecological and Biotechnological Importance of Algae:** Algae as Experimental Systems, CO_2 Fixers, Source of Colloidal Polysaccharides (Agar, Carragenin and Alginate), Biofuels, Biofertilizers; Role of Algae in Bioremediation, Pharmaceuticals and Nutraceuticals; Biotechnological Potential of Symbiotic Algae; Genetic Modification of Algae and its Potential.

SECTION-B

5) **Classification and General Characteristics of Bryophytes:** Origin, General Characteristics, Classification, Habitat, Morphology, Gametophytes and Sporophytes

and Alternation of Generation, Evolution of Gametophytic and Sporophytic Generations, Origin and Fate of Archesporium in Bryophytes, Factors affecting Sexuality in Bryophytes, Economic and Ecological Importance of Bryophytes.

6) **Hepaticopsida:** General Characters, Classification, Morphology, Anatomy, Life Cycle Pattern and Affinities of Marchantiales, Sphaerocarpales, Metzeriales, Jungermanniales and Calobryales.
7) **Anthocerotopsida:** General Characters, Classification, Morphology, Anatomy, Life Cycle Pattern and Affinities of Anthocerotales.
8) **Bryopsida:** General Characters, Classification, Morphology, Anatomy, Life Cycle Pattern and Affinities of Andreaidae, Sphagnidae, Tetraphidae, Polytrichidae, Buxbaumidae, Bryidae and Archidiidae.

RECOMMENDED READINGS:

1. Glime, J.M. and Saxena, D. 1991. Uses of Bryophytes. Today and Tomorrow's Printers and Publication, New Delhi.
2. Kumar, H.D. 1998. Introductory Phycology. East West Press Ltd., New Delhi.
3. Lee, R.E. 2016. Phycology. Cambridge University Press, UK.
4. Morris, I. 1986. An Introduction to the Algae. Cambridge University Press, UK
5. Round, F.E. 1986. The Biology of Algae. Cambridge University Press, Cambridge.
6. Sahoo, D. and Sechbach J. 2015. The Algae World. Springer, Netherland.
7. Schofiled, W.D. 1985. Introduction to Bryology. MacMillan, New York.
8. Van den Hoek, C., Mann, D.J. and John, M.H. 1995. Algae: An Introduction to Phycology. Cambridge University Press.

M.Sc. (Botany) – Part I (SEMESTER I)

Session: 2021-22, 2022-2023			Semester-I
Paper Code	M-BOT-T-1.2		
Name of Course	Mycology		
	Theory	**Practical**	**Internal**
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 Nomenclature, Phylogeny, Genetics, Structure, Reproduction, Diversity and Economic Importance of Different Groups of Fungi and Fungi like Organisms.

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 General Account of Fungi, Fungal Structure and Ultrastructure of Cell Wall, Growth and Differentiation, Fungal Nutrition.
2) Fungal Nomenclature, Classification and Phylogeny, Impact of Molecular Systematics on Fungal Classification.
3) Fungal Genetics: Structure and Organization of Fungal Genome, Mitochondrial Genes, Non-sexual Variation – Haploidy, Heterokaryosis and Parasexuality, Sexual Variation – Homothallism and Heterothallism, Sex Hormones.
4) Fungi like Organisms: General account of Kingdom Chromista with particular reference to Oomycota, Hyphochytridiomycota and Labyrinthulomycota; Kingdom Protozoa with particular reference to Plasmodiophoromycota, Dictyosteliomycota, Acrasiomycota and Myxomycota and Life Cycle Pattern in Fungi like Organisms.

SECION-B

5) A General Account of Chytridiomycota, Zygomycota, Ascomycota and Basidiomycota. Life Cycle Pattern in True Fungi.
6) General Characters of Mitosporic Fungi and Classification.
7) Range of Variations and Evolution of Fructification in Fungi, Variations in Asexual Reproduction in Fungi, Origin and Evolution of Sex in Fungi including Hormonal Control.
8) Economic Importance: Fungi for Food, Enzymes and Pharmaceuticals, as Symbionts (Lichens and Mycorrhiza), as Biological Control Agents; Mushroom: Cultivation - a General Account.

RECOMMENDED READINGS:

1. Agrios, G.N. 2005. Plant Pathology, Academic Press, New York.
2. Alexopoulos, C.J., Mims, C.W. and Blackwell, M. 1996. Introductory Mycology, John Wiley and Sons, New York.
3. Alexopoulos, C.J., Mims, C.W. and Blackwell, M. 2007. Introductory Mycology, 4th Edition, John Wiley and Sons, New York.
4. Aneja, K.R. and Mehrotra, R.S. 2015. An Introduction to Mycology, New Age International Publishers, New Delhi.
5. Deacon, J.W. 2007. Modern Mycology, 3rd Edition, Blackwell Science Ltd., U.K.
6. Heald, F.D. 2016. Manual of Plant Diseases, Volume 1 & 2, Biotech Books, New Delhi.
7. Sumbali, G. 2010. The Fungi, 2nd Edition, Narosa Publishing House, New Delhi.
8. Webster, J. and Webes, R. 2007. Introduction to Fungi, 3rd Edition. Cambridge University Press, Cambridge.

M.Sc. (Botany) – Part I (SEMESTER I)

Session: 2021-22, 2022-2023			Semester-I
Paper Code	M-BOT-T-1.3		
Name of Course	Cell and Molecular Biology		
	Theory	**Practical**	**Internal**
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 the ultra structure of Prokaryotic and Eukaryotic Cell, Cell Organelles and Cytoskeleton. The students will also learn about the Structure of Nucleic Acids, Mechanism of Replication of Genetic Material, Transcription and Translation in Prokaryotes and Eukaryotes.

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 Properties of Cell, Classes of Cells, Cell Structure, Structural Organization and Function of Cell wall, Plasma Membrane and its Composition, Transport across Cell Membranes, Extracellular Matrix and Cell Interactions.
2) Ultrastructure and Function of Cell Organelles: Endoplasmic Reticulum, Golgi Apparatus, Lysosomes, Vacuoles, Ribosomes, Peroxisomes. Nucleus (Nuclear Envelope, Nuclear Pore Complex and Nucleolus).
3) Ultrastructure, Functions, Biogenesis and Semiautonomous Nature of Mitochondria and Chloroplast. Structure and Organization of Microtubules, Intermediate Filaments and Microfilaments and their Role in the Cell Mobility and Cell Division.
4) Mechanism of Cell Cycle Control: Cyclins, Cyclin Dependent Kinases (CDKs), Maturation Promoting Factor (MPF) and Genes involved in Cell Cycle Control, Mechanism of Programmed Cell Death.

SECTION-B

5) Nucleic Acids as Genetic Material: Nomenclature, Composition and Structure, Three Dimensional Structure of DNA (Prokaryotes, Eukaryotes and Viral), Types of DNA (A-, B- , Z-DNA), Organization of DNA in Viral, Prokaryotic and Eukaryotic Chromosomes, C- value Paradox, Cot curve and its Significance, Chromatin and its Organization (Nucleosome Model), Structure and Functions of Different Types of RNA.
6) Replication in Prokaryotes and Eukaryotes: Replication Machinery including DNA Polymerases, DNA Topoisomerase, DNA Ligase and other Components; Replication of DNA in Prokaryotes, RNA Viruses and Eukaryotes.

7) Transcription in Prokaryotes and Eukaryotes: Transcription Factors and Machinery, Formation of Initiation Complex, Transcription activators and Repressors, RNA Polymerases, Elongation and Termination, RNA Processing (Introns and Exons, RNA Modifications through Intron Removal), Spliceosome Machinery, Splicing Pathways, Alternative Splicing, RNA Editing (Exon Shuffling, Polyadenylation and Capping) and mRNA Transport.
8) Translation in Prokaryotes and Eukaryotes: Structure of Ribosomes, Initiation, Elongation and Termination of Polypeptide Chain, Translational Proofreading, Post-Translational Processing of Polypeptide Chain; Inhibitor of Protein Synthesis, Regulation of Translation: Role of Cell Signaling Pathways (Phosphoinositide 3-kinase (PI3K)/AKT and the Mitogen-Activated Protein Kinase (MAPK)) and microRNA (miRNA).

