

FACULTY OF SCIENCES

SYLLABUS FOR THE BATCH

FROM THE YEAR 2023 TO YEAR 2026

Programme Code: BSMD

Programme Name: B.Sc. Medical
(Semester I-IV)

Batch: 2023-2026



DEPARTMENT OF BOTANY
KHALSA COLLEGE, AMRITSAR
(An Autonomous College)

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

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.

B.Sc. Medical Programme: BSMD Scheme of Courses

COURSE SCHEME											
SEMESTER - I											
Course Code	Course Name	Hours/Week	Credits			Total Credits	Max Marks				Page No.
			L	T	P		Th	P	IA	Total	
Major Courses											
BOT111A	Diversity of Microbes	3	2	1	0	3	56	-	50	200	3-4
BOT111B	Diversity of Cryptogams	3	2	1	0	3	56	-			5-6
BOT111P	Botany Lab – I (Based on BOT111A & BOT111B)	4	0	0	2	2	-	38			7

*For practical one credit means two hours of practical/per week; IA = Internal assessment

SEMESTER - II											
Course Code	Course Name	Hours/Week	Credits			Total Credits	Max Marks				Page No.
			L	T	P		Th	P	IA	Total	
Major Courses											
BOT121A	Cell Biology	3	2	1	0	3	56	-	50	200	8-9
BOT121B	Genetics	3	2	1	0	3	56	-			10-11
BOT121P	Botany Lab - II (Based on BOT121A & BOT121B)	4	0	0	2	2	-	38			12-13

*For practical one credit means two hours of practical/per week; IA = Internal assessment

SEMESTER - III											
Course Code	Course Name	Hours/Week	Credits			Total Credits	Max Marks				Page No.
			L	T	P		Th	P	IA	Total	
Major Courses											
BOT 231A	Structure, Development and Reproduction in Flowering Plants – I	3	2	1	0	3	56	-	50	200	14-15
BOT-231B	Structure, Development and Reproduction in Flowering Plants – II	3	2	1	0	3	56	-			16-17
BOT-231P	Botany Practical - III Based on BOT231A & BOT231B	4	0	0	2	2	-	38			18-19

*For practical one credit means two hours of practical/per week; IA = Internal assessment

SEMESTER - IV											
Course Code	Course Name	Hours/Week	Credits			Total Credits	Max Marks				Page No.
			L	T	P		Th	P	IA	Total	
Major Courses											
BOT241A	Diversity of Seed Plants and their Systematics – I	3	2	1	0	3	56	-	50	200	20-21
BOT241B	Diversity of Seed Plants and their Systematics – II	3	2	1	0	3	56	-			22-23
BOT241P	Botany Practical - IV Based on BOT241A & BOT241B	4	0	0	2	2	-	38			24-25

*For practical one credit means two hours of practical/per week; IA = Internal assessment

B.Sc (MEDICAL) SEMESTER-I

Programme: BSMD

Course Code: BOT111A

Course Type: Major (Theory)

Course Title: Diversity of Microbes

Credit L-T-P: 2-1-0

BOT111A: 56 marks

BOT111B: 56 marks

BOT111P: 38 marks

Internal Assessment: 50 marks

Total Marks : 200 marks

BOT111A (Hours Per Week: 3)

Instructions for the Paper Setters:

The question paper will be divided into 5 sections (Section A-E). Section A: (Total weightage 12 marks). This section will have 8 very short answer type questions (maximum limit 50 words) and students have to attempt any 6 questions. Each question will carry 2 marks. Questions are to cover from the whole syllabus. Section B, C, D and E: (Total weightage 44 marks). Each section will have two questions from one unit. The student will have to attempt one question from each section and question will carry 11 marks. The answers should not exceed 6 pages. The questions should not have more than two subparts.

