19/11/2025

BOTANY

Scheme of Programme : Bachelor of Science with Major in Botany

(Scheme UG A2: (Single Major)

BOTANY

Semester 1

Course Code	Course Title	Course ID	L (Hrs)	T (Hrs)	P (Hrs)	L Credits	T Credits	P Credits	Total Credits	MARKS TI	MARKS TE	MARKS PI	MARKS PE	MARKS Total
Core Course(s)														
CC-A1	Plant Diversity and Microbes	250/BOT/CC101	3	-	2	3	-	1	4	25	50	5	20	100
CC-A2	Fundamentals of Cell biology	250/BOT/CC102	3	-	2	3	-	1	4	25	50	5	20	100
CC-A3	Basic Laboratory Techniques in Plant Biology	250/BOT/CC03	3	-	2	3	-	1	4	25	50	5	20	100

Semester 2

Course Code	Course Title	Course ID	L (Hrs)	T (Hrs)	P (Hrs)	L Credits	T Credits	P Credits	Total Credits	MARKS TI	MARKS TE	MARKS PI	MARKS PE	MARKS Total
Core Course(s)														
CC-A4	Plant Anatomy		3	-	2	3	-	1	4	25	50	5	20	100
CC-A5	Plant Resource Utilization		3	-	2	3	-	1	4	25	50	5	20	100
CC-A6	Plant Molecular Biology		3	-	2	3	-	1	4	25	50	5	20	100

24/11/25

Semester 3

Course Code	Course Title	Course ID	L (Hrs)	T (Hrs)	P (Hrs)	L Credits	T Credits	P Credits	Total Credits	MARKS TI	MARKS TE	MARKS PI	MARKS PE	MARKS Total
Core Course(s)														
CC-A7	Diversity of Algae		3	-	2	3	-	1	4	25	50	5	20	100
CC-A8	Diversity of Fungi		3	-	2	3	-	1	4	25	50	5	20	100
CC-A9	Fundamental of Genetics		2	-	2	2	-	1	3	15	35	5	20	75

Semester 4

Course Code	Course Title	Course ID	L (Hrs)	T (Hrs)	P (Hrs)	L Credits	T Credits	P Credits	Total Credits	MARKS TI	MARKS TE	MARKS PI	MARKS PE	MARKS Total
Core Course(s)														
CC-A10	Diversity of Bryophytes and Pteridopytes		3	-	2	3	-	1	4	25	50	5	20	100
CC-A11	Diversity of Gymnosperms and Paleobotany		3	-	2	3	-	1	4	25	50	5	20	100

CC-A12	Reproductive Biology of Angiosperms		3	-	2	3	-	1	4	25	50	5	20	100

Semester 5

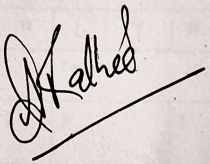
Course Code	Course Title	Course ID	L	T	P	L	T	P	Total Credits	MARKS				
			(Hrs)			Credits				TI	TE	PI	PE	Total
Core Course(s)														
CC-A13	Plant Biotechnology		3	-	2	3	-	1	4	25	50	5	20	100
CC-A14	Plant Physiology		3	-	2	3	-	1	4	25	50	5	20	100
CC-A15	Ecology and phytogeography		3	-	2	3	-	1	4	25	50	5	20	100

Semester 6

Course Code	Course Title	Course ID	L	T	P	L	T	P	Total Credits	MARKS				
			(Hrs)			Credits				TI	TE	PI	PE	Total
Core Course(s)														
CC-A16	Plant Biochemistry and metabolism		3	-	2	3	-	1	4	25	50	5	20	100
CC-A17	Plant systematics		3	-	2	3	-	1	4	25	50	5	20	100

CC-A18	Genomics and Bioinformatics		2	-	2	2	-	1	3	15	35	5	20	75	

Semester 7; 8 (Honours) and Semester 8 (Honours with Research): Detailed Scheme will be prepared in due course of time.