RECOMMENDED READINGS:

1. Alberts, B., Johnson, A., Lewis, J., Morgan, D., Raff, M., Roberts, K., Walter, P. 2015. Molecular Biology of the Cell, 6th Edition. Garland Science. Taylor & Francis Group. New York, US.
2. Cooper G.M. and Hausman, R.E. 2009. The Cell: A Molecular Approach, 5th Edition, Sinauer Associates, MA, USA.
3. Craig, N.L., Cohen-Fix O., Green R., Greider C., Storz G., Wolberger C. 2014. Molecular Biology, Principles of Genome Function, 2nd Edition. Oxford University Press. U.K.
4. De Robertis, E.D.P. and De Robertis, E.M.F. 2006. Cell and Molecular Biology, 8thEdition, Lippincott Williams and Wilkins, Philadelphia.
5. Hardin, J., Bertoni, G. and Kleinsmith, L.J. 2012. Becker's World of the Cell, 8th Edition, Benjamin Cummings, NY, USA.
6. Hyde, D. R. 2016. Genetics and Molecular Biology. McGraw Hill Education (India) Pvt. Ltd. New Delhi.
7. Karp, G. 2014. Cell and Molecular Biology: Concepts and Experiments, 8th Edition, John Wiley and Sons Inc.USA.
8. Klug, W.S., Cummings, M.R. Spenser, C.A. and Palladino, M.A. 2012. Concepts of Genetics, 10th Edition, Pearson Education Inc. USA.
9. Lodish, H., Berk, A. Kaiser, C.A., Bretscher, A. Ploegh, H., Amon, A. and Martin, K.C. 2016. Molecular Cell Biology, 8th Edition, W.H. Freeman and Company, New York, USA.
10. Nelson, D.L. and Cox, M.M. 2015. Lehninger's Principles of Biochemistry, 4th Edition, W. H. Freeman and Company, New York
11. Russell, P.J. 2016. iGenetics- A Molecular Approach. Pearson India Education Services, Pvt. Ltd., Noida, India.
12. Watson, J.D., Baker, T.A., Bell, S.P., Gann, A. Levine, M. and Losick, R. 2019. Molecular Biology of the Gene, 7th Edition, Pearson India Education Pvt. Ltd. Noida, India.

M.Sc. (Botany) – Part I (SEMESTER I)

Session: 2021-22, 2022-2023			Semester-I
Paper Code	M-BOT-T-1.4		
Name of Course	Research Techniques		
	Theory	**Practical**	**Internal**
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 Principles of Research Techniques, Laboratory Safety Protocols, Preparation of Solutions, Principle and Applications of Microscopy, Histochemical and Immunological Techniques, Centrifugation, Spectroscopy, Electrophoresis and Chromatographic Techniques.

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 Principles of Research Techniques and Safety Measures:** Aims of Lab Investigation, Experimental Designs, SI Units, Laboratory Safety Protocols, Material Safety Data Sheets (MSDS), Physical and Biological Hazards, Waste Disposals, Preparation of Solutions (Parts per Million, Percent, Normal, Molar and Molal).
2) **Microscopy:** Principle, Working and Applications of Bright Field and Phase Contrast Microscope, Fluorescent Microscope, Electron Microscope (Transmission and Scanning), Atomic Force Microscope.
3) **Anatomical and Histochemical Techniques:** Principle of Fixation, Types of Fixatives and their Applications, Sectioning (Paraffin, Frozen, Cryostat and Microtome), Stains and Staining Techniques, Maceration Technique, Principle and Methods of Histochemical Localization of Carbohydrates, Lipids, Proteins, Nucleic Acids and Enzymes.
4) **Hybridization and Immunological Techniques:** *In situ* hybridization (ISH), Southern Blotting, Northern Blotting, Fluorescence *in situ* hybridization (FISH), Chromogenic *in situ* hybridization (CISH), Antigen-antibody interactions, Enzyme Linked Immunosorbent Assay (ELISA), Western Blotting, Radioimmunoassay, Immunoprecipitation, Immunofluorescence, Flow cytometry.

SECTION-B

5) **Centrifugation:** Basics of Centrifugation, Types of Rotors, Principle, Working and Applications of Small Bench Centrifuge, High Speed Refrigerated Centrifuge and Ultracentrifuge.
6) **Spectroscopy:** Basics of Spectroscopy, Types of Spectroscopy, Principle, Working and Applications of UV-Visible Spectrophotometer, Spectrofluorometer and Atomic Absorption Spectrometer.
7) **Electrophoresis:** Basics of Electrophoresis, Types of Electrophoresis, Principle, Working

and Applications of Gel (Horizontal and Vertical), SDS PAGE, Pulsed Field Gel Electrophoresis (PFGE) and Two Dimensional Gel Electrophoresis.

8) **Chromatographic Techniques:** Basics of Chromatography, Principle and Applications, Types: Paper Chromatography, Column Chromatography, High Performance Liquid Chromatography (HPLC), Thin Layer Chromatography (TLC), HPTLC, Ion Exchange Chromatography, Gel Filtration Chromatography and Gas Chromatography

RECOMMENDED READINGS:

1. Black, J.G. 2015. Microbiology: Principles and Explorations, 9th Edition, John Wiley & Sons, USA.
2. Buchwalow, I.B. and Bocker, W. 2014. Immunohistochemistry: Basics and Methods, Springer, Berlin Heidelberg.
3. Crown, M.K. 2012. Microbiology, A Systems Approach, 3rd Edition, The McGraw- Hill Companies, New York, USA.
4. Karp, G. 2014. Cell and Molecular Biology: Concepts and Experiments, 8th Edition, John Wiley and Sons Inc.USA.
5. Kiernan, J.A. 2015. Histological and Histochemical Methods, 5th Edition, Cold Spring Harbor Laboratory Press, New York, USA.
6. Nelson, D. L. and Cox M.M. 2013. Lehninger Principles of Biochemistry, 6th Edition. W.H. Freeman and Company, New York.
7. Pelczar, M.J., Chan, E.C.S. and Krieg, N.R. 2001. Microbiology, 5th Edition, Tata McGraw-Hill Education, India.
8. Plummer, David T. 2001. An Introduction to Practical Biochemistry, 3rd Edition, Tata McGraw Hill. Publisher Com. Ltd., New Delhi.
9. Rao, B.S. and Deshpande, V. 2000. Experimental Biochemistry. A Student Companion. I.K. International Pvt. Ltd., New York.
10. Singh, C.P. 2015. Research Methods in Plant Sciences, Agrotech Press, New Delhi.
11. Tortora, G.J. 2014. Microbiology: An Introduction, 12th Edition, Pearson Education, India.
12. Willard, H.H., Merritt, L.L., Dean, J.A. and Settle, F.A. 2018. Instrumental Methods of Analysis, CBS Publishers and Distributors Pvt. Ltd., New Delhi.
13. Wilson, K. and Walker, J. 2009. Principles and Techniques of Biochemistry and Molecular Biology. Cambridge Univ. Press, India.

M.Sc. (Botany) – Part I (SEMESTER I)

Session: 2021-22, 2022-2023			Semester-I
Paper Code	M-BOT-T-1.5		
Name of Course	Microbiology		
	Theory	**Practical**	**Internal**
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 History of Microbiology; Characteristics of different Microbial Groups; Structure and Nutritional Types of Microbes; Culture Techniques, Reproduction and Economic Importance of Microbes.

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:** Historical Development and relevance of Microbiology to Life Sciences. Microbial Groups: Prokaryotes (Bacteria, Archaebacteria, Cyanobacteria, Mycoplasma, Actinomycetes), Eukaryotes (Molds, Slime molds, Yeast, Algae, Fungi, Protozoa) and Viruses (Bacterial, Plant and Animal); a General Account of Characteristics, Structure, Reproduction, Life Cycle and Functions of these Microbial Groups.
2) **Nutrition of Microbes:** Nutritional Categories among Micro-organisms, Role of Carbon, Nitrogen, Oxygen, Sulfur, Growth Factors etc. in Microbial Nutrition.
3) **Microbial Techniques:** Pure culture Techniques, Preparation of Culture Media, Types of Media, Sterilization Techniques, Methods for Culturing Anaerobic and Aerobic Microorganisms, Cultural Characteristics, Synchronous and Continuous culture, Maintenance and Preservation of Cultures.
4) **Growth of Microorganisms:** Definition, Mathematical Expression, Growth Curve (s), Factors affecting Growth of Microorganisms and Measurement of Microbial Growth.

