FACULTY OF SCIENCES

SYLLABUS FOR THE BATCH
FROM THE YEAR 2022 TO YEAR 2025

Programme Code: BSMD

Programme Name: B.Sc. Medical

(Semester I-VI)

Examinations: 2022-2025

DEPARTMENT OF BOTANY
KHALSA COLLEGE, AMRITSAR

(An Autonomous College)

Note: (a) Copy rights are reserved. Nobody is allowed to print it in any form.
(b) Subject to change in the syllabi at any time.
(c) Please visit the University website time to time

S.No.	PROGRAMME OBJECTIVES
1.	General characters, origin and evolution of cyptogams- Algae, Bryophytes and Pteridophytes.
2.	To understand the structures and purposes of basic components of prokaryotic and eukaryotic cells, especially macromolecules, membranes, and organelles.
3.	General characters, origin and evolution of Gymnosperms, geological time scale, evolution of seed habit.
4.	General characters, origin and evolution of Angiosperms.
5.	To understand the conduction path of water and mineral nutrients, translocation of assimilates into different plant parts.
	Analyze morphological description, brief idea of cultivation and economic uses of medicinal plants and pulses.

S.No.	PROGRAMME SPECIFIC OUTCOMES (PSOS)
PSO-1	Understand the range of plant diversity in terms of structure, function and plant classification of Algae, Fungi, Bryophytes, Pteridophytes, Gymnosperms and Angiosperms.
PSO-2	Understand the nature and basic concepts of cell biology, biochemistry, taxonomy and ecology.
PSO-3	Understand contribution of botany in medicines, food, fibers and other plant products.
PSO-4	Understand knowledge of botany in recognizing the position of plant in the broad classification and phylogenetic level.
PSO-5	Students learn to Interpret the plant morphology, anatomy, plant identification, vegetation analysis techniques, physiochemical analyses of plant materials in the plant physiology and biochemistry.
PSO-6	Understand the range of plant diversity in terms of structure, function and plant classification of Algae, Fungi, Bryophytes, Pteridophytes, Gymnosperms and Angiosperms.

B.Sc. Medical
Programme: BSMD
Scheme of Courses
Semester I-VI
Session 2022-2025

Course Scheme					
Semester-I					
Code	**Course Name**	**Max. Marks**			**Page No.**
		Theory/ Practical	Int. Ass.	Total	
BOT111A	Diversity of Microbes	25	25	100	4-5
BOT111B	Diversity of Cryptogams	25			6-7
BOT111P	Botany Practical - I Based on BOT111A & BOT111B	25			8

Course Scheme					
Semester-II					
Code	**Course Name**	**Max. Marks**			**Page No.**
		Theory/ Practical	Int. Ass.	Total	
BOT121A	Cell Biology	25	25	100	9-10
BOT121B	Genetics	25			11-12
BOT121P	Botany Practical - II Based on BOT121A & BOT121B	25			13-14

Course Scheme					
Semester-III					
Code	**Course Name**	**Max. Marks**			**Page No.**
		Theory/ Practical	Int. Ass.	Total	
BOT-231A	Structure, Development and Reproduction in Flowering Plants - I	25	25	100	15-16
BOT-231B	Structure, Development and Reproduction in Flowering Plants - II	25			17-18
BOT231P	Botany Practical - III Based on BOT231A & BOT231B	25			19-20

Course Scheme					
Semester-IV					
Code	**Course Name**	**Max. Marks**			**Page No.**
		Theory/ Practical	Int. Ass.	Total	
BOT241A	Diversity of Seed Plants and their Systematics – I	25	25	100	21-22
BOT241B	Diversity of Seed Plants and their Systematics – II	25			23-24
BOT241P	Botany Practical - IV Based on BOT241A & BOT241B	25			25-26

Course Scheme					
Semester-V					
Code	**Course Name**	**Max. Marks**			**Page No.**
		Theory/ Practical	Int. Ass.	Total	
BOT351A	Plant Physiology	25	25	100	27-28
BOT351B	Biochemistry and Biotechnology	25			29-30
BOT351P	Botany Practical - V (Based on BOT351A & BOT351B)	25			31-32

Course Scheme					
Semester-VI					
Code	**Course Name**	**Max. Marks**			**Page No.**
		Theory/ Practical	Int. Ass.	Total	
BOT361A	Ecology	25	25	100	33-34
BOT361B	Economic Botany	25			35-36
BOT361P	Botany Practical - VI (Based on BOT361A & BOT361B)	25			37-38

B.Sc. (MEDICAL) SEMESTER–I
Programme: BSMD
Course Code: BOT111A
Course Title: Diversity of Microbes

Credit Hours (Per Week): 3
Total Hours : 45
BOT111A : 25 Marks
BOT111B : 25 Marks
BOT111P : 25 Marks
Internal Assessment : 25 Marks
Total : 100 Marks

Instructions for the Paper Setters:
There will be a total of nine questions and candidates will attempt any five questions. Question No. 1 will be compulsory and will consist of five parts with equal distribution from the whole syllabus. Answer to each part should not exceed 3-4 lines. Each part will carry one mark (multiple choice/one-word answer type questions not to be set). The remaining eight questions are to be set two in each of the four units (I-IV). Candidates will be required to attempt four questions, one from each unit. Each question will carry five marks. Answer to each question should not exceed four pages.

Course Objectives:

CO-1	To acquaint students with basic concepts of diversity of Algae, Fungi, Bacteria, Viruses, Lichens etc.
CO-2	To study systematic position, structure, and function of these microbes.

UNIT-I

General Characters and Classification of Algae-Taxonomic parameters including those pertaining to photosynthetic pigments, cell wall, food reserves, flagellation. Economic importance of algae: Uses of algae as food and feed; in agriculture and industry.

UNIT-II

Important features and life history of:
Chlorophyceae – *Volvox, Oedogonium*
Xanthophyceae – *Vaucheria*
Phaeophyceae – *Ectocarpus*
Rhodophyceae – *Polysiphonia*

UNIT-III

General characters, classification and economic importance of Fungi.

Important features and life history of:
Mastigomycotina – *Phytophthora*
Zygomycotina – *Mucor*
Ascomycotina – *Saccharomyces, Peziza*
Basidiomycotina – *Puccinia, Agaricus*
Deuteromycotina – *Colletotrichum*

UNIT-IV

Viruses and Bacteria: General account of viruses, Bacteria – structure, nutrition, reproduction, General account of cyanobacteria.
General account of Lichens.

Suggested Readings:

1. Dubey, R. and Maheshwari, D. (2016). A textbook of Microbiology. S. Chand and company, New Delhi.
2. Alexopoulous, C.J., Mims, C.W. and Blackwell, M. (2002). Introductory Mycology (4th Edition), Wiley - Blackwell, USA.
3. Dube, H.C. (2007). A Textbook of Fungi, Bacteria and Viruses (3rd edition), Scientific Publishers, India
4. Dube, H.C. (2012). An Introduction to Fungi (4th edition), Scientific Publishers., India.
5. James W. Brown. (2014). Principles of Microbial Diversity. ASM press, USA.
6. Ogunseitan, O. (2004). Microbial Diversity: Form and function in Prokaryotes. Wiley Publishers, USA.
7. Sharma, O.P. (2004). Text Book of Thallophytes. McGraw Hill Publishing Co., India.
8. Sharma, P.D. (2004). The Fungi, (2nd Edition) Rastogi Publication, India

Course Outcomes:

CO-1	This course makes student aware about the diversity in various life forms of plant kingdom.
CO-2	It enables students to identify algae and fungi.
CO-3	It enables students to differentiate structural differences among different microbes.
CO-4	Increase the awareness of human friendly viruses, bacteria, algae and their economic importance.

B.Sc. (MEDICAL) SEMESTER–I
Programme: BSMD
Course Code: BOT111B
Course Title: Diversity of Cryptogams

Credit Hours (Per Week):3
Total Hours : 45
BOT111B : 25 Marks

Instructions for the Paper Setters:
There will be a total of nine questions and candidates will attempt any five questions. Question No. 1 will be compulsory and will consist of five parts with equal distribution from the whole syllabus. Answer to each part should not exceed 3-4 lines. Each part will carry one mark (multiple choice/one-word answer type questions not to be set). The remaining eight questions are to be set two in each of the four units (I-IV). Candidates will be required to attempt four questions, one from each unit. Each question will carry five marks. Answer to each question should not exceed four pages.

