Annexure (B)

FACULTY OF LIFE SCIENCES

Syllabus for

Bachelor of Science (Medical/Honours)

(SEMESTER I-IV)

(Under Credit Based Continuous Evaluation Grading System)

Session: 2025-26

Kanya Maha Vidyalaya, Jalandhar (Autonomous)

The Heritage Institution

Kanya Maha Vidyalaya, Jalandhar (Autonomous)
SCHEME AND CURRICULLUM OF EXAMINATION OF FOUR YEAR DEGREE PROGRAMME
Bachelor of Science (Medical/Honours)
(Session 2025-2026)

Semester –I										
Course Name	**Program Name**	**Course Code**	**Course Type**	**Total Marks**	**Marks**					
					Paper	**Credits**	**Ext.**		**CA**	**EXAM TIME In Hrs**
						L-T-P	**L**	**P**		
Botany	Bachelor of Science (Medical/Honours)	BSML- 1075	DSC	100	Diversity of Cryptogams	4-0-0	70	-	30	3
		BSMP- 1075		50	Diversity of Cryptogams Lab	0-0-2	-	35	15	3

Semester –II										
Course Name	**Program Name**	**Course Code**	**Course Type**	**Total Marks**	**Marks**					
					Paper	**Credits**	**Ext.**		**CA**	**EXAM TIME In Hrs**
						L-T-P	**L**	**P**		
Botany	Bachelor of Science (Medical/Honours)	BSML- 2075	DSC	100	Cell Biology and Genetics	4-0-0	70	-	30	3
		BSMP- 2075		50	Cell Biology and Genetics Lab	0-0-2	-	35	15	3
		BSMM-2070	SEC	100	Medicinal Botany	2-0-1	50	20	30	3+2

Kanya Maha Vidyalaya, Jalandhar (*Autonomous*)

SCHEME AND CURRICULLUM OF EXAMINATIONS OF FOUR-YEAR DEGREE PROGRAM

Bachelor of Science (Medical)/Honours

Session 2025-2026

B.Sc (Medical) Semester III								
Course Code	Course Name	Course Type	Credits	Total Marks	Ext.		CA	Examination Time (in Hours)
					L	P		
BSML-3075	Botany (Diversity of Phanerogams)	DSC	4	100	70		30	3
BSMP-3075	Diversity of Phanerogams Lab		2	50	--	35	15	3

SCHEME AND CURRICULLUM OF EXAMINATIONS OF FOUR-YEAR DEGREE PROGRAM

Bachelor of Science (Medical/Honours)

Session 2025-2026

B.Sc. (Medical) Semester IV								
Course Code	Course Name	Course Type	Credits	Total Marks	Ext.		CA	Examination Time (in Hours)
					L	P		
BSML-4075	Botany (Structure, Development And Reproduction In Flowering Plants)	DSC	4	100	70		30	3
BSMP-4075	Structure, Development And Reproduction In Flowering Plants Lab		2	50	--	35	15	3

Bachelor of Science (Medical/Honours) Semester–I (Session 2025-26)

BOTANY (DIVERSITY OF CRYPTOGAMS)
Course Code: BSMM-1075
(THEORY)

Course outcome:

After passing this course the course the student will be able to:

CO1: Understand the classification, characteristic features, life cycle and economic value of algae.

CO2: Develop knowledge about features, classification, life cycle and economic importance of fungi.

CO3: Build up a sound foundation in the subject of Cryptogamic Botany in general and Bryophytes so that the students may be able to apply the acquired knowledge while interacting into the other fields of Botany.

CO4: Acquaint the students about the classification, morphology, biology and economic importance of various pteridophytic plants.