Multidisciplinary Course from the department for pool of the Courses in the University

(These courses are to be offered to students of different discipline/Subject)Botany

Semester 1

Course Code	Course Title	Course ID	L	T	P	L	T	P	Credits	MARKS				
			(Hrs)			Credits				TI	TE	PI	PE	Total
MDC-1	Fundamentals of Botany		2	-	2	2	-	1	3	15	35	5	20	75

Semester 2

Course Code	Course Title	Course ID	L	T	P	L	T	P	Credits	MARKS				
			(Hrs)			Credits				TI	TE	PI	PE	Total
MDC-2	Economic Botany		2	-	2	2	-	1	3	15	35	5	20	75

Semester 3

Course Code	Course Title	Course ID	L	T	P	L	T	P	Credits	MARKS				
			(Hrs)			Credits				TI	TE	PI	PE	Total
MDC-3	Ornamental Plants		2	-	2	2	-	1	3	15	35	5	20	75

19/11/25

Minor Course from the department for pool of the Courses in the University

(These courses are offered by each department for students of other departments/same department to gain a broader understanding beyond the major discipline)

Semester 1

Course Code	Course Title	Course ID	L	T	P	L	T	P	Credits	MARKS				
			(Hrs)			Credits				TI	TE	PI	PE	Total
MIC-1	Plant Diversity		1	-	2	1	-	1	2	5	20	5	20	50

Semester 2

Course Code	Course Title	Course ID	L	T	P	L	T	P	Credits	MARKS				
			(Hrs)			Credits				TI	TE	PI	PE	Total
MIC-2	Plant for Human Welfare		1	-	2	1	-	1	2	5	20	5	20	50

Semester 3

Course Code	Course Title	Course ID	L	T	P	L	T	P	Credits	MARKS				
			(Hrs)			Credits				TI	TE	PI	PE	Total
MIC-3	Organic Farming		2	-	4	2	-	2	4	15	35	15	35	100

19/11/25

Semester 6

Course Code	Course Title	Course ID	L	T	P	L	T	P	Credits	MARKS				
			(Hrs)			Credits				TI	TE	PI	PE	Total
MIC-6	Floriculture		2	-	4	2	-	2	4	15	35	15	35	100

19/11/25

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Vocation Course from the department for pool of the Courses in the University

(These courses are offered by each department for students of other departments/same department and is focused on practical work, preparing students for a particular skilled profession.

Semester 4

Course Code	Course Title	Course ID	L	T	P	L	T	P	Credits	MARKS				
			(Hrs)			Credits				TI	TE	PI	PE	Total
VOC-1	Nursery and Gardening		2	-	4	2	-	2	4	15	35	15	35	100

Semester 5

Course Code	Course Title	Course ID	L	T	P	L	T	P	Credits	MARKS				
			(Hrs)			Credits				TI	TE	PI	PE	Total
VOC-2	Mushroom Cultivation		2	-	4	2	-	2	4	15	35	15	35	100

Semester 6

Course Code	Course Title	Course ID	L	T	P	L	T	P	Credits	MARKS				
			(Hrs)			Credits				TI	TE	PI	PE	Total
VOC-3	Medicinal Plants of India		2	-	4	2	-	2	4	15	35	15	35	100

Skill Enhancement Course from the department for pool of the Courses in the University

(These courses are offered by each department for students of other departments/same department and is designed to provide value-based and/or skill-based knowledge and should contain both theory and lab/hands-on/training/field work.)

Semester 1

Course Code	Course Title	Course ID	L (Hrs)	T (Hrs)	P (Hrs)	L Credits	T Credits	P Credits	Credits	MARKS				
										TI	TE	PI	PE	Total
SEC-1	Plant Hybridization		1	-	4	1	-	2	3	5	20	15	35	75

Semester 2

Course Code	Course Title	Course ID	L (Hrs)	T (Hrs)	P (Hrs)	L Credits	T Credits	P Credits	Credits	MARKS				
										TI	TE	PI	PE	Total
SEC-2	Vertical Farming		1	-	4	1	-	2	3	5	20	15	35	75

Semester 6

Course Code	Course Title	Course ID	L (Hrs)	T (Hrs)	P (Hrs)	L Credits	T Credits	P Credits	Credits	MARKS				
										TI	TE	PI	PE	Total
SEC-3	Olericulture		1	-	4	1	-	2	3	5	20	15	35	75

Ability Enhancement Course from the department for pool of the Courses in the University

(These courses are offered by department of Indian and Foreign Languages for students of other departments/same department and leads to enhancement in the ability of learn
Regional and foreign languages)

Semester 1

Course Code	Course Title	Course ID	L (Hrs)	T (Hrs)	P (Hrs)	L Credits	T Credits	P Credits	Credits	MARKS TI	MARKS TE	MARKS PI	MARKS PE	MARKS Total
AEC-1	English LanguageandCommunication:Level-1 OR □□□□□□□□□□□□.□□□□□□□□□□-1 OR □□□□□□□□□□□□□□□□.□□□□□□□□□□-1								2					50