Course Objectives:

CO-1	The main objective of this course is to introduce the students with the basic knowledge of cyptograms.
CO-2	To study the detailed structure, functions and reproductive system in cyptograms.

UNIT-I

General characters and classification of bryophytes, Amphibians of plants kingdom displaying alternation of generations, Affinities of bryophytes with algae and pteridophytes.

UNIT-II

Structure and reproduction of:
Hepaticopsida: *Marchantia,*
Anthocerotopsida: *Anthoceros,*
Bryopsida: *Funaria,*
(Developmental stages are excluded).

UNIT-III

General characters and classification of Pteridophyta**,** Stelar System, Life cycle showing alternation of generations, General characteristics of Psilopsida, Lycopsida, Sphenopsida and Pteropsida.

UNIT-IV

Structure and reproduction of *Rhynia, Lycopodium, Selaginella, Equisetum, Pteris, Marsilea.* (Developmental stages are excluded).

Suggested Readings:

1. Goffinet B. (2008). Bryophyte Biology. Cambridge University Press, UK.

2. Sambamurty, S.S. (2005)**.** A Textbook of Bryophytes, Pteridophytes, Gymnosperms andPaleobotany. I K International Publishing House Pvt Ltd., India

3. Sharma, O.P. (2014). Bryophyta. Mc Graw Hill Education Pvt Ltd., India.

Course Outcomes:

CO-1	This course makes student aware about the diversity in various life forms of plant kingdom.
CO-2	Students able to differentiate bryophytes and pteridophytes.
CO-3	Students develop critical understanding on morphology, anatomy and reproduction of Bryophytes & Pteridophytes.
CO-4	Students learn about evolution of first land plants.

B.Sc. (MEDICAL) SEMESTER–I
Programme: BSMD
Course Code: BOT111P
Course Title: Practical - I
(Based on BOT111A & BOT111B)

Credit Hours (Per Week): 4.5
Total Hours : 67.5
BOT111P : 25Marks

Course Objective

CO-1	The course will give hands on training to students to work in laboratories.
CO-2	Understand the diversity among bacteria, algae, fungi, brytophytes and pteridophytes.

Suggested Laboratory Exercises

Teachers may select plants/material available in their locality/institution.

1. Gram staining of bacteria.
2. Observation of disease symptoms in hosts infected by fungi, viruses and mycoplasma Section cutting of diseased material and identification of the pathogens as per the theory syllabus.
3. Study of the genera included under algae and fungi.
4. Study of morphology, reproductive structures and anatomy of the examples cited in theory under Bryophyta and Pteridophyta.

Suggested Readings:

Lee, R.E. **(2008).** Phycology, Fourth Edition, Cambridge University Press, USA.

Agrios, G.N. **(1997).** Plant Pathology, 4th edition, Academic Press, U.K.

Course Outcomes:

CO-1	Prepare and view specimens for examination using microscope.
CO-2	Differentiate algae, fungi, bryophytes and pteridophytes on the basis of morphology, reproductive structures and anatomy.
CO-3	Understand and identify plant diseases with special reference to the causative agents, symptoms and etiology.

B.Sc. (MEDICAL) SEMESTER–II
Programme: BSMD
Course code: BOT121A
Course Title: Cell Biology

Credit Hours (Per Week): 3
Total Hours : 45
BOT121A : 25Marks
BOT121B : 25Marks
BOT121P : 25Marks
Internal Assessment : 25Marks
Total : 100Marks

Instructions for the Paper Setters:
There will be a total of nine questions and candidates will attempt five questions. Question No. 1 will be compulsory and will consist of five parts with equal distribution from the whole syllabus. Answer to each part should not exceed 3-4 lines. Each part will carry one mark (multiple choice/one-word answer type questions not to be set). The remaining eight questions will be set from four units of the whole syllabus out of which candidates will be required to attempt one question from each unit. Each question will carry five marks. Answer to each question should not exceed four pages.

Course Objectives:

CO-1	The main objective of this course is to provide fundamental knowledge of structural and functional aspects of cell and cell organelles.
CO-2	To study detailed structure of chromosome and different types of alterations in chromosomes.

UNIT-I

Structure and Function of Nucleus: Ultrastructure; nuclear membrane; nuclear pore models; nucleoplasm; Nuclear matrix; chromatin; nucleolus.
Extranuclear Genome: Presence and function of mitochondrial and plastid DNA; plasmids.

UNIT-II

Structure and Function of Cell Organelles:
Golgi Apparatus,
Endoplasmic Reticulum,
Peroxisomes,
Vacuoles.

UNIT-III

Chromosome Organization: Morphology, centromere and telomere; chromosome alterations; deletions, duplications, translocations, inversions, variations in chromosome number, aneuploidy, polyploidy, sex chromosomes.

UNIT-IV

The Cell Envelopes: Cell wall - structure and function;
Plasma membrane – Chemical composition, Membrane models and functions; membrane transport.

Suggested Readings:

1. Gupta, P.K. (2013). A Text–book of Cell and Molecular Biology (3rd edition). Rastogi Publications, Meerut, India
2. Johnson, A., Raff, L. and Walter, R. (2008). Molecular Biology of the Cell (5th Edition). Taylor and Francis Group, USA.
3. Karp, G. (2013). Cell and Molecular Biology: Concepts and Experiments (7th Edition). Wiley Publishers, USA.
4. Kleinsmith, L.J. and Kish, V.M. (1995). Principles of Cell and Molecular Biology (2nd edition). Harper Collins College Publishers, New York, USA.
5. Lodish, H., Berk, A., Kaiser, C. A., Krieger, M., Bretscher, A. and Ploegh, H. (2016). Molecular Cell Biology, W.H. Freeman & Co., New York, USA.
6. Snustad, D.P. and Simmons, M.J. (2010). Principles of Genetics (5th Edition). John Wiley and Sons Inc., U.S.A.

Course Outcomes:

CO-1	Students learn about basic unit of life i.e., Cell.
CO-2	Students learn about differences between prokaryotic and eukaryotic organism on the basis of cellular details.
CO-3	It enables students to know about chromosomes, genes *etc*.
CO-4	Students learn about the functional role of cell organelles.

B.Sc. (MEDICAL) SEMESTER–II

Programme: BSMD
Course Code: BOT121B
Course Title: Genetics

Credit Hours (Per Week): 3
Total Hours : 45
BOT121B : 25Marks

Instructions for the Paper Setters:
There will be a total of nine questions and candidates will attempt any five questions. Question No. 1 will be compulsory and will consist of five parts with equal distribution from the whole syllabus. Answer to each part should not exceed 3-4 lines. Each part will carry one mark (multiple choice/one-word answer type questions not to be set). The remaining eight questions are to be set two in each of the four units (I-IV). Candidates will be required to attempt four questions, one from each unit. Each question will carry five marks. Answer to each question should not exceed four pages.

Course Objectives:

CO-1	To introduce the students with history of genetics and heredity.
CO-2	To study the basics of genetics (genetic material, variation, cell division, expression and regulation of genes etc.).

UNIT-I

DNA-the Genetic Material: DNA structure; replication; DNA–protein interaction; the nucleosome model, satellite and repetitive DNA.
Genetic Variations: Mutations, spontaneous and induced, transposable genetic elements, DNA damage and repair.

UNIT-II

Cell Division:
Cell cycle;
Mitosis- karyokinesis, cytokinesis, significance of mitosis;
Meiosis- karyokinesis, recombination, crossing over, cytokinesis, significance of meiosis.

UNIT-III

Genetic Inheritance: Mendelism: laws of segregation and independent assortment, linkage analysis; allelic and non–allelic interactions.

UNIT-IV

Gene expression: Structure of gene, transfer of genetic informaton; transcription, translation, genetic code, regulation of gene expression in prokaryotes and eukaryotes.