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. Life cycles in algae, 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

General account of viruses, nature, classification, structure, reproduction, TMV and bacteriophage

General account of bacteria structure, nutrition, reproduction

General account of cyanobacteria, distribution, thallus structure, cell structure, reproduction

General account of Lichens, Organisation of thallus: crustose, foliose and fruticose

Suggested Readings:

1. Dubey, R. and Maheshwari, D. (2016). A textbook of Microbiology. S. Chand and company, New Delhi.
2. Alexopoulos, 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 structurally differentiate 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 Type: Major (Theory)
Course Title: Diversity of Cryptogams

Credit L-T-P: 2-1-0

BOT111B: 56 marks

Hours per week: 3

Instructions for the Paper Setters:

The question paper will be divided into 5 sections (Section A-E). Section A: (Total weightage 12 marks). This section will have 8 very short answer type questions (maximum limit 50 words) and students have to attempt any 6 questions. Each question will carry 2 marks. Questions are to cover from the whole syllabus. Section B, C, D and E: (Total weightage 44 marks). Each section will have two questions from one unit. The student will have to attempt one question from each section and question will carry 11 marks. The answers should not exceed 6 pages. The questions should not have more than two subparts.

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, Bryophytes as amphibians of plants kingdom, life cycle displaying alternation of generations, Affinities of bryophytes with algae and pteridophytes.

UNIT-II

Morphology, anatomy and reproduction of:

Marchantia,

Anthoceros,

Funaria,

(Developmental stages are excluded). Ecological and Economic importance of bryophytes.

UNIT-III

General characters and classification of Pteridophyta, Stejar System, Life cycle showing alternation of generations.

UNIT-IV

Morphology, anatomy and reproduction of *Rhynia*, *Lycopodium*, *Selaginella*, *Equisetum*, *Pteris*, *Marsilea*. (Developmental stages are excluded). Economic importance of Pteridophytes.

Suggested Readings:

1. Goffinet B. (2008). *Bryophyte Biology*. Cambridge University Press, UK.
2. Sambamurty, S.S. (2005). *A Textbook of Bryophytes, Pteridophytes, Gymnosperms and Paleobotany*. I K International Publishing House Pvt Ltd., India
3. Sharma, O.P. (2014). *Bryophyta*. Mc Graw Hill Education Pvt Ltd., India.
4. Rashid, A. (1998). *An Introduction to Bryophyta*. Vikas Publishing House Pvt. Ltd. New Delhi.
5. Vashistha, P.C., Sinha, A.K. and Kumar, A. (2010) *Pteridophyta*. S. Chand. Delhi, 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 Type: Major (Practical)

Course Title: Botany Lab-I

(Based on BOT111A & BOT111B)

Credit L-T-P: 0-0-2

Maximum Marks : 38

Hours per week: 4

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, bryophytes 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 in theory under algae and fungi.
4. Study of morphology, reproductive structures and anatomy Bryophytes (*Marchantia*, *Anthoceros* and *Funaria*) and Pteridophytes (*Lycopodium*, *Selaginella*, *Equisetum*, *Pteris* and *Marsilea*).

Suggested Readings:

1. Lee, R.E. (2008). Phycology, Fourth Edition, Cambridge University Press, USA.
2. 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 Type: Major Course (Theory & Practical)

Course Title: Cell Biology

Credit L-T-P: 2-1-0

BOT121A: 56 marks

BOT121B: 56 marks

BOT121P: 38 marks

Internal Assessment: 50 marks

Total Marks : 200 marks

BOT121A (Hours per Week: 3)

Instructions for the Paper Setters:

The question paper will be divided into 5 sections (Section A-E). Section A: (Total weightage 12 marks). This section will have 8 very short answer type questions (maximum limit 50 words) and students have to attempt any 6 questions. Each question will carry 2 marks. Questions are to cover from the whole syllabus. Section B, C, D and E: (Total weightage 44 marks). Each section will have two questions from one unit. The student will have to attempt one question from each section and question will carry 11 marks. The answers should not exceed 6 pages. The questions should not have more than two subparts.

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

Cell: Prokaryotic and Eukaryotic cell, Ultrastructure and function of plant. Structure and Function of Cell Organelles:

Plastids

Mitochondria

Golgi apparatus

Endoplasmic reticulum

Vacuoles (sap, contractile and air vacuoles)

UNIT-II

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 and their types.