SECTION-B

5) **Microbial Reproduction:** Asexual and Sexual. A Detailed Account on Bacterial Conjugation, Transformation and Transduction.
6) **Role of Microorganisms in Geochemical Cycles:** Microorganisms as Agent of Geochemical Change, Cycles of Matter and Microbial Interactions.
7) **Biological Nitrogen Fixation:** Microbiology of Symbiotic and non-symbiotic Nitrogen Fixation, Root Nodule Formation and its Functions, Nitrogen Fixation by Cyanobacteria.
8) **Economic Importance:** Role of Microbes in Pharmaceutical, Dairy and Food Industry, Biofuel Production and Bioremediation. A Brief Account on Common Microbial Human Diseases.

RECOMMENDED READINGS:

1. Atlas, R.M. 1997. Principles of Microbiology, WC Brown Publishers, USA.
2. Black, J.G. 2015. Microbiology: Principles and Explorations, 9th Edition, John Wiley & Sons, USA.
3. Crown, M.K. 2012. Microbiology: A Systems Approach, 3rd Edition, The McGraw-Hill Companies, New York, U.S.A.
4. Goldman, E. and Green, H.L. 2009. Practical Handbook of Microbiology, CRC Press, USA.
5. Madigan, M.T., Martingo, J.M., Stahl, D.A. and Clark, D.P. 2011. Brock Biology of Microorganisms, Pearson Education Ltd., USA.
6. Nester, E.W. Anderson, D., Roberts, Jr. and Evans, C. 2011. Microbiology: A Human Perspective, McGraw-Hill Education, India.
7. Pelczar, M.J., Chan, E.C.S. and Krieg, N.R. 2001. Microbiology, 5th Edition, Tata McGraw-Hill Education, India.
8. Pommerville, J.C. 2012. Alcamo's Fundamentals of Microbiology, Jones & Bartlett Learning, USA.
9. Shors, T. 2013. Understanding Viruses, Second Edition, Jones & Bartlett Learning, USA.
10. Stanier, R.Y., Ingraham, J.L., Wheelis, M.L. and Painter, P.R. 2005. General Microbiology, 5th Edition, Mac-Millan, Hongkong.
11. Tortora, G.J. 2014. Microbiology: An Introduction, 12th Edition, Pearson Education, India.

M.Sc. (Botany) – Part I (SEMESTER I)

Session: 2021-22, 2022-2023			Semester-I
Paper Code	M-BOT-T-1.6		
Name of Course	Forest Botany		
	Theory	**Practical**	**Internal**
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 the Importance of Forests, Role of different Agencies dealing with Forestry, Forest Laws and Policies, Forest Classification, Forestry System, Principal Indian Timbers, Forest Utilization, Forest Management, Forest Mensuration and Forest Pathology.

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) Forests and Forestry: Introduction, Importance of Forests in Man's Life. Forest Types of India, Role of Forest Research Institute (FRI), National Green Tribunal (NGT), and Ministry of Environment and Forests and Climate Change in Indian Forestry, Forest Laws (Indian Forest Act, 1927; Forest Conservation Act, 1980; Biological Diversity Act, 2002; Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006 and National Forest Policy (1952 and 1988).
2) Forest Areas, Classification and Surveys including a Brief Account of Aerial Photography Interpretation and Remote Sensing and Geographic Information Systems (GIS).
3) Forestry Systems: A Brief account of Agroforestry, Social Forestry, Farm Forestry, Productivity Forestry and Commercial Forestry.
4) Methods for the Estimation of Biomass in Forest Ecosystem, Wood structure, Physical and Mechanical Properties of Wood, Wood Seasoning, Principal Indian Timbers, their Distribution and Grading, Uses of Teak, Sal, Shisham, Babul, Chir, Kail and Deodar.

SECTION-B

5) Forest Utilization: A brief account of Non-Wood Forest Products. Forest based Industries with particular reference to Paper and Pulp, Plywood, Katha, Resins, Match sticks and Sports goods.
6) Forest Management, Deforestation, Aforestation, Joint Forest Management, Village Forest Committees and Forest Mensuration: Objectives, Diameter Measurement, Instruments used in Diameter Measurement, Non instrumental Methods of Height Measurement - Shadow and Single Pole Method.
7) Silviculture and Silviculture Systems, Forest Nursery, Clear Felling, Uniform Felling, Shelter Wood and Coppice System, Tending Operations: Weeding, Cleaning, Thinning (Mechanical, Ordinary, Crown and Advance Thinning), Forest Regeneration: Natural Regeneration (from Seed and Vegetative parts), Coppicing, Pollarding and Root Suckers;

8) Forest Pathology- a general account of Different Decay Types, Symptoms and Management of Important Diseases of Sal, Shisham, Teak, Kiker, Deodar and Kail.

RECOMMENDED READINGS:

1) Champion, H.G. and Seth, S. K. 1968. Revised Classification of Forest types in India. FRI Dehradun.
2) Meerabai, G. and Pullaiah, T. 2015. Plant Biodiversity: Conservation and Management, Daya Publishing House, New Delhi.
3) Parthiban, K.T., Krishnkumar, N. and Karthick, M. 2020. Introduction to Forestry and Agroforestry. Scientific pubishers, Jodhpur.
4) Pearson, R.H. and Brown, H.P. 1981. Commercial Timbers of India (Vol. 1 & 2). A. J. Reprints Agency, New Delhi, India.
5) Puri, G.S. Indian Forest Ecology (Vol. 1 & 2). 1960. Oxford Books and Stationers, New Delhi.
6) Shanmughavel, P. 2014. Forest Botany. Pointer Publishers, Jaipur.
7) Tainter, F.H. and Baker, F.A. 2014. Principles of Forest Pathology. John Wiley & Sons, USA.

M.Sc. (Botany) – Part I (SEMESTER I)

Session: 2021-22, 2022-2023	**Semester-I**
Paper Code	M-BOT-L-1.1
Practical Paper	Pertaining to M-BOT-T-1.1 and 1.2
Maximum Marks	60
Pass Percentage	35%
Credits	3

M-BOT-T-1.1 Phycology and Bryology

1. Study of Morphological and Reproductive parts of following Algal genera:
2. Cyanophyta: *Anabaena*, *Microcystis*, *Oscillatoria*, *Scytonema.*
3. Chlorophyta: *Acetabularia*, *Chlorella*, *Cladophora*, *Chara*, *Codium*, *Hydrodictyon*, *Oedogonium*, *Pithophora*, *Spirogyra*, *Volvox*, *Ulothrix*, *Ulva*, *Zygnema*.
4. Xanthophyta: *Vaucheria*
5. Phaeophyta: *Dictyota*, *Ectocarpus*, *Fucus*, *Padina* and *Zonaria*.
6. Rhodophyta: *Batrachosepermum*, *Gelidium*, *Gracillaria* and *Polysiphonia*.
7. Permanent slide preparation: *Chara, Dictyota* and *Ulva.*
8. Study of morphological, anatomical and reproductive parts of following Bryophyte genera, Liverworts: *Riccia*, *Marchantia*, *Plagiochasma* and *Pellia*.
9. Study of Morphological, Anatomical and Reproductive parts of Hornworts: *Anthoceros*.
10. Study of Morphological, Anatomical and Reproductive parts of Mosses: *Funaria*, *Polytrichum* and *Pogonatum*.

    Note: The students are required to collect and submit 5 Algal and 5 Bryophytes specimens.