Suggested Readings:

1. Brown, T.A. (2011). Genetics: A Molecular Approach (3rd Edition). BIOS Scientific Publishers, UK.
2. Fletcher, H., Hickey, I. and Winter, P. (2010). Instant Notes on Genetics (3rd edition) Taylor and Francis Group, USA.
3. Gardner, E.J., Simmons, M.J. and Snustad, D.P. (2012). Principles of Genetics (8th Edition). Wiley Sons, USA.
4. Gupta, P.K. (2016). Cell and Molecular Biology, Rastogi Publications, Meerut, India.
5. Kleinsmith, L.J. and Kish, V.M. (1995). Principles of Cell and Molecular Biology (2nd Edition). Harper Collins College Publishers, New York, USA.
6. Krebs, B. E., Goldstein, E.S. and Kilpatrick, S.T. (2011). Lewins Genes X. Jones and Bartlett Publishers, LLC, UK.
7. Lodish, H., Berk, A., Kaiser, C. A., Krieger, M., Bretscher, A. and ploegh, H. (2016). Molecular Cell Biology, W.H. Freeman & Co., New York, USA.
8. Singh, B.D. (2007). Molecular Genetics. Kalyani Publishers, India.
9. Snustad, D.P. and Simmons, M.J. (2010). Principles of Genetics (5th Edition). John Wiley and Sons Inc., U.S.A.

Course Outcomes:

CO-1	It makes students aware about heredity and variation.
CO-2	Students come to know how children are different from parents.
CO-3	Develop concept wise understanding of laws of inheritance, genetic basis of loci and alleles and their linkage.
CO-4	Students able to differentiate between alleles and non-alleles and allelic and non-allelic interactions.
CO-5	Students learn about genetic material and various factors responsible for variations in plants.

B.Sc. (MEDICAL) SEMESTER–II

Programme: BSMD
Course Code: BOT121P
Course Title: Practical - II
(Based on BOT121A & BOT121B)

Credit Hours (Per Week): 4.5
Total Hours : 67.5
BOT121P : 25Marks

Course Objective

CO-1	Train students for microprepration of slides to understand the fundamentals of cell biology and related processes.
CO-2	Students will learn the laws of inheritance and mode of inheritance of linked genes.

Suggested Laboratory Exercises

Teachers may select plants/material available in their locality/institutions.

1. To study cell structure from onion leaf peels; demonstration of staining and mounting methods.
2. Comparative study of cell structure in onion cells, *Hydrilla* and *Spirogyra*. Study of cyclosis in *Tradescantia* Staminal Cells.
3. Study of plastids to examine pigment distribution in plants (e.g. *Cassia*, *Lycopersicon* and *Capsicum*).
4. Examination of electron micrographs of eukaryotic cells with special reference to organelles.
5. Study of electron micrographs of viruses, bacteria, cyanobacteria and eukaryotic cells for comparative cellular organization.
6. Examination of various stages of mitosis and meiosis using appropriate plant material (e.g. onion root tips, onion flower buds).
7. Preparation of karyotypes from dividing root tip cells and pollen grains.
8. Cytological examination of special types of chromosomes: bar body, lampbrush and polytene chromosomes.
9. Working out the laws of inheritance using seed mixtures.
10. Working out the mode of inheritance of linked genes from test cross and/or F2 data.

Suggested Readings:-

1. Fukui, K. and Nakayama, S. (1996). Plant Chromosomes; Laboratory Methods, CRC Press, Boca Raton, Florida.
2. Gunning, B.E.S. and Steer, M.W. (1996). Plant Cell Biology; Structure and Function, Jones and Barllett Publishers, Boston, Massachusetts.
3. Harns, N. and Oparka, K.J. (1994). Plant Cell Biology, A Practical Approach. IRL Press, at Oxford University Press, Oxford, UK.

4. Sharma, A.K. and Sharma, A. (1999). Plant Chromosomes; Analysis. Manipulation and Engineering, Harwood Academic Publishers, Australia.
5. Plopper, G. (2016). Principles of Cell Biology. Jones and Barnett Learning, Boston, Massachusetts.

Course Outcomes:

CO-1	Students will gain knowledge on staining and fixation of specimens on slides.
CO-2	Students will be able to critically examine the cell structure, its components and pigments.
CO-3	Understand the basic cellular processes including mitosis and meiosis with the help of plant material.
CO-4	Prepare karyotypes and gain knowledge on special chromosomes.
CO-5	Understand the concept of inheritence and linked genes.

B.Sc. (MEDICAL) SEMESTER–III

BOTANY
Programme: BSMD
Course code: BOT231A
Course Title: Structure, Development and Reproduction in Flowering Plants–I

Credit Hours (Per Week): 3
BOT231A : 25 Marks
BOT231B : 25 Marks
BOT231P : 25 Marks
Internal Assessment : 25 Marks
Total : 100 Marks

Course Code: BOT231A
Course Title: STRUCTURE, DEVELOPMENT AND REPRODUCTION IN FLOWERING PLANTS–I

Time: 3 Hrs.
Theory Lectures: 3 Hours/Week **Max. Marks: 25**

Instructions for the Paper Setters:
There will be a total of nine questions and candidates will attempt any five questions. Question No. 1 will be compulsory and will consist of five parts with equal distribution from the whole syllabus. Answer to each part should not exceed 3-4 lines. Each part will carry one mark (multiple choice/one-word answer type questions not to be set). The remaining eight questions are to be set two in each of the four units (I-IV). Candidates will be required to attempt four questions, one from each unit. Each question will carry five marks. Answer to each question should not exceed four pages.

Course Objectives:

CO-1	To introduce the students with the terminologies used in description of angiosperms, stem modification, phyllotaxy, Diversity in angiosperms.
CO-2	To study the role of primary and secondary growth in basic body plan of angiosperms.
CO-3	To study the different types of tissues in plants.

UNIT I

The basic body plan of a flowering plant-modular type of growth. Diversity in plant form in annuals, biennials and perennials; trees: largest and longestlived. Branching pattern; monopodial and sympodial growth; canopy architecture.

UNIT II

The Shoot System: The shoot apical meristem and its histological organization; Theories of shoot apical meristem, meristematic tissues, structure, classification based on origin, position and function, Tissues and Tissue systems (Epidermal, ground and vascular) simple permanent tissues and complex permanent tissues, secretory tissues, formation of internodes.

UNIT III

Vascular Cambium: Origin and position, structure of cambium, activity of cambium Wood anatomy-A brief account, types of wood (spring wood, autumn wood, Heart Wood, Sap Wood, Porus wood and Non Porous wood). Secondary growth in Dicot stem, Periderm, Anamalous secondary growth in *Dracena* and *Boerhaavia*,secondary phloem-structure function relationships; periderm. Internal structure of stem: *Helianthus annuus* and *Zea mays*.

UNIT IV

Leaf: Origin, parts of a leaf, types of leaves, arrangement or phyllotaxy, modification of leaves and diversity in size and shape; internal structure of monocot leaf and dicot leaf, internal structure in relation to photosynthesis and water loss; adaptations to water stress; senescence and abscission.

Suggested Readings:

1. Beck, C.B. (2010). An Introduction to Plant Structure and Development: Plant anatomy for the Twenty First Century (2nd Edition). Cambridge University Press, UK.
2. Cutler, D. F., Botha, T. and Stevenson, D. M. (2007). Plant Anatomy: An Applied Approach. Blackwell Publishing, Oxford, UK.
3. Dickison, W.C. (2000). Integrative Plant Anatomy. Academic Press, California, USA.
4. Mauseth, J.D. (1988). Plant Anatomy, The Benjamin/Cummings Publishing Company Inc., Menlo Park, California, USA.
5. Peau, K (1977) Anatomy of Seed Plants, 3rd edition. John Wiley & Sons, New York.
6. Raven, P.H., Evert, R.F. and Eichhorn, S.E. (1999). Biology of Plants, 5th edition. W.H. Freeman and Co., Worth Publishers, New York.
7. Rudall, P. J. (2007). Anatomy of Flowering Plants: An Introduction to Structure and Development (3rd Edition). Cambridge University Press, UK.
8. Thomas, P. (2000) Trees: Their Natural History, Cambridge University Press, Cambridge.
9. Srivastava, H.N. (2018) Diversity of Seed Plants and Their Systematics, Vol. III, Pradeep's Publication.

Course Outcomes:

CO-1	This course enables students to differentiateflowering and non-flowering plants.
CO-2	Students learn about various types of leaves and their modifications.
CO-3	Learnvarious types of tissues in plants and their role in the growth of plant.
CO-4	Understand the diversity in angiosperms.

B.Sc. (MEDICAL) SEMESTER–III
BOTANY

Programme: BSMD
Course Code: BOT231B
(Course Title Structure, Development and Reproduction in Flowering Plants–II)

Credit Hours (Per Week): 3
BOT231B : 25 Marks

Instructions for the Paper Setters:
There will be a total of nine questions and candidates will attempt any five questions. Question No. 1 will be compulsory and will consist of five parts with equal distribution from the whole syllabus. Answer to each part should not exceed 3-4 lines. Each part will carry one mark (multiple choice/one-word answer type questions not to be set). The remaining eight questions are to be set two in each of the four units (I-IV). Candidates will be required to attempt four questions, one from each unit. Each question will carry five marks. Answer to each question should not exceed four pages.