UNIT-III

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

UNIT-IV

The Cell Envelopes: Cell wall - structure and function; Plasma membrane – Chemical composition, Membrane models and functions; membrane transport: diffusion, active, passive and bulk 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.
7. Cooper, G.M. and Hausman, R.E. (2013). The Cell: A Molecular Approach (6th Edition). Sinauer Associates Inc.

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 Type: Major Course (Theory & Practical)

Course Title: Genetics

Credit L-T-P. 2-1-0

BOT121B: 56 marks

Hours per week: 3

Instructions for the Paper Setters:

The question paper will be divided into 5 sections (Section A-E). Section A: (Total weightage 12 marks). This section will have 8 very short answer type questions (maximum limit 50 words) and students have to attempt any 6 questions. Each question will carry 2 marks. Questions are to cover from the whole syllabus. Section B, C, D and E: (Total weightage 44 marks). Each section will have two questions from one unit. The student will have to attempt one question from each section and question will carry 11 marks. The answers should not exceed 6 pages. The questions should not have more than two subparts.

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, Mutations: Types of mutations; Molecular basis of Mutations; Mutagens: physical and chemical (Base analogs, deaminating, alkylating and intercalating agents); transposable genetic elements

UNIT-II

Genetic Inheritance: Mendelism: laws of segregation and independent assortment, linkage analysis; allelic and non–allelic interactions. (Incomplete dominance and co-dominance, Multiple alleles, Lethal alleles, Epistasis, Pleiotropy, Recessive and Dominant traits).

UNIT-III

Gene expression: Structure of gene, transfer of genetic information; transcription, translation, genetic code, Gene regulation, Operon model.

UNIT-IV

Population and Evolutionary Genetics: Allele frequencies, Hardy-Weinberg Law, role of natural selection, genetic drift. Genetic variation and Speciation.

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 Type: Major Course (Theory & Practical)
Course Title: Botany Lab-II
(Based on BOT121A & BOT121B)

Credit L-T-P: 0-0-2
Hours per week: 4

Maximum Marks: 38

Course Objective

CO-1	Train students for micropreparation 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 generalized plant cell structure from onion leaf peels; demonstration of staining and mounting methods.
2. Comparative study of cell structure in onion cells, *Hydrilla* and *Spirogyra*.
3. Study of cyclosis in *Tradescantia* Staminal Cells.
4. Examination of electron micrographs of eukaryotic cells with special reference to organelles: chloroplast, mitochondria, endoplasmic reticulum, golgi apparatus, nucleus).
5. Study of electron micrographs of viruses, bacteria, cyanobacteria and eukaryotic cells for comparative cellular organization.
6. Study of plastids to examine pigment distribution in plants.
7. Examination of various stages of mitosis and meiosis using appropriate plant material (e.g. onion root tips, onion flower buds).
8. Preparation of karyotypes from dividing root tip cells.
9. Cytological examination of special types of chromosomes: bar body, polytene chromosomes.
10. Working out the laws of inheritance using seed mixtures.
11. 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 Barlett 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 inheritance and linked genes.

B.Sc (MEDICAL) SEMESTER–III

Programme: BSMD

Course Code: BOT231A

Course Type: Major (Theory)

Course Title: Structure, Development and Reproduction in Flowering Plants – I

Credit L-T-P: 2-1-0

BOT231A: 56 marks

BOT231B: 56 marks

BOT231P: 38 marks

Internal Assessment: 50 marks

Total Marks : 200 marks

BOT231A (Hours per week: 3)

Instructions for the Paper Setters:

The question paper will be divided into 5 sections (Section A-E). Section A: (Total weightage 12 marks). This section will have 8 very short answer type questions (maximum limit 50 words) and students have to attempt any 6 questions. Each question will carry 2 marks. Questions are to cover from the whole syllabus. Section B, C, D and E: (Total weightage 44 marks). Each section will have two questions from one unit. The student will have to attempt one question from each section and question will carry 11 marks. The answers should not exceed 6 pages. The questions should not have more than two subparts.