Semester 2

Course Code	Course Title	Course ID	L (Hrs)	T (Hrs)	P (Hrs)	L Credits	T Credits	P Credits	Credits	MARKS TI	MARKS TE	MARKS PI	MARKS PE	MARKS Total

AEC-2	English LanguageandCommunication:Level-2 OR □□□□□□□□□□□.□□□□□□□□□-2 OR □□□□□□□□□□□□□ व .□□□□□□□□□-2								2					50

Semester 3

Course Code	Course Title	Course ID	L	T	P	L	T	P	Credits	MARKS				
			(Hrs)			Credits				TI	TE	PI	PE	Total
AEC-3	English LanguageandCommunication:3 OR □□□□□□□□□□ व . □□□□□□□□□-3 OR □□□□□□□□□□□ एव . □□□□□□□□□-3								2					50

Semester 4

Course Code	Course Title	Course ID	L (Hrs)	T (Hrs)	P (Hrs)	L Credits	T Credits	P Credits	Credits	MARKS				
										TI	TE	PI	PE	Total
AEC-4	English Language and Communication: Level-4 OR □□□□□□□□□□ व . □□□□□□□□□-4 OR □□□□□□□□□□ एव . □□□□□□□□□-4								2					50

Value Added Course from the department for pool of the Courses in the University

(All the departments will offer value added course for semester 3 for the students of same or different departments. In the first year, students will study (i) Human Values and Ethics and (ii) Envioronmental Studies as value added course)

Semester 1

Course Code	Course Title	Course ID	L	T	P	L	T	P	Credits	MARKS				
			(Hrs)			Credits				TI	TE	PI	PE	Total
VAC-1	Human Values andEthics OR EnvironmentalStudies								2					50

Semester 2

Course Code	Course Title	Course ID	L	T	P	L	T	P	Credits	MARKS				
			(Hrs)			Credits				TI	TE	PI	PE	Total
VAC-2	Human Values andEthics OR Environmental Studies								2					50

Semester 3

Course Code	Course Title	Course ID	L (Hrs)	T (Hrs)	P (Hrs)	L Credits	T Credits	P Credits	Credits	MARKS				
										TI	TE	PI	PE	Total
VAC-3									2					50

Nature of Work	Course Credits	Contact hours per week	Contact hours per semester (15 weeks)
Lecture	01	01	15
Tutorial per paper	01	01	15
Practical, Seminar, Internship, field practice/project, or community engagement, etc.	01	02	30

Note: Tutorial batch size (UG programme: 20-25, PG Programme: 12-15)

The distribution of credits among the lectures/tutorial/practicum will be as follows:

Courses	Total Credits	L (Credits)	T (Credits)	P (Credits)	MARKS			
					TI	TE	PI	PE
Only Theory	4	3 (3 hrs)	1	-	30	70	-	-
	3	2 (2 hrs)	1	-	25	50	-	-

	2	1	1	-	15	35	-	-
Theory and Practicum	4	3 (3 hrs)	-	1 (2 hrs)	25	50	5	20
	4 (Where pract. is dominant)	2 (2 hrs)	-	2 (4 hrs)	15	35	15	35
	3	2 (2 hrs)	-	1 (2 hrs)	15	35	5	20
	2	1	-	1 (2 hrs)	5	20	5	20
When Practicum is separate course	2	-	-	2 (4 hrs)	-	-	15	35
	3	-	-	3 (6 hrs)	-	-	25	50
	4	-	-	4 (8 hrs)	-	-	30	70
AEC/VAC	2	2 (2 hrs)			15	35	-	-
SEC	3	1 (1 hrs)		2 (4 hrs)	5	20	15	35
	2	1		1 (2 hrs)	5	20	5	20
DSEC	4	3 (3 hrs)		1 (2 hrs)	25	50	5	20
Minor/VOC	4	2 (2 hrs)		2 (4 hrs)	15	35	15	35
Internship	4	--	--	4 (8 hrs)			30	70

L= Lecture; T= Tutorial, P= Practicum; Ti= Theory Internal Assessment; TE= Theory End Semester Examination; PI= Practicum Internal; PE= Practicum End Semester examination

Botany (Major)