M-BOT-T-1.2 Mycology

1. To study the Morphology of following Myxomycetous Fungi: *Trichia*, *Hemitrichia* and *Stemonitis*.
2. To study comparative morphology of sporangiophores of the following Oomycetous Fungi: *Peronospora*, *Bremia* and *Sclerospora*.
3. To study Comparative Morphology of Ascocarps with particular reference to Cleistothecia (*Erysiphe*,), Perithecia (*Phyllachora*) and Apothecia (*Peziza)*, and *Morchella*.
4. To study Symptoms and Histopathological details of following: *Albugo candida*, *Synchytricum endobioticum*, *Protomyces macrosporus*, *Physoderma maydis*, *Erysiphe graminis*, *Urocystis tritici*, *Puccinia griminis tritici*, *P. recondita*, *P. striformis*, *Alternaria solani*, *Cercospora arachidicola* and *Colletotrichum capsici*.
5. To study Symptoms and Spore Morphology of *Ustilago*, *Urocystis*, *Sphaelotheca* .
6. To study the Range of Variation in Fructification of the following Basidiomycetous Fungi: *Clavaria*, *Ganoderma*, *Agaricus*.
7. To study different Spore Stages in the Life Cycle of *Puccinia* on Primary and Secondary host.

M.Sc. (Botany) – Part I (SEMESTER I)

Session: 2021-22, 2022-2023	Semester-I
Paper Code	M-BOT-L-1.2
Practical Paper	Pertaining to M-BOT-T-1.3 and 1.4
Maximum Marks	60
Pass Percentage	35%
Credits	3

M-BOT-T-1.3 Cell and Molecular Biology

1. To Compare the Stomatal Index of Surface of the Leaf (Dicot and Monocot).
2. To Study the Different Cell Organelles (Nucleus, Chloroplast, Mitochondria, Endoplasmic Reticulum, Golgi apparatus, Lysosomes, Vacuoles, Ribosomes and Peroxisomes) using Electron Micrographs.
3. Isolation of Chloroplasts from Spinach leaves.
4. Isolation of Chromatin from the Plant Material.
5. Determination of Chlorophyll Content using Spectrophotometer.
6. Isolation of Mitochondria from Liver.
7. Microscopic Observation of Actin and Myosin Filaments (using permanent slides).
8. To Study different Stages of Mitotic Cell Cycle in *Allium cepa* or *Vicia faba.*
9. To Study different Stages of Meiotic Cell Cycle in *Allium cepa.*
10. Isolation and Characterization of DNA from the Plant material.
11. Separation of DNA using $CsCl_2$-Density Gradient.
12. To Draw and Interpret Cot Curves from the Data.
13. To deduce the Sequence of Polypeptide from given DNA Sequences.

M-BOT-T-1.4 Analytical Techniques

1. To Prepare the Percent, Normal, Molal, Molar, ppm Solutions of Ethanol, Hydrogen Peroxide, Sodium Chloride and Glucose.
2. To Study the Principle, Design and Working of Micropipette, Autoclave, Hot Air Oven, Water Bath, Microscope, Laminar Air Flow, pH Meter, BOD Incubator.
3. To Study the difference between Magnification and Resolution Using Light Microscope.
4. Culture Technique for isolation and enumeration of Microbes.
5. Single Spore Isolation.
6. To Measure the size of given Pollen Grains/ Spores/ Cells with the help of Ocular Micrometer.
7. Maceration technique for the analysis of chromosomes and preparation of Camera Lucida Drawings for different stages.
8. Fixation and Staining technique for Chromosomal Studies.
9. To Study the histochemical localization of Proteins, Lipids and DNA using different Stains and Fixatives.
10. Spectrophotometric technique for Quantification of Proteins and Carbohydrates.
11. Chromatographic technique for Separation of Pigments/Amino Acids.
12. Preparation of Agarose Gel and SDS-PAGE for DNA Separation and Protein Separation.
13. Separation of DNA fragments using Horizontal Gel Electrophoresis.
14. Demonstration of Microtomy.

M.Sc. (Botany) – Part I (SEMESTER I)

Session: 2021-22, 2022-2023	Semester-I
Paper Code	M-BOT-L-1.3
Practical Paper	Pertaining to M-BOT-T-1.5 or 1.6
Maximum Marks	30
Pass Percentage	35%
Credits	1.5

M-BOT-T-1.5: Microbiology

1. Preparation of Culture Media for Culturing Bacteria, Blue-green Algae and Fungi.
2. Isolation of Microorganisms from Soil, Air and Water by Plating Technique.
3. Isolation of Microorganisms by Enrichment Technique.
4. Enumeration of Microorganisms from Soil by Plate Count Method.
5. Counting of Cells in the Culture using Haemocytometer.
6. To Measure the Size of Various Microbes (Fungi/Bacteria) using Ocular and Stage Micrometers.
7. Study of Bacteria from Curd and Root Nodules including Gram staining.
8. Study of Growth of Microorganism and Determination of Generation Time and Growth Rate Constant.

M-BOT-T-1.6: Forest Botany

1. To Study Wood Anatomy (T.S. / T.L.S. and R.L.S.) of important Timbers.
2. To Study the Vascular Elements of Soft and Hard wood by Maceration Technique.
3. To Measure the Diameter of Timbers using Vernier Calipers and Measuring Tape.
4. To Measure the Diameter of Forked, Buttressed, Fluted and Leaning trees.
5. To Measure the Height of Standing Trees by Shadow Method and single Pole Method.
6. To Demonstrate the various Tending operations used in Forest Management (Weeding, Cleaning, Thinning (Mechanical, Ordinary, Crown and advance Thinning).
7. To Measure the Volume of logs using various Formulae.
8. Preparation of a Nursery Lay out.
9. To Practice different Vegetative Propagation Techniques applicable to Forest Management.
10. Detailed study of different types of Wood Rots (Brown rot, White rot, Soft rot, Root rot, etc.).
11. Anatomical identification of different types of wood: Soft and hard wood, porous and non- porous wood, ring porous and diffuse porous wood.
12. Visit to nearby Forest Based Industries.

M.Sc. (Botany) – Part I (SEMESTER II)

Session: 2021-22, 2022-2023			Semester-II
Paper Code	M-BOT-T-2.1		
Name of Course	Pteridophytes and Gymnosperms		
	Theory	**Practical**	**Internal**
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 the students about the Origin, Classification, Evolution of Gametophyte and Sporophyte of Liverworts, Hornworts and Mosses, Fossil Pteridophytes, Structure, Reproduction and Comparative Account of different groups of Fern and Fern allies. The student will also learn about Fossil Gymnosperms, Origin and Evolution of Gymnosperms, cone and seed habit, structure and reproduction of different groups of Gymnosperms.

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) **Pteridophytes:** General Characters, Classification, Apogamy, Apospory, Heterospory, Seed Habit, Evolution of Stelar system and Economic Importance and distribution of Pteridophytes in India.
2) **Psilotopsida:** A Comparative account of Morphology, Fructification, Gametophytes, Evolutionary Tendencies and Inter- Relationships.
3) **Lycopsida and Sphenopsida:** A Comparative account of Morphology, Spore Producing Organs, Gametophytes, Evolutionary Tendencies and Inter-relationships.
4) **Pteropsida:** A Study of Plant Organization, Anatomy, Spore Producing Organs, Gametophytic Generations and Inter-relationships, Evolution of Sorus and Sporangium in Eusporangiate and Leptosporangiate Ferns.

SECTION-B

5) **Gymnosperms:** Characteristic Features, Origin and Evolution, Classification, Variation and Evolution of Cone in Gymnosperms, Structure and Evolution of Gametophyte and Seed in Gymnosperms, Polyembryony in Gymnosperms, Economic Importance and Distribution of Gymnosperms in India.
6) General Characters and Evolutionary Significance of Progymnosperms, Pteridosperms, Cycadeoideales and Cordaitales.
7) **Comparative Account of Gymnosperms:** Comparative Account of Morphology, Anatomy and Reproduction in Cycadales, Ginkgoales, Pentoxylales, Coniferales, Taxales, Ephedrales, Gnetales and Welwitschiales.
8) **Paleobotany:** Geological Time Scale, Fossils: Process of Fossilization, Types of Fossils, and Role of Paleobotany in Taxonomy.