Course Objectives:

CO-1	To make students aware of basics of plant reproduction and development, different tissue forms, anomalous structures etc.
CO-2	To study different methods of vegetative reproduction.
CO-3	To study the detailed structure of reprductive structures of plant.
CO-4	To study different types of pollintaion methods.
CO-5	Types of seeds and fruits.

UNIT I

The Root System: The root apical meristem; differentiation of primary and secondary tissues and their roles; structural modification for storage, respiration, reproduction and for interaction with microbes.

UNIT II

Vegetative Reproduction: Various methods of vegetative propagation. Natural and Artificial method of vegatative propagation, Micropropagation, Advantages and disadvantages of vegetative propagation.

Flower: A modified shoot; structure, development and varieties of flower; functions.

Inflorescence; simple, compound, mixed and special.

UNIT III

Reproduction: Structure of anther and pistil; The male and female gametophytes.

Pollination: Types of Pollination; attractions and reward for pollinators; (sucking and foraging types); pollen-pistil interaction self incompatibility.

UNIT IV

Double fertilization: Formation of endosperm and embryo.

Fruit: Types, development and maturation.

Significance of Seed: Suspended animation; ecological adaptation; unit of genetic recombination with reference to reshuffling of genes and replenishment; dispersal strategies.

Note for Teachers:

Wherever required, role of environment and hormones in plant development and reproduction should be emphasized.

Suggested Readings:

1. Bhojwani, S.S. and Bhatnagar, S.P. (2000). The Embryology of Angiosperms, 4th revised and enlarged edition. Vikas Publishing House, Delhi.
2. Hartmann, H.T. and Kestler, D.E. (1976). Plant Propagation: Principles and Practices, 3rd edition, Prentice Hall of India Pvt. Ltd., New Delhi.
3. Mauseth, J.D. (1988). Plant Anatomy, The Benjamin/Cummings Publishing Company Inc., Menlo Park, California, USA.
4. Peau, K. (1977). Anatomy of Seed Plants, 3rd edition. John Wiley & Sons, New York.
5. Pegeri, K. and Vander Pijl (1979). The Principles of Pollination Biology, Pergamon Press, Oxford.
6. Raven, P.H., Evert, R.F. and Eichhorn, S.E. (1999). Biology of Plants, 5th edition. W.H. Freeman and Co., Worth Publishers, New York.
7. Srivastava, H.N. (2018) Diversity of Seed Plants and Their Systematics, Vol. III, Pradeep's Publication.

Course Outcomes:

CO-1	Learning development and differentiation in multicellular plants.
CO-2	Students acquire the knowledge of structural modification of root and shoot.
CO-3	Students learn how plants reproduce.
CO-4	Understanding general aspects of plant embryology.

B.Sc. (MEDICAL) SEMESTER–III

BOTANY

Programme: BSMD
Course Code: BOT231P
Course Title: Practical-III
(Based on BOT231A & BOT231B)

Credit Hours (Per Week): 4.5
BOT131P : 25 Marks

Course Objectives:

Students will get hands on training to study

CO-1	Description of primary and secondary growth in plants.
CO-2	Diversity in angiosperms and their parts
CO-3	Anatomy of shoot and root
CO-4	Microscopic study of wood
CO-5	Study of flower and their mode of pollination, megasporogenesis, microsporogenesis
CO-6	Embryo development in monocots and dicots

Suggested Laboratory Exercises

1. Study of any commonly occurring dicotyledonous plant (for example *Solanum nigrum* or Kalanchoe) to the body plan, organography and modular type of growth.
2. Life forms exhibited by flowering plants (by a visit to a forest or a garden, Study of tree-like habit in cycads, bamboo, banana, traveller's tree (*Revenala madagascariensis*) and Yucca and comparison with true trees as exemplified by conifers and dicotyledons.
3. L.S. Shoot tip to study the cytohistological zonation and origin of leaf primordia.
4. Monopodial and sympodial types of branching in stems (especially rhizomes).
5. Anatomy of primary and secondary growth in monocots and dicots using free hand razor technique (*Solanum, Boerhavia, Helianthus, Mirabilis, Nyctanthus, Draceana,* Maize) hand sections (or prepared slides). Structure of secondary phloem and xylem. Growth rings in wood, Microscopic study of wood in T.S., T.L.S. and R.L.S.
6. Field study of diversity in leaf shape, size, thickness, surface properties. Internal structure of leaf. Structure and development of stomata (using epidermal peels of leaf).
7. Anatomy of the root. Primary and secondary structure.
8. Examination of a wide range of flowers available in the locality and methods of their pollination.
9. Structure of anther, microsporogenesis (using slides) and pollen grains (using whole mounts). Pollen viability using *in vitro* pollen germination.
10. Structure of ovule and embryo sac development using serial sections from permanent slides.

11. Nuclear and cellular endosperm. Embryo development in monocots and dicots (using permanent slides/dissections).
12. Simple experiments to show vegetative propagation (leaf cuttings in *Bryophyllum*. *Sansevieria*, *Begonia*; stem cuttings in rose, *Salix*, money plant, Sugarcane and *Bougainvillea*).
13. Germination of non-dormant and dormant seeds.

Suggested Readings (for laboratory exercises):

1. Bhojwani, S.S. and Bhatnagar, P. (2000). The Embryology of Angiosperms (4th revised and enlarged edition), Vikas Publishing House, New Delhi.
2. Mauseth, J.D. (1988). Plant Anatomy, The Benjamin/Cumminas Publishing Co., Inc., Mehlo Park, California, USA.
3. Raven, P.H., Evert, R.F. and Eichhorn, S.E. (1992). Biology of Plants (5th Edition). Worth Publishers, New York.
4. Steeves, T.A. and Sussex, I.M. (1989). Patterns in Plant Development (2nd Edition). Cambridge University Press, Cambridge.

Course Outcomes:

After completing the course students will be able to

CO-1	Differentiate between monocot and dicot plants through morphological and anatomical studies.
CO-2	Understand the diversity in angiosperms.
CO-3	Understand the primary/secondary growth and formation of wood in seed plants.
CO-4	Understand the mode of pollination and differentiate between self and cross pollinated plants.
CO-5	Understand the process of formation of male gametophyte and female gametophyte in the plant development.

B.Sc. (MEDICAL) SEMESTER–IV

BOTANY

Course code: BOT241A
Course Title: Diversity of Seed Plants and Their Systematics–I

Credit Hours (Per Week): 3
BOT241A : 25 Marks
BOT241B : 25 Marks
BOT241P : 25 Marks
Internal Assessment : 25 Marks
Total : 100 Marks

BOT241A

Time: 3 Hrs.
Theory Lectures: 3 Hours/Week **Max. Marks: 25**

Instructions for the Paper Setters:
There will be a total of nine questions and candidates will attempt any five questions. Question No. 1 will be compulsory and will consist of five parts with equal distribution from the whole syllabus. Answer to each part should not exceed 3-4 lines. Each part will carry one mark (multiple choice/one-word answer type questions not to be set). The remaining eight questions are to be set two in each of the four units (I-IV). Candidates will be required to attempt four questions, one from each unit. Each question will carry five marks. Answer to each question should not exceed four pages.

Course Objectives:

CO-1	The main objective of this course is to introduce the students with the basic knowledge of structure, reproduction and evolution in Gymnosperms.
CO-2	To study the vegetative and reproductive structures of Gymnosperms.

UNIT I

Characteristics of seed plants, Evolution of the seed habit, Distinguishing features of angiosperms and gymnosperms. General features of gymnosperms and their classification.

UNITII

Evolution and diversity of Gymnosperms including fossil and living gymnosperms, Reconstruction of the following fossil plants: *Lyginopteris Williamsonia Cycadeoidea* (*Bennettites*) Geological time scale, Fossils and Fossilization (Process involved, types of fossils and importance of fossils). Angiosperms: Origin and evolution, some examples of primitive angiosperms.

UNIT III

Morphology of vegetative and reproductive parts, Anatomy of root, Stem and leaf, Reproduction and life cycle of *Pinus* and *Cycas*.