Bachelor of Science (Medical/Honours) Semester–I (Session 2025-26)

BOTANY (DIVERSITY OF CRYPTOGAMS)
Course Code: BSML-1075
(THEORY)

Time: 3 Hrs. **Max. Marks: 100**
Credits (L-T-P): 4-0-0 **Theory: 70**
C.A.:30

Instructions for the Paper Setters:-

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

SECTION–A

Algae: General characters, classification and economic importance; important features and life history of Chlorophyceae– *Volvox*, *Oedogonium*; Xanthophyceae–*Vaucheria*; Phaeophyceae–*Ectocarpus*; Rhodophyceae–*Polysiphonia*.

SECTION–B

Fungi: Important features and life history of Mastigomycotina–*Phytophthora*; Zygomycotina–*Mucor*; Ascomycotina–*Saccharomyces*, *Peziza*; Basidiomycotina–*Puccinia*, *Agaricus*; Deuteromycotina–*Colletotrichum*. General account of Lichens.

SECTION–C

Bryophyta: Amphibians of plant kingdom displaying alternation of generations; structure, reproduction, ecology and economic importance. Classification of bryophytes, Structure and reproduction of *Marchantia* (Hepaticopsida), *Anthoceros* (Anthocerotopsida), *Funaria* (Bryopsida).

SECTION–D

Pteridophyta: First vascular plant; classification; ecology and economic importance of pteridophytes. Important characteristics of Psilopsida, Lycopsida, Sphenopsida and Pteropsida. Structure and reproduction in *Rhynia*, *Lycopodium*, *Selaginella*, *Equisetum*, and *Pteris*

Suggested Readings:

1. Alexopoulous, C.J., Mims, C.W. and Blackwell, M. Introductory Mycology (4th Edition), Wiley - Blackwell, USA.
2. Dube, H.C., 2007, A Textbook of Fungi, Bacteria and Viruses (3rd edition), Scientific Publishers, India
3. Dube, H.C., 2013, An Introduction to Fungi (4th edition), Scientific Publishers., India.
4. Goffinet B. (2008). Bryophyte Biology. Cambridge University Press, UK.
5. Sambamurty, S.S. (2013). A Textbook of Bryophytes, Pteridophytes, Gymnosperms and Paleobotany. I K International Publishing House Pvt Ltd., India
6. Sharma, O.P. (2014). Bryophyta. McGraw Hill Education Pvt Ltd., India.
7. Srivastava, H.N., 2018, Diversity of Microbes and Cryptogams, Vol. I, Pradeep's Publication.
8. Vashishta, P.C, Sinha, A.K, Kumar, A., (2010). Botany for Degree Students Pteridophyta (Vascular cryptogams). S.S. Chand Publications.
9. Sharma, O.P., 2004, Text Book of Thallophytes. McGraw Hill Publishing Co., India.
10. Sharma, P.D., 2004, The Fungi, (2nd Edition) Rastogi Publication, India.

Bachelor of Science (Medical) Semester–I (Session 2025-26)
BOTANY (DIVERSITY OF CRYPTOGAMS Lab)
Course Code: BSMP-1075
(PRACTICAL)

Course outcome:

After passing this course the course the student will be able to:

CO1: Students will assess various phylogenetic information sources, such as ultrastructure and morphology, to understand algae and fungi.

CO2: Understand the evolutionary history and time-scale of non-vascular plants, including the development of the first terrestrial plants from green algae.

CO3: Identify fungal disease symptoms in host plants and study pathogen morphology through section cutting. CO4: Identify and classify different types of lichens.

Bachelor of Science (Medical/Honours) Semester–I (Session 2024-25)
BOTANY (DIVERSITY OF CRYPTOGAMS)
Course Code: BSMP-1075
(PRACTICAL)

Time: 3 Hrs **Max. Marks: 50**
Credits (L-T-P): 0-0-2 **Practical: 35**
C.A.:15

Suggested Laboratory Exercises:-

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

1. Study of the genera included under algae and fungi.
2. Study of morphology, reproductive structures and anatomy of the examples cited in theory under Bryophyta and Pteridophyta
3. Observation of disease symptoms in hosts infected by fungi.
4. Section cutting of diseased material and identification of the pathogens as per the theory syllabus.
5. Study of morphology of Lichens (crustose, foliose and fruticose).