RECOMMENDED READINGS:

1. Kubitzki, K. (Ed.) 1990. The Families and Genera of Vascular Plants. Vol. I Pteridophytes and Gymnosperms, Springer-Verlag, Berlin, New York.
2. Rashid, A. 1999. An Introduction to Pteridophyta. Vikas Publication House Pvt. Ltd., New Delhi.
3. Sporne, K.R. 1991. The Morphology of Pteridophytes. M/s Publishing Pvt. Ltd., Bombay.
4. Bhatanagar, S.P. and Moitra, A. 1996. Gymnosperms. New Age International Pvt. Ltd., New Delhi.
5. Sahni, K.C. 1990. Gymnosperms of India and Adjacent Countries. BSMPS, DehraDun.
6. Stewart, W.N. and Rathwell, G.W. 1993. Paleobotany and the Evolution of Plants. Cambridge, University Press, London.

M.Sc. (Botany) – Part I (SEMESTER II)

Session: 2021-22, 2022-2023			Semester-II
Paper Code	M-BOT-T-2.2		
Name of Course	Plant Genetics		
	Theory	**Practical**	**Internal**
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 the Structure and Types of Chromosome and Genes, Chromosomal alterations with reference to Structure and Number, Alien Gene Transfer and Genetic Recombination. The students will also learn about the Mutations, DNA damage and repair, methods of Gene mapping and different aspects of Population Genetics.

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) **Chromosome and Genes:** Chromosome: Definition, Karyotype, Karyotype Analysis, Banding Pattern, Molecular Organization of Telomere and Centromere, Euchromatin and Heterochromatin, Special Types of Chromosomes: B-Chromosomes, Polytene Chromosomes, Lampbrush Chromosomes, Sex Chromosomes. Gene: Definition, Classical and Modern Concept of Gene, Types of Genes and their Functions.
2) **Structural Alterations in Chromosomes**: Origin, Meiosis and Breeding Behaviour of Duplications, Deficiencies, Inversions and Translocation (Robertsonian Translocations, B-A Translocations, Translocation Tester Sets).
3) **Numerical Alterations in Chromosomes:** Classification, Euploidy and Aneuploidy: Origin and Meiotic Behaviour of Haploids and Polyploids and their Role in Cytogenetics and Plant Breeding. General Account of Trisomics, Monosomics, Tetrasomics and Nullisomics. Role of Trisomics and Monosomics in Chromosome Mapping.
4) **Alien Gene Transfer:** Production, Characterization and Utility of Alien Addition and Substitution**,** Alien Gene Transfer through Chromosome manipulations with Special Reference to Wheat, Transfer of Whole Genome, Transfer of Individual Chromosome and Chromosome Segments.

SECTION-B

5) **Genetic Recombination:** Introduction, Role of Independent Assortment and Crossing Over in Recombination, Genetic Recombination in Bacteria and Viruses; Genetic Recombination in Eukaryotes; Molecular Mechanism of Recombination (Role of Rec A, Rec BCD Enzymes), Site Specific Recombination.

6) **Mutation, DNA Damage and Repair:** Types of Mutations, Concept and Molecular Basis of Mutation, Mechanism of Spontaneous Mutations and Site Directed Mutagenesis, Physical and Chemical Mutagens, Bioassays for Testing Mutations, DNA Damage and Mechanism of Repair.
7) **Gene Mapping**: Definition, Linkage Maps, Gene Mapping through Recombination Method (Two Point and Three Point Test Crosses), Tetrad Analysis. Restriction Mapping, Role of Chromosome Walking and Chromosome Jumping in Gene mapping.
8) **Population Genetics**: Gene Pool and Gene Frequencies, Hardy-Weinberg Equilibrium of Gene Frequencies, Change in Gene Frequencies by Mutation, Selection, Migration and Genetic Drift.

RECOMMENDED READINGS:

1. Bass, H. and Birchler, J.A. (Ed.) 2020. Plant Cytogenetics: Genome Structure and Chromosome, Springer Nature.
2. Brown, T.A. 2017.Genomes, 4th Edition, John Wiley and Sons, New York.
3. Gardner, E.J., Simmons, M.J. and Snustad, D.P. 2006. Principles of Genetics. John Wiley and Sons. Inc., New York.
4. Gupta, P.K. 2007. Cytogenetics. Rastogi Publications, Meerut.
5. Hyde, D. R. 2016. Genetics and Molecular Biology. McGraw Hill Education (India) Pvt. Ltd. New Delhi.
6. Karp, G. 2014. Cell and Molecular Biology: Concepts and Experiments, 8th Edition, John Wiley and Sons Inc.USA.
7. Klug, W., Cumming, M.R., Spencer, C.A. and Palladino, M.A. 2016. Concepts of Genetics, 10th Edition, Pearson Education India.
8. Russell, P.J. 2016. iGenetics - A Molecular Approach. Pearson India Education Pvt. Ltd., Noida, India.
9. Snustad, D.P. and Simmons, M.J. 2015. Principles of Genetics, 7th Edition, John Wiley and Sons. Inc., New York.
10. Tamarin, R. 2017. Principles of Genetics, 7th Edition. McGraw Hill Education (India) Pvt. Ltd. New Delhi.
11. Watson, J.D., Baker, T.A., Bell, S.P., Gann, A. Levine, M. and Losick, R. 2019. Molecular Biology of the Gene, 7th Edition, Pearson India Education Pvt. Ltd. Noida, India.

M.Sc. (Botany) – Part I (SEMESTER II)

Session: 2021-22, 2022-2023			Semester-II
Paper Code	M-BOT-T-2.3		
Name of Course	Plant Physiology		
	Theory	**Practical**	**Internal**
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 various Physiological Processes occurring in the Plant Cells. The students will learn about Plant-Water Relations, Uptake and Transport of Water by Plants, Signal Perception and Transduction, Role of Plant Growth Regulators, various aspects of Stress Physiology, Significance of Photobiology, Mechanism of Flowering Process, Programmed Cell Death, Aging and Senescence.

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) **Plant Water Relations**: Water Potential and its Significance in Soil-Plant Atmosphere Continuum; Mechanism of Water Absorption and Transport; Water Transport Processes and Water Transport in Xylem.
2) **Membrane Transport and Translocation of Solutes**: Root-Microbe Interactions in Facilitating Nutrient Uptake, Comparison of Xylem and Phloem Transport, Phloem Loading and Unloading, Passive and Active Solute Transport, Membrane Transport Proteins with Particular reference to Role of Carriers, Channels and Proton Pumps in Solute accumulation and Transport.
3) **Transpiration**: Driving Force for Water Loss and its Regulation, Mechanism of Water Loss and Energy Relations, Recent Advances in Stomatal Physiology governing Water Loss from the Leaf, Water Use Efficiency.
4) **Stress Physiology**: Concept of Stress, Types of Stresses & Stressors (Water deficit and Drought, Salinity, Metal Toxicity, Heat and Freezing,), and Oxidative stress. Plant Responses to Abiotic and Biotic Stresses, Stress Constraints, Stress Detection, Stress induced Gene Expression, Mechanism of Biotic and Abiotic Stress Tolerance.

SECTION-B

5) **Signal Transduction**: Receptors and G-Proteins, Phospholipid Signaling, Role of Cyclic Nucleotides, Calcium-Calmodulin Cascade, Diversity in Protein Kinases and Phosphatases, Specific Signaling Mechanisms in Bacteria and Plants (Two-Component Sensor Regulator Systems); Sucrose - Sensing Mechanism.
6) **Sensory Photobiology**: Phytochromes and Cryptochromes and their Photochemical and Biological Properties, Photophysiology of Light-Induced Responses, Cellular

Localization, Molecular Mechanism of Action of Photomorphogenetic Receptors, Signaling and Gene Expression.

7) **Plant Growth Regulators and Elicitors**: Physiological Effects and Mechanism of Action of Auxins, Gibberellins, Cytokinins, Ethylene, Abscisic Acid, Brassinosteroids, Polyamines, Jasmonic Acid and Salicylic Acid, Hormone Receptors.
8) **Flowering Process and Senescence**: Photoperiodism and its Significance, Endogenous Clock and its Regulation, Floral Induction and Development - Genetic and Molecular Analysis, ABC Model of Flowering, Vernalization, Programmed Cell Death, Aging and Senescence.