UNIT IV

Morphology of vegetative and reproductive parts, Anatomy of root, Stem and leaf, Reproduction and life cycle of *Epherda* and *Ginkgo*.

Suggested Readings:

1. Bhatnagar, S.P. and Moitra, A. (1996). Gymnosperms, New Age Internationl Limited, New Delhi.
2. Gifford, E.M. and Foster, A.S. (1988). Morphology and Evolution of Vascular Plants, W.H. Freeman & Company, New York.
3. Pellant, C. (1994). Fossils, Dragon's World, Great Britain
4. Sporne, K.R. (1965). The Morphology of Gymnosperms, Hutchinson & Co. (Publishers) Ltd., London.
5. Taylor, T. N., Taylor, E. L. and Krings, M. (2008). Paleobotany: The Biology and Evolution of Fossil Plants (2nd Edition). Elsevier Inc. Netherlands.
6. Vashistha, P. C. (2016). Botany for degree students. S. Chand and Company, New Delhi.

Course Outcomes:

CO-1	Students learn about the evolved group of non-flowering plants with naked seeds i.e., Gymnosperms.
CO-2	Students learn about the habitat and economic importance of these plants.

B.Sc. (MEDICAL) SEMESTER–IV

BOTANY

Programme: BSMD
Course Code: BOT241B
Course Title Structure, Diversity of Seed Plants and their Systematics–II

Credit Hours (Per Week): 3
BOT241B : 25 Marks

Course Code: BOT241B

Course Title: DIVERSITY OF SEED PLANTS AND THEIR SYSTEMATICS–II

Time: 3 Hrs.
Theory Lectures: 3 Hours/Week **Max. Marks: 25**

Instructions for the Paper Setters:
There will be a total of nine questions and candidates will attempt any five questions. Question No. 1 will be compulsory and will consist of five parts with equal distribution from the whole syllabus. Answer to each part should not exceed 3-4 lines. Each part will carry one mark (multiple choice/one-word answer type questions not to be set). The remaining eight questions are to be set two in each of the four units (I-IV). Candidates will be required to attempt four questions, one from each unit. Each question will carry five marks. Answer to each question should not exceed four pages.

Course Objectives:

CO-1	To complement the students with the basic knowledge of plant taxonomy and systematic in addition to the diversity of Angiosperms.
CO-2	To study flowering plants belonging to different families in detail.

UNIT I

Angiosperm taxonomy; Brief history, Aims and fundamental components (alpha-taxonomy, Omega-taxonomy, Holotaxonomy); Identification keys, Taxonomic literature; Major contribution of cytology, Phytochemistry and taximetrics to taxonomy.

UNIT II

Botanical nomenclature: Taxonomic ranks, Type concept, Principle of priority. Classification of angiosperms; Salient features of the systems proposed by Bentham and Hooker, Engler and Prantl.

UNIT III

Diversity of flowering plants and detailed study of the members of the families Ranunculaceae, Brassicaceae, Rutaceae, Fabaceae, Apiaceae, Acanthaceae, Apocynaceae.

UNIT IV

Diversity of flowering plants and detailed study of the members of the families Asclepiadaceae, Solanaceae, Lamiaceae, Chenopodiaceae, Euphorbiaceae, Liliaceae, Orchidaceae and Poaceae.

Suggested Readings:

1. Bendre, A. (2007). Practical Botany, Rastogi Publications, Meerut.
2. Davis, P.H. and Heywood, V.H. (1963). Principles of Angiosperm Taxonomy, Oliver and Boyd, London.
3. Gifford, E.M. and Foster, A.S. (1988). Morphology and Evolution of Vascular Plants, W.H. Freeman & Company, New York.
4. Jeffrey, C. (1982). An Introduction to Plant Taxonomy, Cambridge University Press, Cambridge, London.
5. Jones, S.B., Jr. and Luchsinger, A.E. (1986). Plant Systematics (2nd edition). McGraw-Hill Book Co., New York.
6. Radford, A.E. (1986). Fundamental of Plant Systematics, Harper and Row, New York.
7. Singh, G. (1999). Plant Systematics: Theory and Practice, Oxford and IBH Pvt. Ltd., New Delhi.
8. Sinha, S. (2012). Encyclopedia on Morphology of Angiosperms, Oxford Book Company, Jaipur.
9. Siddiqui, M., Pathak, A. and Dikshit, A. (2016). Taxonomy of Angiosperms: Basic Concepts, Molecular Aspects and Future prospects. Studera Press. Vedam Books, New Delhi.

Course Outcomes:

CO-1	This course is the backbone of botany as it enables students to learn about systematics, without which no advanced study in botany can be pursued.
CO-2	Students acquire the skill of identifying and naming of plants.

B.Sc. (MEDICAL) SEMESTER–IV

BOTANY

Programme: BSMD
Course Code: BOT241P
Course Title: Practical-IV
(Based on BOT241A & BOT241B)

Credit Hours (Per Week): 4.5
BOT241P : 25 Marks

Course Objectives:

Students will get hands on training on

CO-1	Detailed morphological and anatomical description of angiosperm flowers
CO-2	Made familiar with the use of identification keys
CO-3	Detailed morphological and anatomical description of vegetative and reproductive parts of *Cycas, Pinus, Ginkgo* and *Ephedra*

Suggested Laboratory Exercises

Angiosperms

The following species are suitable for study. This list is only indicative. Teachers may select plants available in their locality.

Teachers may select plants/material available in their locality/institution.

1. Ranunculaceae: *Ranunculus, Delphinium*.
2. Brassicaceae: *Brassica, Alyssum, Iberis, Coronopus.*
3. Malvaceae: *Hibiscus, Abutilon.*
4. Rutaceae: *Murraya, Citrus.*
5. Fabaceae: *Faboideae: Lathyrus, Cajanus, Melilotus, Trigonella, Caesalpinioideae: Cassia, Caeslpainia, Mimosoideae: Prosopis, Mimosa, Aeacia.*
6. Apiaceae: *Coriander, Foeniculum, Anethum*.
7. Acanthaceae: *Adhatoda, Peristrophe.*
8. Apocynaceae: *Vinca, Thevetia, Nerium*.
9. Asclepiadaceae: *Calotropis.*
10. Solanaceae: *Solanum, Withania, Datura.*
11. Euphorbiaceae: *Euphorbia, Phyllanthus.*
12. Lamiaceae: *Ocimum, Salvia.*
13. Chenopodiaceae: *Chenopodium, Beta.*
14. Liliaceae: *Asphodelus, Asparagus.*
15. Poaceae: *Avena, Triticum, Hordeum Poa, Sorghum*.

The students should be made familiar with the use of identification keys including use of computers in taxonomy.
The teachers should prevent students from collecting plants from the wild and submitting them for the practical examination.
Instead, the student should be asked to prepare field reports.

Gymnosperms

Cycas (i) Habit, armour of leaf bases on the stem (if specimen is not available show photography), very young leaf (circinate vernation) and old foliage leaves, sclae leaf, bulbils, male cone (specimen); Microsporophyll, megasporophyll, mature seed. (ii) Study through permanent slides—normal root (T.S.), stem (T.S.) (if sections are not available show photographs), ovule (L.S.). (iii) Study through hand sections or dissections-coralloid root (T.S.), rachis (T.S.), leaflet (V.S.), microsporophyll (V.S.) pollen grains (W.M.).

Pinus (i) Habit, long and dwarf shoot showing cataphylls and scale leaves, T.S. wood showing growth rings, male cone, 1st year, 2nd year and 3rd year female cones, winged seeds. (ii) Study through permanent slides-root (T.S.), female cone (L.S.) ovule (L.S.), embryo (W.M.) showing polycotyledonous condition. (iii) Study through hand sections or dissections-young stem (T.S.), old stem (wood) (T.L.S. and R.L.S.), needle (T.S. male cone (L.S.), male cone (T.S.), Pollen grains (W.M.).

Ephedra (i) Habit and structure of whole and female cones. (ii) Permanent slides-female cone (L.S.). (iii) Hand sections/dissections-node (L.S.), internode (T.S.), macerated stem to see vessel structure; epidermal peel mount of vegetative parts to study stomata, male cone (T.S. and L.S.), pollen grains.

Ginkgo (i) Habit and structure of whole plant. (ii) Permanent slides-male and female reproductive parts. (iii) pollen grains.