Bachelor of Science (Medical) Semester–II (Session 2025-26)
BOTANY (CELL BIOLOGY AND GENETICS)
Course Code: BSML-2075
(THEORY)

Course outcome:

After passing this course the course the student will be able to: -

CO1: Explain the structure of cell and organelles associated with it.

CO2: Understand cellular envelopes and their functions.

CO3: Understand the chemical basis of hereditary material i.e., DNA., Mitosis, Meiosis and gene interactions

CO4: Understand different methods of gene expression in prokaryotes and eukaryotes AND various methods of genetic mutation and variations in living beings.

Bachelor of Science (Medical) Semester–II (Session 2025-26)
BOTANY (CELL BIOLOGY AND GENETICS)
Course Code: BSML-2075
(THEORY)

Time: 3 Hrs. **Max. Marks: 100**
Credits (L-T-P): 4-0-0 **Theory: 70**
C.A.:30

Instructions for the Paper Setters:-

Eight questions of equal marks (14 marks each) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Unit-I

Nucleus: Ultrastructure; nuclear membrane; nucleolus; nucleoid in prokaryotes. Histone proteins: structure and function, Extra nuclear Genome: mitochondrial and plastid DNA; plasmids. Structure and function of cellular organelles.
The Cell Envelopes: Ultra structure of plasma membrane: bi-layer lipid structure, extrinsic and intrinsic proteins, functions. Ultra structure of cell wall, cell wall composition and its functions.

Unit-II

DNA the Genetic Material: DNA structure and its types (A, B, Z DNA); replication; DNA–protein interaction; the nucleosome model; genetic code; satellite and repetitive DNA, Cell Division: Mitosis; meiosis.

Unit-III

Genetic Inheritance: Mendelism; laws of segregation and independent assortment; linkage analysis; Incomplete dominance and co-dominance, multiple alleles, lethal alleles, epistasis, pleiotropy, penetrance and expressivity, polygenic inheritance.

Unit-IV

Gene expression: Structure of gene; transfer of genetic information; transcription, translation, protein synthesis, tRNA; ribosomes; regulation of gene expression in prokaryotes and eukaryotes.
Genetic Variations: Mutations, spontaneous and induced; transposable genetic elements; DNA, damage and repair

Suggested Readings:-

1. Johnson, A., Raff, L. and Walter, R. (2008). Molecular Biology of the Cell (5th Edition). Taylor and Francis Group, USA.
2. Karp, G. (2013). Cell and Molecular Biology: Concepts and Experiments (7th Edition). Wiley Publishers, USA.
3. Kleinsmith, L.J. and Kish, V.M. (1995). Principles of Cell and Molecular Biology (2nd edition). Harper Collins College Publishers, New York, USA.

4. 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.
5. Snustad, D.P. and Simmons, M.J. (2010). Principles of Genetics (5th Edition). John Wiley and Sons Inc., U.S.A.
6. Brown, T.A. (2011). Genetics: A Molecular Approach (3rd Edition). BIOS Scientific Publishers, UK.
7. Fletcher, H., Hickey, I. and Winter, P. (2010). Instant Notes on Genetics (3rd edition) Taylor and Francis Group, USA.
8. Gardner, E.J., Simmons, M.J. and Snustad, D.P. (2012). Principles of Genetics (8th Edition). Wiley Sons, USA.
9. Gupta, P.K. (2016). Cell and Molecular Biology, Rastogi Publications, Meerut, India.
10. Krebs, B. E., Goldstein, E.S. and Kilpatrick, S.T. (2011). Lewins Genes X. Jones and Bartlett Publishers, LLC, UK.
11. Singh, B.D. (2007). Molecular Genetics. Kalyani Publishers, India.
12. Fukui, K. and Nakayama, S. (1996). Plant Chromosomes; Laboratory Methods, CRC Press, Boca Raton, Florida.
13. Gunning, B.E.S. and Steer, M.W. (1996). Plant Cell Biology; Structure and Function, Jones and Barllett Publishers, Boston, Massachusetts.
14. Harns, N. and Oparka, K.J. (1994). Plant Cell Biology, A Practical Approach. IRL Press, at Oxford University Press, Oxford, UK.
15. Sharma, A.K. and Sharma, A. (1999). Plant Chromosomes; Analysis. Manipulation and Engineering, Harwood Academic Publishers, Australia.
16. Plopper, G. (2016). Principles of Cell Biology. Jones and Barnett Learning, Boston, Massachusetts.