RECOMMENDED READINGS:

1. Bala, M., Gupta, S., Gupta, N.K. and Sangha, M.K. 2013. Practicals in Plant Physiology and Biochemistry, Scientific Publishers (India), Jodhpur.
2. Bhattacharya, K., Ghosh, A.K. and Hait, G. 2018. A Textbook of Botany, Volume III, New Central Book Agency Pvt. Ltd, Kolkata.
3. Hopkins, W.G. and Huner, N.P. 2009. Introduction to Plant Physiology, 4th Edition, John Wiley and Sons, USA.
4. Salisbury, F.B. and Ross, C.W. 2005. Plant Physiology, 4th Edition, Eastern Press, Pvt. Ltd. Bangalore.
5. Srivastava, L.M. 2002. Plant Growth and Development: Hormones and Environment, Academic Press, Oxford, UK.
6. Stiles, W. 2016. Principles of Plant Physiology, Discovery Publishing House, New Delhi.
7. Taiz, L. and Zeiger, E. 2010. Plant Physiology, 5th Edition, Sinauer Associates Inc., USA.
8. Yadav, P., Kumar S., & Jain V. 2016. Recent Advances in Plant Stress Physiology, Daya Publishing House, New Delhi.

M.Sc. (Botany) – Part I (SEMESTER II)

Session: 2021-22, 2022-2023			Semester-II
Paper Code	M-BOT-T-2.4		
Name of Course	Plant Biochemistry and Metabolism		
	Theory	**Practical**	**Internal**
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 student about the various Metabolic Pathways occurring in the Plants. Students will learn about the Energy Flow, Photosynthetic and Respiratory Processes, Nitrogen, Lipid, Protein and Sulphur Metabolism and Secondary Metabolites.

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) **Energy Flow:** Energy Forms, Principles of Thermodynamics in Biology, The Concept of Enthalpy, Entropy, Free Energy and Chemical Potential; Energy Transfer and Energy Conservation, Redox Reactions; Biological Energy Transducers, Structure and Function of ATP, Coupled Reactions.
2) **Macromolecules:** Classification, Structure and Function of Proteins, Carbohydrates (Polysaccharides, Mucopolysaccharides, Mucoproteins and Glycoproteins) and Lipids.
3) **Enzymes:** General Aspects, Regulatory and Active Sites, Regulation of Enzyme Activity, Michaelis - Menten Equation and its Significance; Lineweaver–Burk Plot, Kinetics of Enzymatic Catalysis, Allosteric Mechanism: Negative and Positive Cooperativity; Activators and Inhibitors, Isozymes, Ribozymes and Abzymes.
4) **Secondary Metabolites:** Different Classes of Secondary Metabolites, Functions, Biosynthesis of Terpenes, Phenols and Nitrogenous Compounds.

SECTION-B

5) **Photochemistry and Photosynthesis:** Photosynthetic Pigments and Light Harvesting Complexes, Photo-Oxidation of Water, Mechanism of Electron and Proton Transport; Carbon Assimilation - The Calvin Cycle, Photorespiration and its Significance, C_4 Cycle, CAM Pathway, Biosynthesis of Starch and Sucrose.
6) **Respiration:** Glycolysis, the TCA Cycle, Electron Transport Chain and ATP Synthesis, Pentose Phosphate Pathway, Glycolate Cycle, Alternative Oxidase Systems, Gluconeogenesis, Interconversion of Hexoses and Pentoses. Importance of Respiration in different Biosynthetic Processes, Coordinated Control of Metabolism.

7) **Nitrogen Metabolism:** Biological Nitrogen Fixation, Nodule Formation and Nod Factors, Mechanism of Nitrate Uptake and Reduction, Ammonium Assimilation; Nitrogen Transformation during Plant Development.
8) **Lipid and Sulphur Metabolism:** Structure and Function of Lipids, Fatty Acid Biosynthesis, Synthesis of Membrane Lipids, Structural Lipids and Storage Lipids and Their Catabolism, Conversion of Fats on Germinating Fatty Seeds. Sulphate Uptake, Transport and Assimilation.

RECOMMENDED READINGS:

1. Bala, M., Gupta, S., Gupta, N.K. and Sangha, M.K. (2013). Practicals in Plant Physiology and Biochemistry, Scientific Publishers (India), Jodhpur.
2. Berg J. M., Tymoczko J. L., Gatto Jr., J., Gregory, Jr., Stryer, L. 2015. Biochemistry, W. H. Freeman and Company, New York.
3. Bhattacharya, K., Ghosh, A.K. and Hait, G. (2018). A Textbook of Botany, Volume III, New Central Book Agency Pvt. Ltd, Kolkata.
4. Buchanan, B.B, Gruissem, W. and Jones, R.L. 2007. Biochemistry and Molecular Biology of Plants, (2nd Edition), Ik International Pvt. Ltd., New Delhi.
5. Hopkins, W.G. and Huner, N.P. (2009). Introduction to Plant Physiology, 4th Edition. John Wiley and Sons, USA.
6. Nelson, D. L. and Cox M.M. 2013. Lehninger Principles of Biochemistry, 6th Edition. W.H. Freeman and Company, New York.
7. Salisbury, F.B. and Ross, C.W. (2005). Plant Physiology, 4th Edition. Eastern Press, Pvt. Ltd. Bangalore.
8. Stiles, W. 2016. Principles of Plant Physiology, Discovery Publishing House, New Delhi.
9. Taiz, L. and Zeiger, E. 2010. Plant Physiology, 5th Edition. Sinauer Associates Inc., USA.

M.Sc. (Botany) – Part I (SEMESTER II)

Session: 2021-22, 2022-2023			Semester-II
Paper Code	M-BOT-T-2.5		
Name of Course	Ethnobotany and Intellectual Property Rights		
	Theory	**Practical**	**Internal**
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 students about the Historical Perspectives and Importance of Ethnobotany along with providing insight about the Sacred Plants and Groves and Plants of Ethnobotanical and Traditional knowledge. The Students are made well versed with the types and importance of Intellectual Property Rights along with the Laws and Policies dealing with the Protection of IPR at National and International level.

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) **Ethnobotany:** Introduction, History and Importance of Ethnobotany, Ethnic Communities in India, Application in Modern science, Ethnobotanical Documentation of Traditional Medicine.
2) **Plants of Ethnobotanical Value***: Acacia nilotica*, *Capparis decidua*, *Citrullus colocynthis*, *Cordia dichotoma*, *Cuscuta reflexa*, *Ginkgo biloba, Ipomoea fistulosa*, *Oxalis corniculata*, *Ricinus communis*, *Trichopus zeylanicus*, *Terminalia arjuna, T. bellerica, T. chebula,* and *Withania somnifera*.
3) **Sacred Plants:** Definition, Importance of Sacred plants in Indian Culture and Vedas, Important Sacred Plant of India: Ashok Tulsi, Pipal, Banyan, Banana, Bael, Coconut, Gulmohr, Harshingar, Kadamba, Juhi, Mahua, Mango, Neem, Palash, Sandalwood and Lotus.
4) **Sacred Grooves:** Concept, Importance and Preservation of Sacred groves in India, Important Sacred Grooves: Beed, Bani, Devban, Jahera, Kavu, Kovil Kadu, Kaya Kalp Vriksh, Sarpa Kavu, Devarakadu, Gumpa forests. Current Status of sacred plants and sacred grooves.

SECTION-B

5) **Intellectual Property Rights:** Meaning, Historical Perspective, Types and Importance of IPR, IPR in India and World: Genesis, Scope, India's New IP Policy (2016), Paris Convention (1883), Berne Convention (1886), Universal Copyright Convention (1952), WIPO Convention (1967), Patent, Co-operation Treaty (1970), TRIPS Agreement, 1994
6) **Patents, Copyright and Trademark:** Patents: Elements of Patentability, Novelty, Inventive Steps, Registration Procedure, Rights and Duties of Patentee, Assignment and license, Infringement, Remedies and Penalties - Patent office and Appellate Board;

Copyright: Nature, Differences from Patents, Works Protected under Copyright, Transfer of Copyrights; Trademarks: Concept, Types and Infringement.