Session 2025-26				
Part A				
Subject	**Botany**			
Semester	1st			
Name of the Course	**Plant Diversity and Microbes**			
Course Code/ID	**250/BOT/CC101**			
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	**CC-A1**			
Level of the course(AsperAnnexure-I)				
Pre-requisite for thecourse(if any)				
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1. Students will understand the fundamental characteristics of Algae, Fungi, Bryophytes, Pteridophytes, Gymnosperms and Angiosperms. 2. Students will gain knowledge about reproduction and evolutionary trends in Algae, Fungi, Bryophytes, Pteridophytes, Gymnosperms and Angiosperms. 3. Students will be able to learn general characteristics and mode of the reproduction in Bacteria and Viruses. 4. Students will learn morphology of the Algae, Fungi, Bryophytes, Pteridophytes, Gymnosperm and Angiosperm.			
Credits	Theory	Practical	Total	
	3	1	4	
Contact Hours	3	2	5	
Theory				
Max. Marks: 75 Internal Assessment Marks:25 End Term Exam Marks: 50	Time:2Hours			
Practical				
Max. Marks: 25 Internal Assessment Marks:5 End Term Exam Marks: 20	Time:2Hours			

Part B- Contents of the Course

Instructions for Paper-Setter

Nine questions will be set in all. All questions will carry equal marks.
Question No.1 will be short answer type covering the entire syllabus and will be compulsory. The remaining eight questions will be set unit wise selecting two questions from each unit. The candidate will be required to attempt question No. 1 and four more questions selecting one question from each unit.

Govt. College Girls
Sect-14

19/11/2025

Unit	Topic	Contact Hours
I	**Algae**: General characteristic features, cell structure, range of thallus, methods of reproduction and evolutionary classification (only upto groups). Brief account of *Chlamydomonas* and *Sargassum*. **Fungi:** General characteristic features, reproduction and broad classification. Myxomycetes and their similarities with fungi, plants and animals. Brief account of *Rhizopus* and *Agaricus*. Introduction to lichens.	11
II	**Bryophytes**: General characteristic features and reproduction, adaptation to land habit, broad classification, evolutionary trends in Bryophytes. Brief account of *Marchantia* and *Funaria*. **Pteridophytes**: General characteristic features and reproduction, broad classification, evolutionary trends in Pteridophytes, affinities with Bryophytes. Brief account of *Selaginella* and *Equistem*.	11
III	**Gymnosperms:** General characteristic features and reproduction, broad classification, evolutionary trends in Gymnosperm, affinities with Pteridophytes. Brief account of *Cycas* and *Pinus*. **Angiosperms:** General characteristic features and reproduction, Concept of natural, artificial and phylogenetic system of classification. Affinities with Gymnosperms.	12
IV	**Bacteria:** General characteristic features, cell structure, asexual reproduction and modes of gene tansfer (conjugation, transformation and transduction), brief introduction to Archaebacteria. **Viruses**: General characteristic features, replication, RNA virus (structure of TMV), DNA virus (structure of T-phage), Lytic and Lysogenic life cycle (Lambda phage).	11
V*	1. To study structure of TMV and Bacteriophage (electron micrographs/models). 2. To study morphology of *Chlamydomonas* and *Sargassum* (Temporary preparation/specimens/slides). 3. To study *Rhizopus* and *Agaricus and* Rhizopus (Temporary preparations) 4. To study *Marchantia* (morphology, WM of rhizoids and scales), Anthoceros (morphology), *Funaria* (morphology WM of rhizoid and leaf). 5. To study *Selaginella* (morphology, WM of strobilus and spores), *Equisetum* (morphology, WM of spores). 6. To study *Cycas* (morphology, leaf, leaflet anatomy, coralloid root, bulbils, megasporophyll and microsporophyll); *Pinus* (morphology of dwarf shoot, needle anatomy, male and female cones, WM pollen grains). 7. To study variation in leaf venations in dicots and	

	monocots (at least two specimens each).	

Recommended Books/e-resources/LMS:

1. Parihar, N.S. (1991). An Introduction to Embryophyta. Vol.II. Pteridophytes. Prayagraj: U.P.: Central Book Depot.
2. Singh,V., Pandey,P.C., Jain,D.K. (2001).A Text Book of Botany. Meerut, UP: Rastogi and Co.
3. Webster, J., Weber, R. (2007). Introduction to Fungi. Cambridge, Cambridge University Press.
4. Campbell, N.A., Reece,J.B. (2008) Biology, 8th edition, Pearson Benjamin Cummings, San Francisco.
5. Evert, R. F., Eichhorn,S.E. (2012).Raven Biology of Plants, 8th edition, New York, NY: W.H.Freeman and Company.
6. Bhatnagar, S.P., Moitra, A. (1996).Gymnosperms. New Delhi, Delhi, New Age International (P) Ltd. Publishers.
7. Kumar, H.D. (1999). Introductory Phycology, 2nd edition .Delhi, Delhi, Affiliated East West. Press Pvt. Ltd.
8. Pelczar, M. J. (2001). Microbiology, 5th edition. NewDelhi, Delhi:TataMcGraw-HillCo.
9. Puri,P. (1985). Bryophytes. New Delhi, Delhi, Atma Ram and Sons.
10. Sethi, I.K. and Walia, S.K. (2018). Textbook of Fungi and Their Allies. (2nd Edition), Medtech Publishers, Delhi.
11. Tortora,G.J., Funke, B.R., Case, C.L. (2007). Microbiology. San Francisco, U.S.A, Pearson Benjamin Cummings.
12. Vashishta, P.C., Sinha, A.K., Kumar, A. (2010). Pteridophyta. New Delhi, Delhi, S.Chand & Co Ltd.
13. Singh, G. (2019) Plant Systematics-An Integrated Approach. 4th edition. CRC Press, Taylor and Francis Group.

Botany Core C

Botany (Major)

Session 2025-26			
Part A			
Subject	Botany		
Semester	1st		
Name of the Course	Fundamentals of Cell Biology		
Course Code/ID	250/BOT/CC102		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	CC-A2		
Level of the course(AsperAnnexure-I)			
Pre-requisite for thecourse(if any)			
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to 1. Students will understand the fundamental characteristics of cells. 2. Students will acquire comprehensive knowledge about cell wall, cell membrane and cell organelles. 3. Students will understand the fundamental characteristics of cell signaling. 4 Students will acquire comprehensive knowledge about cytodifferentiation and cell death. 5. Students will acquire comprehensive knowledge about structure and characteristics of cancer cells.		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
Theory			
Max. Marks: 75 Internal Assessment Marks: 25 End Term Exam Marks: 50	Time:2Hours		
Practical			
Max. Marks: 25 Internal Assessment Marks:5 End Term Exam Marks: 20	Time:2Hours		
Part B- Contents of the Course			
Instructions for Paper-Setter Nine questions will be set in all. All questions will carry equal marks. Question No.1 will be short answer type covering the entire syllabus and will be compulsory. The remaining eight questions will be set unit wise selecting two questions from each unit. The candidate will be required to attempt question No. 1 and four more questions selecting one question from each unit.			

Unit	Topic	Contact Hours
I	Cell as a unit of structure and function; Characteristics of prokaryotic and eukaryotic cells; Origin of Eukaryotic cell (Endosymbiotic theory). Cell Wall and Plasma membrane. The Nucleus -Nuclear Envelope- structure of nuclear pore complex, nuclear lamina, Transport across Nuclear Envelope, Chromatin: molecular organization, Nucleolus and rRNA Processing. Protein Sorting and Transport, The Endoplasmic reticulum, The Golgi Apparatus, Mechanism of Vesicular Transport, Lysosomes.	12
II	Mitochondria, Chloroplasts and Peroxisomes, Structural organization, Function, Marker enzymes, Mitochondrial biogenesis, Protein import in mitochondria, Semiautonomous nature of mitochondria and chloroplast, chloroplast DNA, Peroxisomes' assembly, Cytoskeleton and Cell Structure, organization of actin filaments, myosin and cell movement, intermediate filaments, microtubules.	11
III	The extracellular matrix and cell matrix interactions; cell-cell interactions. Cell Signalling: Signalling molecules and their receptor, functions of cell surface receptors; Intracellular signal transduction pathway (GPCR). The Cell Cycle: Eukaryotic Cell Cycle, Regulation of Cell cycle progression, Events of Mitotic Phase, Meiosis .	11
IV	Cell Death and Cell Renewal Programmed Cell Death, Stem Cells and Maintenance of adult tissues, Embryonic Stem Cells and Therapeutic cloning. **Cancer**: Development and Causes of Cancer, Tumor Viruses, Oncogenes, Tumor Suppressor genes, **Cancer Treatment**-molecular approach.	11
V*	1. To demonstrate the presence of mitochondria in cheek epithelial cell using vital stain Janus Green B. 2. Study of polyploidy in Onion root tip by colchicine treatment. 3. Preparations of temporary mount of onion flower bud anthers and study the different stages of Meiosis. 4. Study the effect of organic solvent and temperature on membrane permeability. 5. Study of structure of cell organelles through electron micrographs. 6. Preparations of temporary mount of onion flower bud anthers and study the different stages of Meiosis. 7. Study of mitosis and meiosis from permanent slides. 8. Identification and study of cancer cells-Slides/Photomicrographs.	30

Recommended Books/e-resources/LMS:

1. Karp, G. (2010). Cell and Molecular Biology: Concepts and Experiments. VI Edition. John Wiley & Sons.Inc.

2. De Robertis, E.D.P. and De Robertis, E.M.F. (2006).Cell and Molecular Biology. VIII Edition. Lippincott Williams and Wilkins, Philadelphia.