Bachelor of Science (Medical) Semester–II (Session 2025-26)
BOTANY (CELL BIOLOGY AND GENETICS LAB)
Course Code: BSML-2075
(PRACTICAL)

Course Outcome:

After passing this course the student will be able to:

CO1: Study of cell structure and plastids examination.

CO2: Understand microscopic structure of cell through light microscope and electron micrograph.

CO3: Evaluate methodologies in the design of genetics experimental procedures.

CO4: Analyze special chromosome types and apply inheritance laws using genetic data.

Bachelor of Science (Medical) Semester–II (Session 2025-26)

BOTANY (CELL BIOLOGY AND GENETICS LAB)
Course Code: BSML-2075
(PRACTICAL)

Time: 3 Hrs **Max. Marks: 50**
Credits (L-T-P):0-0-2 **Theory: 35**
C.A.:1

Suggested Laboratory Exercises:

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*.
3. Study of cyclosis in *Tradescantia* Staminal Cells.
4. Study of plastids to examine pigment distribution in plants (e.g. *Cassia, Lycopersicon* and *Capsicum*).
5. Examination of electron micrographs of eukaryotic cells with special reference to organelles.
6. Study of electron micrographs of viruses, bacteria, cyanobacteria and eukaryotic cells for comparative cellular organization.
7. Examination of various stages of mitosis and meiosis using appropriate plant material (e.g. onion root tips, onion flower buds).
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.

Bachelor of Science (Medical/Honours) Semester–II (Session 2025-26)

BOTANY (MEDICINAL BOTANY)
Course Code: BSMM -2070
(Theory)

Course Outcomes:

After completion of course students will be able to:

CO1: Understand the historical significance and foundational concepts of Ayurveda, Siddha, and Unani medicinal systems.

CO2: Identify and conserve endangered and endemic medicinal plants.

CO3: Acquire skills in the propagation techniques of medicinal plants.

CO4: Explore ethnobotany and its application in traditional and modern medicine.

Bachelor of Science (Medical/Honours) Semester–II (Session 2025-26)

BOTANY (MEDICINAL BOTANY)
Course Code: BSMM -2070
(Theory)

Time: 3 Hrs. **Max. Marks: 100**
Credits (L-T-P): 2-0-0 **Theory: 50**
C.A.: 30

Instructions for the Paper Setters:

Eight questions of equal marks (10 marks each) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Unit-I

1. History, Scope and Importance of Medicinal Plants: Indigenous Medicinal Sciences; Definition and Scope-*Ayurveda*: History, origin, *panchamahabhutas*, *saptadhatu* and *tridosha* concepts, *Rasayana*, plants used in ayurvedic treatments, Siddha: Origin of Siddha medicinal systems, Basis of Siddha system, plants used in Siddha medicine. Unani: History, concept: *Umoor-e- tabiya*, tumors treatments/ therapy, polyherbal formulations.

Unit-II

2. Conservation of endangered and endemic medicinal plants: Definition; Endemic and Endangered medicinal plants, Red list criteria; *In situ* conservation: Biosphere reserves, sacred groves, National Parks; *Ex situ* conservation: Botanical Gardens.