7) **Protection of Traditional Knowledge:** Concept of Traditional Knowledge, Bio-Prospecting and Bio-Piracy, Protectability, need for a Sui-Generis regime, Traditional Knowledge in the International Arena at World Trade Organization (WTO) and at National level, Traditional Knowledge Digital Library.
8) **Plant Variety and Biotechnology Protection:** Plant Variety Protection: Objectives, Benefit Sharing, Protection of Plant Breeders and Farmers Right (Act, 2001), Procedure for Registration of Plant Variety, Protection of Plant varieties in India, National Gene Bank; Biotechnology and IPR: Concept of Novelty and Inventive Step in Biotechnology Inventions, Patenting Biotechnology Inventions; Objective, Applications.

RECOMMENDED READINGS:

1. Ahuja, V.K. 2015. Intellectual Property Rights in India, 2nd Edition. Lexis Nexis Publication, New York, U.S.A.
2. Cunningham, A.B., 2001. Applied Ethnobotany, People, Wild Plant Use and Conservation. WWF, UNESCO, Royal Botanical Gardens, Kew. Earthscan Publications, London.
3. Das, A.P. and Pandey, A.K. 2007. Advances in Ethnobotany. Bishen Singh and Mahendra Pal Singh, Dehradun.
4. Dutfield, G. 2000. Intellectual Property Rights Trade and Biodiversity: Seeds and Plant Varieties, 1st Edition. Routledge Pub., U.K.
5. Jain, S.K. and Mudgal, V. 1999. A Handbook of Ethnobotany, Bishen Singh Mahindra Pal Singh, Dehradun.
6. Lokganathan, E.T.2012. Intellectual Property Rights (IPRs): Trips, Agreement and Indian Laws. New Century Publications, New Delhi.
7. Martinez J.J., Muñoz-Acevedo, Rai, M. 2019. Ethnobotany, Application of Medicinal Plants. CRC Press. Taylor and Francis Ltd. Florida, U.S.A.
8. Nyatlo, S.M. 2013. Intellectual Property Rights Management in Developing countries/NAM S & T Centre. Daya Publishing House, New Delhi.
9. Pandey, N. and Dharni K. 2014. Intellectual Property Rights. PHI Learning Pvt. Ltd., Delhi.
10. Ramappa, T. 2010. Intellectual Property Rights- Law in India, Asia Law House, Hyderabad, Telangana.
11. Subba, T. B. and Ghosh, G.C. 2003. Anthropology of North-East India. Orient Longman Limited, New Delhi.

M.Sc. (Botany) – Part I (SEMESTER II)

Session: 2021-22, 2022-2023			Semester-II
Paper Code	M-BOT-T-2.6		
Name of Course	Environmental Toxicology		
	Theory	**Practical**	**Internal**
Maximum Marks	70	30	30
Pass Percentage	35%	35%	35%
Credits	4	1.5	-
	4	3	-

Objective of the paper is to acquaint the students about the meaning of toxicology, types of toxicity, different types of toxicants and the dose response relationships of these toxicants. The students are made well versed with the different pathways of absorption, distribution and excretion of toxicants and the biotransformation & bio-activation of these toxicants. The insight is provided about the toxic effects of these toxic substances and the methods of toxicity studies.

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) **Toxicology:** Definition and scope of toxicity Studies: Purpose, Criteria for selection of test organism; types of toxicity - acute, sub acute, chronic and selective; Teratogenicity, Carcinogenicity and Mutagenicity.
2) **Toxicant and Xenobiotics**: Toxic Chemicals in the Environment, Biochemical Aspects of Arsenic, Chromium, Cadmium, Lead, Mercury, Carbon monoxide, Ozone, Peroxyacyl Nitrates (PAN), Pesticides and Carcinogens; **Radiations:** Dosimetry, Types of Dosimeters, Radioactive Substances; **Risk Assessment:** Definition, Acceptable Daily Intake (ADI), Procedure for estimating ADI, Potential Daily Intake (PDI), Relationship between ADI and PDI, Models for Estimating Risk.
3) **Dose-Response Relationships:** Graded and Quantal Responses, Time Action Curves, Dose Synergism and Antagonism, Threshold Limit Value (TLV), Toxicity Curves, Cumulative Toxicity and Lethal Dose (LD_{50}) and Consensus Toxicity Factors (CTF). Concept LC_{50} and IC_{50} values.
4) **Absorption, Distribution and Excretion of Toxicants:** Passive diffusion, filtration, carrier mediated transport, Phagocytosis, Respiratory tract and Lungs, Gastro-intestinal tract Skin Barriers, Biliary excretion, Urinary excretion.

SECTION B

5) **Toxic Effects:** Spectrum of Toxic Effects, Idiosyncratic and Allergic effects, Target organs: Liver, Kidney, Intestine, Central Nervous System, Molecular Targets: DNA, RNA, Proteins, Enzymes.
6) **Biotransformation and Bio-activation of Toxicants:** Threshold Levels of Toxicants in Body, Biotransformation: Definition, Phase I (Degradation) reactions: Oxidation,

Reduction and Hydrolysis; Phase II (Conjugation) reaction: Glucuronide/ Glucouronic acid formation, Sulfate conjugation, Methylation, Acetylation, Amino acid conjugation, Glutathione conjugation; Bio-activation: Epoxide formation, N-Hydroxylation, Free radicals and Superoxide formation, Activation in gastrointestinal tract.

7) **Bioassays for Mutagenicity/ Genotoxicity:** Importance and Limitations of Bioassays, Ames mutagenicity assay, Disc diffusion assay, *Allium cepa* root chromosomal aberration assay, micronuclei assay in pollen mother cells of *Tradescantia/ Vicia faba* stamen hair, Comet assay.
8) **Cell lines:** Cell Culture Media, Primary and Secondary cell cultures, Contaminants of cell cultures, Cell Lines, Common cell lines, National Centre for Cell Science (NCCS), Applications of Cell lines, Cytotoxicity assays (MTT assay, Calcein assay, Neutral Red assay and Lactate Dehydrogenase (LDH) assay).

RECOMMENDED READINGS:

1. Frank C.L. and Sam K. 2002. Lu's Basic Toxicology: Fundamentals, Target Organs and Risk Assessment. 4th Edition. Taylor and Francis, London.
2. Helgason, C.D. and Miller, C.L. 2005. Basic Cell Culture Protocols. Humana Press, Totowa, New Jersey.
3. Moon, T.W. and Mommsen, T.P. 2005. Environmental Toxicology. Elsevier Publisher, UK.
4. Omkar, A.P. and Dev, B. 2017. Concept of Toxicology. 3rd Edition. Vishal Publishing Company, New Delhi.
5. Rana, S.V.S. 2011. Environmental Pollution: Health and Toxicology. Narosa Publishing House, New Delhi.
6. Shaw, I. and Chadwick, J. 1998. Principles of Environmental Toxicology. CRC Press, USA
7. Stacey, G., Doyle, A. and Ferro, M. 2001. Cell Culture Methods for *in vitro* Toxicology. Springer Netherlands.
8. Subramanian, M.A. 2010. Toxicology: Principles and Methods. MJP Publishers, Chennai, TN.
9. Tambrell, J. 2002. Introduction to Toxicology. Taylor and Francis, London.