Suggested Readings:

1. Angiosperm Phylogeny Group (2003). An update of the Angiosperm Phylogeny Group classification for the orders and families of the flowering plants: APG II. Botanical Journal of the Linnaean Society 141: 399-436.
2. Cronquist, A. (1981). An Integrated System of Classification of Flowering Plants. Columbia University Press, New York.
3. Simpson, M.C. (2006). Plant Systematics. Elsevier, Amsterdam.

Course Outcomes:

After completing the course students will be able to

CO-1	Identify and classify plants into different angiosperm families
CO-2	Use of identification keys in plant taxonomy
CO-3	Identify and classify another group of seed plants i.e., gymnosperms
CO-4	Make temporary mounts of vegetative and reproductive parts of gymnosperms
CO-5	Differentiate between two groups of seed plants i.e., angiosperms and gymnosperms

B.Sc. (MEDICAL) SEMESTER–V

BOTANY

Programme: BSMD
Course code: BOT351A
Course Title: Plant Physiology

Credit Hours (Per Week): 3

BOT351A	**: 25 Marks**
BOT351B	**: 25 Marks**
BOT351P	**: 25 Marks**
Internal Assessment	**: 25 Marks**
Total	**: 100 Marks**

Course Code: BOT351A
Course Title: PLANT PHYSIOLOGY

Time: 3 Hrs.
Theory Lectures: 3 Hours/Week **Max. Marks: 25**

Instructions for the Paper Setters:
There will be a total of nine questions and candidates will attempt any five questions. Question No. 1 will be compulsory and will consist of five parts with equal distribution from the whole syllabus. Answer to each part should not exceed 3-4 lines. Each part will carry one mark (multiple choice/one word answer type pquestions not to be set). The remaining eight questions are to be set two in each of the four units (I-IV). Candidates will be required to attempt four questions, one from each unit. Each question will carry five marks. Answer to each question should not exceed four pages.

Course Objectives:

CO-1	The main objective of this course is to introduce the students with the basic knowledge of major physiological processes in plants.
CO-2	To study the mechanisms of absorption, mineral nutrition and transportation in plants.
CO-3	To study the mechanism of photosynthesis.
CO-4	To study the physiology of flowering and seed germination.
CO-5	To study the role of plant hormones in growth and development.

UNIT I

Plant-Water Relation: Importance of water to plant life, physical properties of water, (imbibition) diffusion and osmosis, plasmolysis, mechanism of water absorption, concept of apoplast and symplast, ascent of sap and transpiration, significance of transpiration physiology of stomata, guttation.

UNIT II

Mineral Nutrition: Essential macro-and microelements and their role, mechanism of mineral uptake, deficiency and toxicity symptoms (hydroponics, Aeroponics).

Transport of Organic Substances: Mechanism of phloem transport, source-sink relationship, factors affecting translocation.

UNIT III

Photosynthesis: Significance, historical aspects, photosynthetic pigments, location of photosynthetic pigments in chloroplast, action and absorption spectra and mechanism of photosynthesis, Hill reaction, enhancement effects, concept of two photosystems, Z-scheme, photophosphorylation, Calvin cycle, photorespiration, C4 pathway, CAM plants, Blackman's law of limiting factors.

UNIT IV

Growth and Development: Definitions, phases of growth and development, kinetics of growth, growth curves, seed dormancy, seed germination and factors of their regulation, plant movements, the concept of photoperiodism, physiology of flowering, florigen concept, biological clocks, physiology of senescence, plant hormones - auxins, gibberellins, cytokinins, abscissic acid and ethylene, history of their discovery, biosynthesis and mechanism of action, general account of salicylic acid, jasmonates and brassinosteroids, photomophogensis, phytochromes and cryptochromes, their discovery, physiological role and mechanism of action.

Suggested Readings:

1. Dennis, D.T., Turpin, D.H. Lefebvre, D.D. and Layzell (eds.) (1997). Plant Metabolism (2nd Edition). Longman, Essex, England.
2. Galston, A.W. (1989). Life Processes in Plants. Scientific American Library, Springer-Verlag, New York, USA.
3. Hopkins, W.G. and Huner, A. (2008). Introduction to Plant Physiology (4^{th} Edition). John Wiley and Sons. U.S.A.
4. Mandavia, C., Patel, S. V., Mandavia, M. K., Golakiya, B. A. and Chovatia, V. P. (2009). Glimpses in Plant Physiology. International Book Distributing Co., Lucknow, India.
5. Mohr, H. and Schopfer, P. (1995). Plant Physiology. Springer-Verlag, Berlin, Germany.
6. Salisbury, F.B. and Ross, C.W. (1992). Plant Physiology (4^{th} Edition). Wadsworth Publishing Co., California, USA.
7. Taiz, L. and Zeiger, E. (2010). Plant Physiology (5^{th} Edition). Sinauer Associates Inc. USA.
8. Buchanan, B.B., Gruissem, W. and Jones, R.L. (2002). Biochemistry and Molecular Biology of Plants, American Society of Plant Physiologists, Maryland.

Course Outcomes:

CO-1	Students able to understand water relation of plants with respect to various physiological processes.
CO-2	Students able to learn role of micro and macro nutrients in plant development.
CO-3	Understand mechanisms of absorption, mineral nutrition, transportation and photosynthesis in plants.
CO-4	Learning the role of plant hormones in growth and development.

B.Sc. (MEDICAL) SEMESTER–V
BOTANY

Programme: BSMD
Course Code: BOT351B
Course Title: Biochemistry and Biotechnology
Credit Hours (Per Week): 3
BOT351B : 25 Marks

Instructions for the Paper Setters:
There will be a total of nine questions and candidates will attempt any five questions. Question No. 1 will be compulsory and will consist of five parts with equal distribution from the whole syllabus. Answer to each part should not exceed 3-4 lines. Each part will carry one mark (multiple choice/one word answer type questions not to be set). The remaining eight questions are to be set two in each of the four units (I-IV). Candidates will be required to attempt four questions, one from each unit. Each question will carry five marks. Answer to each question should not exceed four pages.

Course Objectives:

CO-1	To introduce the students with basics of enzymology.
CO-2	To study mechanism of plant respiration.
CO-3	To study nitrogen and lipid metabolism in plants.
CO-4	To study recombinant DNA technology.

UNIT I

Basics of Enzymology: Introduction, Discovery and Nomenclature, characteristics of enzymes, biological importnace, and distibution of enzymes, concept of holoenzyme, apoenzyme, coenzymes and cofactors regulation of enzyme activity, mechanism of action.

UNIT II

Respiration: ATP-the biological energy currency, aerobic and anaerobic respiration, Factors influencing rate of respiration, Kreb's cycle, electron transport mechanism (chemi-osmotic theory), redox potential, oxidative phosphorylation, pentose phosphate pathway.

UNIT III

Nitrogen and Lipid Metabolism: Biology of nitrogen fixation, importance of nitrate reductase and its regulation, ammonium assimilation, structure and function of lipids & fatty acid, saturated and unsaturated fatty acids, β-oxidation biosyntehsis. ,.

UNIT IV

Genetic Engineering: Tools and techniques of recombinant DNA technology, cloning vectors, genomic and cDNA library, transposable elements, techniques of gene mapping.
Biotechnology: Functional definition, basic aspects of plant tissue culture, cellular totipotency, differentiation and morphogenesis, biology of *Agrobacterium*, vectors for gene delivery and marker genes, salient achievements in crop biotechnology.

Suggested Readings:

1. Bhojwani, S.S. (1990). Plant Tissue Culture: Applications and Limitations. Elsevier Science Publishers, New York, USA.
2. Dennis, D.T., Turpin, D.H. Lefebvre, D.D. and Layzell (eds.) (1997). Plant Metabolism (2nd Edition). Longman, Essex, England.
3. Galston, A.W. (1989). Life Processes in Plants. Scientific American Library, Springer-Verlag, New York, USA.
4. Glick, B.R., Pasternak, J.J. (2003). Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington.
5. Lea, P.J. and Leegood, R.C. (1999). Plant Biochemistry and Molecular Biology. John Wiley & Sons, Chelichester, England.
6. Old, R.W. and Primrose, S.B. (1989). Principles of Gene Manipulation, Blackwell Scientific Publishers, Oxford, UK.
7. Snustad, D.P. and Simmons, M.J. (2010). Principles of Genetics (5^{th} Edition). John Wiley and Sons Inc., U.S.A.
8. Stewart, C.N. Jr. (2008). Plant Biotechnology & Genetics: Principles, Techniques and Applications. John Wiley & Sons Inc. U.S.A.
9. Vasil, I.K. and Thorpe, T.A. (1994). Plant Cell and Tissue Culture. Kluwer Academic Publishers, The Netherlands.