Unit-III

3. Propagation of Medicinal Plants: Objectives of the nursery, its classification, important components of a nursery, sowing, pricking, use of green house for nursery production, propagation through cuttings, layering, grafting and budding.

Unit-IV

4. **Ethnobotany and Folk medicines:** Definition; Ethnobotany in India: Methods to study ethnobotany; Applications of Ethnobotany: National interacts, Palaeo-ethnobotany, folk medicines of ethnobotany, ethnomedicine, ethnoecology, ethnic communities of India. Application of natural products to certain diseases- Jaundice, cardiac, infertility, diabetics, Blood pressure and skin diseases.

Suggested Readings

1. Trivedi P C, 2006. Medicinal Plants: Ethnobotanical Approach, Agrobios, India.

2. Dhaduk, H. L, 2016, Medicinal Plants: Cultivation and Uses. India: DAYA Publishing House.

Bachelor of Science (Medical/Honours) Semester–II (Session 2025-26)

BOTANY (MEDICINAL BOTANY LAB)
Course Code: BSMM -2070
(PRACTICAL)

Time: 2 Hrs. **Practical: 20**

Credits (L-T-P): 0-0-1

Suggested Laboratory Exercises

1. To visit the nurseries for the study of medicinal and aromatic plants.
2. To visit Botanical Garden and Herbal Garden for the identification of Medicinal Plants.
3. To study harvesting, drying, grading, storage, processing techniques for medicinal and aromatic plants.
4. Collection and Identification of locally used ethnobotanicals.
5. To extract essential oils from aromatic plants by hydrodistillation method.
6. To study major ethnomedicinal plants and practices followed in India.
7. Qualitative analysis of secondary metabolites from plant sample.

Bachelor of Science (Medical/Honours) Semester–III (Session 2025-2026)

BOTANY (DIVERSITY OF PHANEROGAMS)
Course Code: BSML-3075
(THEORY)

Course outcome: -
After passing this course the student will develop:

CO1: Understand seed plant characteristics and seed evolution in angiosperms and gymnosperms, including gymnosperm traits, classification, and evolution. Examine vegetative and reproductive morphology of *Pinus*, *Cycas*, and *Ephedra*.

CO2: Understanding of Botanical Nomenclature, classification of angiosperms and Salient features of the systems proposed by Bentham and Hooker, Hutchinson, Engler and Prantl

CO3: Understanding diversity of flowering plants in families like Apocynaceae, Asclepiadaceae, Solanaceae, Lamiaceae, Chenopodiaceae, Euphorbiaceae, Liliaceae, Orchidaceae and Poaceae.

CO4: Understanding diversity of flowering plants in families like Ranuculaceae, Brassicaceae, Rutaceae, Fabaceae, Apiaceae, Acanthaceae, Asteraceae.

Bachelor of Science (Medical/Honours) Semester–III (Session 2025-26)

BOTANY (DIVERSITY OF PHANEROGAMS)
Course Code: BSML-3075
(THEORY)

Time: 3 Hrs. **Max. Marks: 100**
Credits (L-T-P): 4-0-0 **Theory: 70**
C.A.:30

Instructions for the Paper Setters:-

Eight questions of equal marks (Fourteen marks each) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

SECTION–A

Seed plants: Characteristics, distinguishing features of angiosperms and gymnosperms, primitive angiosperms.

Gymnosperms: General features, classification, diversity of Gymnosperms including fossil and living gymnosperms; Geological time scale and fossilization. Study of Morphology, anatomy (root, Stem and leaf) and reproduction (life-cycle) of Pinus, Cycas, and Epherda.

SECTION–B

Angiosperm Taxonomy: Brief history, Aims and fundamental components (alpha-taxonomy, Omega-taxonomy, Holotaxonomy); Identification keys. Botanical nomenclature: Taxonomic ranks; Type concept; Principle of priority. Systems of Plant Taxonomy: Artificial, Natural and Phylogenetic systems of classification. Salient features of the systems proposed by Bentham and Hooker, Engler and Prantl, Hutchinson.