M.Sc. (Botany) – Part I (SEMESTER II)

Session: 2021-22, 2022-2023	Semester-II
Paper Code	M-BOT-L-2.1
Practical Paper	Pertaining to M-BOT-T-2.1 and 2.2
Maximum Marks	60
Pass Percentage	35%
Credits	3

M-BOT-T-2.1: Pteridophytes and Gymnosperms

1. Morphological study from museum jars/class work material of *Psilotum, Lycopodium*, *Phylloglossum*, *Azolla pinnata, Selaginella, Isoetes, Equisteum debile, E. arvense, Marseilea, Salvinia, Daplazium, Polysticum, Osmunda, Ophioglossum*.
2. Section cutting: *Lycopodium, Equisetium, Sellaginella, Marsilea, Thelypteris, Pteris.*
3. Morphological studies from Museum jars/shows cases of major genera of all the orders of Gymnosperms.
5. To cut and study T.S., T.L.S. & R.L.S. of wood of *Pinus, Cedrus, Taxus, Ginkgo,* stem of *Ephedra* and, *Gnetum.*
6. To study the Anatomical Details of the leaf/leaflet of *Pinus, Cedrus, Podocarpus, Cupressus, Cryptomeria/Taxodium, Araucaria, Cycas, Ginkgo and Gnetum.*
7. To study male cones of *Zamia*, *Cycas*, *Ginkgo*, *Pinus*, *Cedrus*, *Thuja*, *Cryptomeria*, *Podocarpus*, *Araucaria*, *Ephedra* and *Gnetum*.
8. To Study of female cones of *Zamia*, *Cycas*, *Ginkgo*, *Pinus*, *Cedrus*, *Thuja*, *Cryptomeria*, *Podocarpus*, *Araucaria*, *Ephedra* and *Gnetum*.
9. Study of Fossil Gymnosperms: Leaf impression of *Glossopteris, Pterophyllum, Pecopteris, Sphenopteris*; Stem petrifaction of *Pentoxylon, Confieroxylon, Bucklanadia,* wood petrifaction *of Cordaires*; Petrified reproductive structures - bisexual flower and female receptacle of *Cycadeoidea.*
10. To study Fossil slides of T.S. *Lygenodendron*, T.S. *Rachiopteris*, L.S. *Lygenostoma*, T.S. root of *Lygenopteris*, T.L.S. *Cordaites* wood and V.S. *Cordiates* leaf.
11. Study of Fossil Specimens of Leaf Impression of *Pecopteris phegopteroiudes, Dicksonia, Phenophyllum speciousm, Gleichenia gleichenioides* and *stem petrifaction of Calamites*.

M-BOT-T-2.2: Plant Genetics

1. Preparation of various Stains and fixatives for Cytogenetic studies.
2. Determination of Chromosome Number through study of Meiosis in *Zea*, *Chrysanthemum* and *Phlox*.
3. To study the Pollen Fertility using Glycero-acetocarmine and Aniline Blue.
4. Analysis of Karyotype from a given Diagram.
5. Study of Meiotic Abnormalities like Structural changes in Chromosomes, Multivalent/ Univalent formation, B chromosomes, Laggards, Bridges and Cytomixis from Permanent slides or Microphotographs.
6. Numerical problems pertaining to Epistasis.
7. Numerical Problems pertaining to Linkage and Recombination.
8. Numerical Problems pertaining to Gene mapping.
9. Numerical Problems pertaining to Population Genetics.
10. To study the impact of Miss-sense mutations, Nonsense mutations, Frame shift Mutations, Silent Mutations and Amino Acid Sequences of Proteins for given Data.
11. Detection of Mutations by Ames assay.

M.Sc. (Botany) – Part I (SEMESTER II)

Session: 2021-22, 2022-2023	Semester-II
Paper Code	M-BOT-L-2.2
Practical Paper	Pertaining to M-BOT-T-2.3 and 2.4
Maximum Marks	60
Pass Percentage	35%
Credits	3

M-BOT-T-2.3: Plant Physiology

1. To demonstrate the phenomena of (a) Electrical adsorption and (b) Mechanical adsorption.
2. To Determine the Water Holding Capacity of different types of Soils.
3. To Demonstrate the Operation of the Solubility Theory of Permeability.
4. To Determine the Osmotic Pressure of the Cell Sap of the given Plant Material by Plasmolytic Method.
5. To Determine the Water Potential of Plant Tissue by Classical Method.
6. To Determine the Water Potential of Potato Tuber Tissue by the Falling Drop Method.
7. To Study the Effect of Strong and Weak Acids and Alkalis' on the Permeability of Plant Cell Membrane.
8. To Determine the Effect of Temperature and Alcohol on Permeability and find out Thermal Death Point.
9. To Determine the Surface Tension of Alcohol by Drop Counting Method.
10. To Illustrate the Preparation, Standardization and Utilization of Cobalt Chloride Paper in measuring Water Loss from the Upper and Lower surface of Leaves from different plants.
11. To Study the Effect of Light on the Relative Loss of Water Vapor from Leaves.
12. To Measure and Compare the Rate of Transpiration under Different Environmental Conditions with a Simple Potometer.
13. To Compare the Rate of Transpiration from Two sides of a Leaf by Gravimetric Method.
14. To Demonstrate Suction due to transpiration (or transpiration pull).
15. To demonstrate transpiration by using Ganong's potometer.
16. To Trace the Path of Water in a Plant by using Dye.

M-BOT-T-2.4: Plant Biochemistry and Metabolism

1. Qualitative Identification of Carbohydrates: Molisch's test for Carbohydrates, Iodine Test for Starch, Barfoed's Test for Monosaccharides, Seliwanoff's test for Ketoses, Fehling's test for Reducing sugars and Bial's test for Pentoses.
2. Quantitative Determination of Carbohydrate from Plant Material.
3. Quantitative Determination of Proteins from the Plant Material.
4. Quantitative Determination of Lipids in the provided sample.
5. To Demonstrate the Effect of CO_2, Light Intensity and Temperature with Time on the Rate of Photosynthesis in twigs of *Hydrilla* stem.
6. Demonstrate the Blackman's Law of Limiting Factor.
7. To Demonstrate that Light, Chlorophyll and CO_2 is necessary for Photosynthesis.
8. To Separate Leaf pigments by (i) Column Chromatography (ii) Paper Chromatography.

9. To Separate Chloroplast Pigments from Leaf by Chemical Method and Calculate the Retention factor (Rf) Value.
10. Quantitative Determination of Photosynthesis Pigments from given Plant material.
11. To Show that Oxygen is released during Photosynthesis.
12. To demonstrate the Phenomenon of Anaerobic Respiration.
13. To demonstrate that O_2 is taken in and CO_2 is given out during Respiration.
14. To determine the Respiratory Quotient of given Plant material by Ganong's Respirometer.
15. To Measure the Activity of PPO and POD Antioxidants from a given Plant Material by Spectrophotometric method.
16. To Quantify Ascorbic Acid from given Plant material by Spectrophotometric Method.

M.Sc. (Botany) – Part I (SEMESTER II)

Session: 2021-22, 2022-2023	Semester-II
Paper Code	M-BOT-L-2.3
Practical Paper	Pertaining to M-BOT-T-2.5 or 2.6
Maximum Marks	30
Pass Percentage	35%
Credits	1.5

M-BOT-T-2.5: Ethnobotany and Intellectual Property Rights

1. Qualitative estimations of different phytochemicals in *Acacia nilotica*, *Capparis decidua*, *Citrullus colocynthis*, *Cordia dichotoma*, *Cuscuta reflexa*, *Ipomoea fistulosa*, *Oxalis corniculata*, *Ricinus communis* and *Withania somnifera*.
2. Taxonomic studies and parts used of following plants: Tulsi, Pipal, Banyan, Pakad, Banana, Aamla, Bilva, Chandan, Kadamba, Mango, Neem, Mahua, Ashok, Arjun, Bakul, Coconut, Gulmohar, Palash, Harsingar.
3. Field visits to identify and collect ethno medicinal plants used by local tribes/folklore
4. To study ecological parameters of any Sacred grove & make inventory of flora.
5. To make a case study of IPR of any plant or plant use.
6. To make report on filing of Patent.
7. To make case study and filling procedure of any Geographical indicator in India.

M-BOT-T-2.6: Environmental Toxicology

1. To study the effect of different concentrations of Heavy Metals (any two mentioned in theory) on the Morphology (Root and Shoot Length) of *Brassica juncea/Triticum aestivum* grown in the *in vitro* conditions.
2. To study the effect of different concentrations of Heavy Metals (any two mentioned in theory) on the Morphology of *Brassica juncea/Triticum aestivum* grown *in* fields or pots.
3. Determination of LD_{50} value of Cadmium, Chromium and Lead on *Brassica juncea.*
4. Determination of LD_{50} value of Cadmium, Chromium and Lead on *Zea mays.*
5. To study the effect of heavy metals (Lead or Chromium) on Chromosomes using *Allium cepa* root chromosomal aberration assay.
6. To study the genotoxic effect of heavy metals or air pollutants by using the Micronucleus test of *Tradescantia* / *Vicia faba.*
7. To study the effect of toxicants using the Disc Diffusion Agar Method.
8. To study the mutagenicity using Ames assay.