Course Outcomes:

CO-1	Learning basics of enzymology: nomenclature, characteristics and mechanism of action.
CO-2	Understanding the production of energy generation in plants.
CO-3	Understand the metabolic processes of nitrogen and lipids.
CO-4	Learning the basic concepts of genetic engineering.

B.Sc. (MEDICAL) SEMESTER–V

BOTANY

Programme: BSMD
Course Code: BOT351P
Course Title: Practical –V (Based on BOT351A & BOT351B)
Credit Hours (Per Week): 4.5
BOT351P : 25 Marks

Course Objectives

CO-1	Students will get insight on physical processes of water i.e., diffusion, osmosis, absorption of water and factors affecting water absorption process.
CO-2	Students will learn about the ascent of sap and its mechanism.
CO-3	Students will be able to understand the processes in plants, namely – photosynthesis, respiration, and role of phytohormones in plant development and growth.
CO-4	Students will be able to learn, how to prepare nutrient media, use explants in micropropagation techniques
CO-5	Students will be able to know about the basic requirements and setting up the tissue culture laboratory.

Suggested Laboratory Exercises:

1. To study the permeability of plasma membrane using different concentrations of organic solvents.
2. To study the effects of temperature on permeability of plasma membrane.
3. To prepare the standard curve of protein and determine the protein content in unknown samples.
4. To study the enzyme activity of catalase and peroxidase as influenced by pH and temperature.
5. Separation of chloroplast pigments by solvent method.
6. Determining the osmotic potential of vacuolar sap by plasmolytic method.
7. Determining the water potential of any tuber.
8. Separation of amino acids in a mixture by paper chromatography and their identification by comparison with standards.
9. Bioassay of auxin, cytokimin, GA, ABA and ethylene using appropriate plant material.
10. Demonstration of the technique of micropropagation by using different explants, e.g., axillary buds, shoot meristems.
11. Demonstration of the technique of anther pollen culture.
12. Demonstrationof the ascent of sap.
13. Demonstration of root and shoot formation from the apical and basal portion of stem segments in liquid medium containing different hormones.
14. Demonstration of osmosis by potato osmoscope.
15. Comparison of loss of water from two surfaces of leaf by four leaf method.
16. Demonstration of imbibition by plaster of paris method.

17. Demonstration that 0_2 is evolved during photosynthesis.
18. Separation of pigments by paper chromatography/TLC method.
19. Demonstration of phototropism movements.
20. Demonstration the measurements of growth by arc auxanometer.
21. Preparation of nutrient medium.
22. Sterilization of glassware and plant material.
23. Preparation of explant for aseptic manipulation.
24. Requirements for setting up the tissue culture laboratory.

Suggested Readings (For Laboratory Exercises)

1. Bajracharya D. (1999). Experiments in Plant Physiology-A Laboratory Manual. Narosa Publishing House, New Delhi.
2. Devi, P. (2000). Principles and Methods of Plant Molecular Biology, Biochemistry and Genetics. Agrobios, Jodhpur, India.
3. Dixon, R.A. (Ed.) (1987). Plant Cell Culture: A Practical Approach, IRL Press, Oxford.
4. Kochhar, S. L. and Gujral, S. K. (2012). Comprehensive Practical Plant Physiology. Macmillan Publishers India Ltd., Delhi.
5. Moore, T.C. (1974). Research Experiences in Plant Physiology: A Laboratory annual. Springer-Verlag. Berlin.
6. Plummer, D.T. (1996). An Introduction to Practical Biochemistry (3rd Edition). Tata McGraw-Hill Publishing Co. Ltd. New Delhi.
7. Roberts, J. and Tuckar, G.A. (Eds.) (2000). Plant Hormone Protocols. Human Press, New Jersey, USA.
8. Scott, R.P.W. (1995). Techniques and Practices of Chromotography. Marcel Dekker, Inc., New York.
9. Smith, R.H. (2000). Plant Tissue Culture: Techniques and Experiments. Academic Press, New York.
10. Wilson, K. and Goulding, K.H. (Eds.) (1986). A Biologists Guide to Principles and Techniques of Practical Biochemistry. Edward Arnold, London, UK.

Course Outcomes

CO-1	Understand the significance and mechanism of photosynthesis, role of light and evolution of O_2 in photosynthesis.
CO-2	Learn about different pigments involved in photosynthesis.
CO-3	Students able to analyze the transpiration and respiration processes in plants.
CO-4	Students able to know the micro propagation and plant tissue culture techniques.

B.Sc. (MEDICAL) SEMESTER–VI

BOTANY

Programme: BSMD
Course code: BOT361A
Course Title: Ecology

Credit Hours (Per Week): 3

BOT361A	**: 25 Marks**
BOT361B	**: 25 Marks**
BOT361P	**: 25 Marks**
Internal Assessment	**: 25 Marks**
Total	**: 100 Marks**

BOT361A

Instructions for the Paper Setters:
There will be a total of nine questions and candidates will attempt any five questions. Question No. 1 will be compulsory and will consist of five parts with equal distribution from the whole syllabus. Answer to each part should not exceed 3-4 lines. Each part will carry one mark (multiple choice/one-word answer type questions not to be set). The remaining eight questions are to be set two in each of the four units (I-IV). Candidates will be required to attempt four questions, one from each unit. Each question will carry five marks. Answer to each question should not exceed four pages.

Course Objectives:

CO-1	The main objective of this course is to introduce the students with the basic principles and concepts of plant ecology, ecosystem, population, biome, ecological succession etc.
CO-2	To study about biogeographical regions andvegetation types of India, landscape ecology.

UNIT I

Plants and Environment: Atmosphere (gaseous compositions), water (properties of water cycle), light, effect of light on plants, stratification, photoperiodism, effect of temperature (high and low) on plants, thermal stratification, soil (development, soil profiles, physico-chemical properties), topographic factors.

Morphological, anatomical and physiological responses of plants to water (hydrophytes and xerophytes), temperature (thermoperiodicity and vernalization), light (photoperiodism, heliophytes and sciophytes) and salinity.

UNIT II

Population Ecology: Growth curves, ecotypes, ecads.

Community Ecology: Community characteristics-qualitative and quantitative, absolute and relative frequency, density and dominance, basal area and importance value index (IVI), Whittaker's classification of biodiversity, indices of alpha, beta and gamma diversity, life forms, biological spectrum, biota, vertical stratification, analysis of plant community, plant succession.

UNIT III

Ecosystem: Structure, abiotic and biotic components, food chain, food web, ecological pyramids-pyramid of biomass, number, energy flow, biogeochemical cycles of carbon, nitrogen and phosphorus.

UNIT IV

Biogeographical Regions of India

Vegetation types of India: Forests and grasslands

Landscape Ecology: Definition & concept, effect of patch size and shape on biodiversity, dynamics of land use.

Suggested Readings

1. Kocchar, S.L. (1998). Economic Botany in Tropics, 2nd edition, Macmillan India Ltd., New Delhi.
2. Kumar, H.D. (2011). Modern Concepts of Ecology. Vikas Publishing House, New Delhi.
3. Mackenzie, A. et al. (1999). Instant Notes in Ecology. Viva Book Pvt. Ltd., New Delhi.
4. Odum, E.P. and Barrett, G.W. (2012). Fundamentals of Ecology. Cengage Learning India Pvt. Ltd., New Delhi.
5. Sambarmurthy, A.V.S.S. and Subramanyam, N.S. (1989). A Textbook of Economic Botany, Wily Eastern Ltd., New Delhi.
6. Sharma, O.P. (1996). Hill's Economic Botany (Late Dr. A.F. Hill, adapted by O.P. Sharma). Tata McGraw Hill Co. Ltd., New Delhi.
7. Sharma, P.D. (2013). Environmental Biology. Rastogi Publications, Meerut.
8. Simpson, B.B. and Conner-Ogozaly, M. (1986). Economic Botany-Plants in Our World. McGraw Hill, New York.

Course Outcomes:

CO-1	Students learn about environment and core concepts of biotic and abiotic factors.
CO-2	Students learn the concept of ecosystem.
CO-3	Learn the concept of population, community and biome.
CO-4	Learn concept of ecological succession.