SECTION–C

Diversity of flowering plants as illustrated by members of the families Apocynaceae, Asclepiadaceae, Solanaceae, Lamiaceae, Chenopodiaceae, Euphorbiaceae, Liliaceae, Orchidaceae and Poaceae.

SECTION–D

Diversity of flowering plants as illustrated by members of the families Ranuculaceae, Brassicaceae, Rutaceae, Fabaceae, Apiaceae, Acanthaceae, Asteraceae.

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
7. Bendre, A. (2007). Practical Botany, Rastogi Publications, Meerut.
8. Davis, P.H. and Heywood, V.H. (1963). Principles of Angiosperm Taxonomy, Oliver and Boyd, London.
9. Gifford, E.M. and Foster, A.S. (1988). Morphology and Evolution of Vascular Plants, W.H. Freeman & Company, New York.
10. Jeffrey, C. (1982). An Introduction to Plant Taxonomy, Cambridge University Press, Cambridge, London.
11. Jones, S.B., Jr. and Luchsinger, A.E. (1986). Plant Systematics (2nd edition). McGraw- Hill Book Co., New York.
12. Radford, A.E. (1986). Fundamental of Plant Systematics, Harper and Row, New York
13. Angiosperm Phylogeny Group (2003). An update of the Angiosperm Phylogeny Group classification for the orders and families of the flowering plants: APG
14. 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.
15. Simpson, M.C. (2006). Plant Systematics. Elsevier, Amsterdam

Bachelor of Science (Medical/Honours) Semester–III (Session 2025-2026)

BOTANY (DIVERSITY OF PHANEROGAMS)
Course Code: BSMP-3075
(PRACTICAL)

Course outcome:

After passing this course the student will able to:

CO1: Demonstrate practical knowledge of vegetative and reproductive structures of *Cycas*, *Pinus* and *Ephedra* through specimen observation, dissection, and slide analysis.

CO2: Analyze anatomical features of gymnosperm organs using transverse, longitudinal, and vertical sections, including reproductive structures and developmental stages.

CO3: Identify and classify representative angiosperms from major plant families using morphological and floral characteristics.

CO4: Demonstrate understanding of taxonomic diversity and key diagnostic features of selected dicot and monocot families.

Bachelor of Science (Medical/Honours) Semester–III (Session 2025-2026)

BOTANY (DIVERSITY OF PHANEROGAMS)
Course Code: BSMP-1075
(PRACTICAL)

Time: 3 Hrs **Max. Marks: 50**

Credits (L-T-P): 0-0-2 **Pracrical: 35**

C.A.:15

Instructions for the paper setter: question paper is to be set on the spot jointly by the Internal and External Examiners. Two copies of the same may be submitted for the record to COE Office, Kanya Maha Vidyalaya, Jalandhar

Suggested Laboratory Exercises:-

1. **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, scale 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.

2. **Angiosperms**

This list is only indicative. 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, Acacia*.
6. Apiaceae: *Coriandrum. 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*.

Bachelor of Science (Medical/Honours) Semester–IV (Session 2025-2026)

BOTANY (STRUCTURE, DEVELOPMENT AND REPRODUCTION IN FLOWERING PLANTS)
Course Code: BSML-4075

Course outcome:

After passing this course the course the student will be able to: -

CO 1: Understand the structural organization and development of the shoot system in flowering plants, including meristematic activity, tissue differentiation, and secondary growth.

CO 2: Explain the structure and function of wood, secondary phloem, and leaves, including their roles in transport, photosynthesis, stress adaptation, and senescence.

CO 3: Understand root structure, development, and modifications, along with methods and economic significance of vegetative reproduction, including grafting and budding.

CO 4: Understand flower structure, pollination mechanisms, fertilization processes, and seed and fruit development, including their ecological roles and dispersal strategies.