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, Porous wood and Non Porous wood). Secondary growth in Dicot stem, Periderm, Anamalous secondary growth in *Dracena* and *Boerhaavia*, secondary phloem-structure function relationships. 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 differentiate flowering and non-flowering plants.
CO-2	Students learn about various types of leaves and their modifications.
CO-3	Learn various 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

Programme: BSMD

Course Code: BOT231B

Course Type: Major (Theory)

Course Title: Structure, Development and Reproduction in Flowering Plants – II

Credit L-T-P: 2-1-0

BOT231B: 56 marks

Hours per week: 3

Instructions for the Paper Setters:

The question paper will be divided into 5 sections (Section A-E). Section A: (Total weightage 12 marks). This section will have 8 very short answer type questions (maximum limit 50 words) and students have to attempt any 6 questions. Each question will carry 2 marks. Questions are to cover from the whole syllabus. Section B, C, D and E: (Total weightage 44 marks). Each section will have two questions from one unit. The student will have to attempt one question from each section and question will carry 11 marks. The answers should not exceed 6 pages. The questions should not have more than two subparts.

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 reproductive structures of plant.
CO-4	To study different types of pollination 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 vegetative 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

Programme: BSMD

Course Code: BOT231P

Course Type: Major Course (Theory & Practical)

Course Title: Botany Lab-III

(Based on BOT231A & BOT231B)

Credit L-T-P: 0-0-2

Maximum Marks: 38

Hours per week: 4

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

Programme: BSMD

Course Code: BOT241A

Course Type: Major (Theory)

Course Title: Diversity of Seed Plants and Their Systematics-I

Credit L-T-P: 2-1-0

BOT241A: 56 marks

BOT241B: 56 marks

BOT241P: 38 marks

Internal Assessment: 50 marks

Total Marks : 200 marks

BOT241A (Hours per week: 3)

Instructions for the Paper Setters:

The question paper will be divided into 5 sections (Section A-E). Section A: (Total weightage 12 marks). This section will have 8 very short answer type questions (maximum limit 50 words) and students have to attempt any 6 questions. Each question will carry 2 marks. Questions are to cover from the whole syllabus. Section B, C, D and E: (Total weightage 44 marks). Each section will have two questions from one unit. The student will have to attempt one question from each section and question will carry 11 marks. The answers should not exceed 6 pages. The questions should not have more than two subparts.

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.

UNIT II

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 *Ephedra* and *Ginkgo*.

Suggested Readings:

1. Bhatnagar, S.P. and Moitra, A. (1996). Gymnosperms, New Age International 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

Programme: BSMD

Course Code: BOT241B

Course Type: Major (Theory)

Course Title: Diversity of Seed Plants and Their Systematics-II

Credit L-T-P: 2-1-0

BOT241B: 56 marks

Hours per week: 3

Instructions for the Paper Setters:

The question paper will be divided into 5 sections (Section A-E). Section A: (Total weightage 12 marks). This section will have 8 very short answer type questions (maximum limit 50 words) and students have to attempt any 6 questions. Each question will carry 2 marks. Questions are to cover from the whole syllabus. Section B, C, D and E: (Total weightage 44 marks). Each section will have two questions from one unit. The student will have to attempt one question from each section and question will carry 11 marks. The answers should not exceed 6 pages. The questions should not have more than two subparts.

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 taxometrics 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

Programme: BSMD

Course Code: BOT241P

Course Type: Major Course (Theory & Practical)

Course Title: Botany Lab-IV

(Based on BOT241A & BOT241B)

Credit L-T-P: 0-0-2

Maximum Marks: 38

Hours per week: 4

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 <i>Cycas</i> , <i>Pinus</i> , <i>Ginkgo</i> and <i>Ephedra</i>

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*, *Caesalpinia*, *Mimosoideae*: *Prosopis*, *Mimosa*, *Aecia*.
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