B.Sc. (MEDICAL) SEMESTER–VI

BOTANY
Programme: BSMD
Course Code: BOT361B
Course Title: Economic Botany

Credit Hours (Per Week): 3
BOT361B : 25 Marks

Instructions for the Paper Setters:
There will be a total of nine questions and candidates will attempt any five questions. Question No. 1 will be compulsory and will consist of five parts with equal distribution from the whole syllabus. Answer to each part should not exceed 3-4 lines. Each part will carry one mark (multiple choice/one-word answer type questions not to be set). The remaining eight questions are to be set two in each of the four units (I-IV). Candidates will be required to attempt four questions, one from each unit. Each question will carry five marks. Answer to each question should not exceed four pages.

Course Objectives:

CO-1	The main objective of this course is to provide students comprehensive knowledge of usefulness of plant resources for human welfare.
CO-2	To study about food plants, vegetable oils are yielding plants, spices and condiments, medicinal plants, wood/beverages/rubber/fibres yielding plants.

UNIT I

Food Plants: Botanical description, cultivation practices and processing of economically important food crops viz: *Oryza sativa* (Rice), *Triticum aestivum* (Wheat), *Zea mays* (Maize), *Solanum tuberosum* (Potato), *Saccharum officinarum* (Sugarcane).

Vegetable Oils: Extraction techniques of vegetable oils from *Arachis hypogea* (Groundnut), *Brassica campestris* (Mustard) and *Glycine max* (Soyabean oil).

UNIT II

Spices and Condiments: General account of *Piper nigrum* (Black pepper), *Eugenia caryophyllum* (Cloves), *Cinnamomum zeylanicum* (Cinnamomum), *Elettaria cardamomum* (cardamom), *Zingiber officinalis* (Ginger), *Curcuma longa* (Turmeric), *Ocimum sanctum* (Tulsi), *Foeniculum vulgaris* (Fennel) and *Mentha arvensis* (Mint).

UNIT III

Medicinal Plants: General account of *Terminalia chebula* (Harar), *Terminalia belerica* (Bahera), *Azadirachta indica* (Neem), *Phyllanthus emblica* (Amla), *Tinospora cordifolia* (Giloy), *Aloe vera* (Aloe), *Glycyrrhiza glabra* (Mulathi) *Datura stramonium* (Datura), *Withania somniferum* (Ashwagandha) and *Papaver somniferum* (Poppy).

UNIT IV

Wood: General account of sources of firewood, timber and bamboos.

Fibres: *Gossypium hirsutum* (Cotton) and *Cocos nucifera* (Coconut).

Beverages: *Camellia sinensis* (Tea) and *Coffea arabica* (Coffee).

Rubber: Morphology of *Hevea brasiliensis* (Rubber), Processing and Uses.

Suggested Readings:

1. Council of Scientific & Industrial Research (1986). The Useful Plants of India. Publications and Information Directorate. CSIR, New Delhi.
2. Das, K. (2010). Medicinal plants- Their importance in Pharmaceutical Sciences, Kalyani Publishers, New Delhi.
3. Kocchar, S.L. (2000). Economic Botany of the Tropics, Macmillan India Pvt. Ltd., New Delhi.
4. Prinentel, D. and Hall, C.W. (Eds.) (1989). Food and Natural Resources. Academic Press, London, New York.
5. Reddy, K. et al. (2007). Advances in Medicinal plants, Universities Press, Hyderabad.
6. Sharma, O.P. (1996). Hill's Economic Botany. Tata McGraw Hill Co. Ltd., New Delhi.
7. Swaminathan, M.S. and Kocchar, S.L. (Eds) (1989). Plants and Society. Macmillan Publications Ltd., London.
8. Verma, V. (2009). Textbook of Economic Botany, ANE Books, New Delhi.

Course Outcomes:

CO-1	Students able to understand the core concepts of Economic Botany.
CO-2	Develop a basic knowledge of plant wealth such as medicinal/crop/ fibre/ wood yielding plants and beverages.

B.Sc. (MEDICAL) SEMESTER–VI

BOTANY

Programme: BSMD
Course Code: BOT361P
Course Title: Practical-VI (Based on BOT361A & BOT361B)

Credit Hours (Per Week): 4.5
BOT361P : 25 Marks

Course Objectives

CO-1	Students will learn about the morphological, anatomical features of hydrophytes and Xerophytes.
CO-2	Students will learn about the effect of pollution on different water bodies and plant life.
CO-3	Students will learn about the quadrate methods used in the estimation of species.
CO-4	Students will learn about the morphology and economic importance of food plants, fibres, oil yielding plants

Suggested Laboratory Exercises

1. To determine minimum number of quadrats required for reliable estimate of species diversity in grasslands through species area curves.
2. To study the frequency of herbaceous species in grassland and to compare the frequency distribution with Raunkiaer's Standard Frequency Diagram.
3. To estimate Importance Value Index for grassland species on the basis of relative frequency, relative density and relative dominance in protected and grazed grassland.
4. To measure the vegetation cover of grassland through point frame method.
5. To measure the above ground plant biomass in a grassland.
6. To study the morphological anatomical features of hydrophytes (root, stem, leaf *Hydrilla*, *Eichhornia*) Xerophytes (stem, leaf-*Nerium*, *Calotropis*).
7. To determine diversity indices (species richness, Simpson, Shannon-Weaver) in grazed and protected grassland.
8. To estimate bulk density and porosity of grassland and woodland soils.
9. To determine moisture content and water holding capacity of grassland and woodland soil.
10. To study the vegetation structure through profile diagram.
11. To estimate transparency, pH and temperature of different water bodies.
12. To measure dissolved oxygen content in polluted and unpolluted water samples.
13. To estimate salinity of different water samples.
14. To determine the percentage leaf area injury of different leaf samples collected around polluted sites.
15. To estimate dust-holding capacity of the leaves of different plant species.
16. **Food Plants:** Study of the morphology, structure and simple microchemical tests of the foods storing tissues rice, wheat, maize, potato and sugarcane. Microscopic examination of starch in these plants (excepting sugarcane).
17. **Fibres:** Study of cotton flowers, sectioning of the cotton ovules/developing seeds to trace the origin and development of cotton fibers. Microscopic study of cotton and test for cellulose. Sectioning and staining of jute stem to show the location and development of fibers. Microscopic structure. Tests for lignocelluloses.

18. **Vegetable Oils:** Study of hand sections of groundnut, mustard and coconut and staining of oil droplets by Sudan III and Sudan Black.
19. **Field Visits:** To study sources of firewood (10 plants)/timber yielding trees (10 trees)/bamboos, list to be prepared mentioning special features, collection of plant based articles of common use.
20. **Spices:** Examine black pepper, cloves, cinnamon (hand sections) and opened buds of cardamom and describe them briefly.
21. Preparations of an illustrated inventory of 10 medicinal plants used in indigenous systems of medicine or allopathy: Write their botanical and common names of parts used and diseases/disorders for which they are prescribed.
22. **Beverages:** Hand section of boiled coffee beans and tea leaves to study the characteristic structural features.
23. Visit to *in situ* conservation site/Botanical Garden.

Suggested Readings (for laboratory exercises)

1. Council of Scientific & Industrial Research. (1986). The Useful Plants of India. Publications and Information Directorate. CSIR, New Delhi.
2. Kocchar, S.L. (2000). Economic Botany of the Tropics, Macmillan India Pvt. Ltd., New Delhi.
3. Krebs, C.J. (1989). Ecological Methodology. Harper and Row, New York, USA.
4. Ludwig, J.A.and Reynolds, J.F. (1988). Statistical Ecology, Wiley, New York.
5. Moore, P.W. and Chapman, S.B. (1986). Methods in Plant Ecology, Blackwell Scientific Publications.
6. Prinentel, D. and Hall, C.W. (Eds.) (1989). Food and Natural Resources. Academic Press, London, New York.
7. Sharma, O.P. (1996). Hill's Economic Botany. Tata McGraw Hill Co. Ltd., New Delhi.
8. Swaminathan, M.S. and Kocchar, S.L. (Eds.) (1989). Plants and Society. Macmillan Publications Ltd., London.

Course Outcomes:

CO-1	Students able to know the significance of hydrophytes and xerophytes in relation to environment.
CO-2	Students able to estimate different species of plants through quadrate methods.
CO-3	After studying economic botany, students get vast understanding of food plants, fibres, oil yielding plants
CO-4	Students able to know sources of firewood, timber yielding trees