Bachelor of Science (Medical/Honours) Semester–IV (Session 2025-2026)

BOTANY (STRUCTURE, DEVELOPMENT AND REPRODUCTION IN FLOWERING PLANTS)
Course Code: BSML-4075

Time: 3 Hrs. **Max. Marks: 100**
Credits (L-T-P): 4-0-0 **Theory: 70**
C.A.:30

Instructions for the Paper Setters:-

Eight questions of equal marks (14 marks each) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

SECTION–A

The basic body plan of a flowering plant: Diversity in plant form; branching pattern; monopodial and sympodial growth; canopy architecture.

The Shoot System: The shoot apical meristem and its histological organization; meristematic and permanent tissue, formation of internodes. Cambium and its functions; formation of secondary xylem.

SECTION–B

General account of wood structure: Role in conduction of water and minerals; characteristics of growth rings, sapwood and heart wood; secondary phloem-structure function relationships; periderm. **Leaf:** Origin, development, arrangement and diversity in size and shape; internal structure in relation to photosynthesis and water loss; adaptations to water stress; senescence and abscission.

SECTION–C

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.

Vegetative Reproduction: Methods of vegetative propagation, detailed study and types of grafting and budding, economic aspects.

SECTION–D

Flower: A modified shoot; structure, development and varieties of flower; functions, structure of anther and pistil; the male and female gametophytes; types of pollination; attractions and reward for pollinators; (sucking and foraging types); pollen-pistil interaction self-incompatibility.

Double fertilization: formation of seed endosperm and embryo; fruit development and maturation Significance of seed; ecological adaptation; dispersal strategies.

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, CambridgeBhojwani, S.S. and Bhatnagar, S.P. (2000). The Embryology of Angiosperms, 4th revised and enlarged edition. Vikas Publishing House, Delhi.

9. Hartmann, H.T. and Kestler, D.E. (1976). Plant Propagation: Principles and Practices, 3rd edition, Prentice Hall of India Pvt. Ltd., New Delhi.

10. Mauseth, J.D. (1988). Plant Anatomy, The Benjamin/Cummings Publishing Company Inc., Menlo Park, California, USA.

11. Peau, K. (1977). Anatomy of Seed Plants, 3rd edition. John Wiley & Sons, New York.

12. Pegeri, K. and Vander Pijl (1979). The Principles of Pollination Biology, Pergamon Press, Oxford. 13. 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.

14. Bhojwani, S.S. and Bhatnagar, P. (2000). The Embryology of Angiosperms (4th revised and enlarged edition), Vikas Publishing House, New Delhi.

15. Mauseth, J.D. (1988). Plant Anatomy, The Benjamin/Cumminas Publishing Co., Inc., Mehlo Park, California, USA.

16. Raven, P.H., Evert, R.F. and Eichhorn, S.E. (1992). Biology of Plants (5th Edition). Worth Publishers, New York.

17. Steeves, T.A. and Sussex, I.M. (1989). Patterns in Plant Development (2nd Edition). Cambridge University Press, Cambridge.

Bachelor of Science (Medical/Honours) Semester–IV (Session 2025-2026)

BOTANY (STRUCTURE, DEVELOPMENT AND REPRODUCTION IN FLOWERING PLANTS LAB)
(PRACTICAL)

Course Outcome

After passing this course the student will be able to:

CO1: Develop knowledge about the role of herbarium techniques in plant identification.

CO2: Understand different life forms exhibited by flowering plants.

CO3: Understand anatomy of different plant parts using free hand razor technique.

CO4: Examine flower and their mode of pollination.

Bachelor of Science (Medical/Honours) Semester–IV (Session 2025-2026)

BOTANY (STRUCTURE, DEVELOPMENT AND REPRODUCTION IN FLOWERING PLANTS LAB)
(PRACTICAL)

Time: 3 Hrs **Max. Marks: 50**
Credits (L-T-P):0-0-2 **Theory: 35**
C.A.:15

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 and 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.