3. Cooper, G.M. and Hausman, R.E. (2009). The Cell: A Molecular Approach. V Edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.

4. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. (2009). The World of the Cell.VII Edition. Pearson Benjamin Cummings Publishing, San Francisco.

Botany Core Co

Session 2025-26			
Part A			
Subject	Botany		
Semester	1st		
Name of the Course	Basic Laboratory Techniques in Plant Biology		
Course Code/ID	250/BOT/CC103		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	CC-A3		
Level of the course(AsperAnnexure-I)			
Pre-requisite for thecourse(if any)			
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to 1. Students will be able to gain knowledge about Lab safety and good lab practices. 2. Students will be able to understand uses and maintenance of various lab equipment's. 3. Students will be able to learn Microscopy and its types. 4. Students will be develop analytic knowledge about preparation of solutions and buffers used in Lab. 5. Students will be able to learn Basis culturing Lab techniques. Students will be able to practical knowledge on Fundamentals of data collection and data types, basic computer skills of Biology and field skills.		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
Theory			
Max. Marks: 75 **Internal Assessment Marks:25** **End Term Exam Marks: 50**	**Time: 2Hours**		
PRACTICAL			
Max. Marks: 25 **Internal Assessment Marks:5** **End Term Exam Marks: 20**	**Time: 2Hours**		
Part B- Contents of the Course			

Instructions for Paper-Setter

Nine questions will be set in all. All questions will carry equal marks.
Question No.1 will be short answer type covering the entire syllabus and will be compulsory. The remaining eight questions will be set unit wise selecting two questions from each unit. The candidate will be required to attempt question No. 1 and four more

19/11/25

questions selecting one question from each unit.		
Unit	Topic	**Contact Hours**
I	**Lab safety and good lab practices –** General laboratory safety, good laboratory practices, biosafety measures (first-aid practices to be followed in case of burn, acid spills and injury), safety symbols, lab safety equipments (fire extinguisher, fume hood, safety glasses), classes of laboratory chemicals, maintenance and handling of chemicals (Labels, Quality - LR/ AR/ Molecular biology grade/ HPLC grade/Tissue culture grade; Expiry date; Precautions for use), Disinfectants, Biocontainment, Disposal of hazardous chemicals, radioactive and biological waste, Laboratory waste management.	11
II	**Use and maintenance of Laboratory equipment**- Weighing balance (Top loading and Analytical), pH meter (calibration and use), magnetic stirrer, pipettes and micropipettes, autoclave, laminar airflow, BOD incubator, incubator shaker, micrometer, haemocytometer, spectrophotometer, Agarose gel electrophoresis unit, centrifuge, distillation unit, conductivity meter, Lux meter. **Microscopy, sample and slide preparation** -Microscopes (Dissecting, Compound and Electron microscopes), Fixation and Preservation (for light and electron microscopy); staining, mounting; basic introduction to other types of microscopes (Confocal, Fluorescence), Temporary and permanent slides.	11
III	**Measurements and calculations** -Units of measurements and conversion from one unit to another, measurement of volumes of liquids, Weighing, **calculations**: scientific notations, powers, logarithm and fractions. **Solutions and Buffers**- Molarity, Molality, Normality, percent solution, stock solution, standard solution, dilution, dilution series, pH, acids and bases, buffers - phosphate, Tris-acetate, Tris- Cl and Citrate buffer. **Basic culturing techniques**- Basic culture media (LB, YEB, PDA)- liquid and solid, Culture techniques: plating (streak, spread & pour), replica plating, serial dilution.	11
IV	**Data collection, statistical analysis and interpretation Fundamentals of data collection, data types** - primary and secondary, methods of data collection, sample, sampling methods - merits and demerits, technical and biological replicates, classification - tabulation and presentation of data, Descriptive statistics - Mean, Mode, Median, difference between sample mean and population mean.	12

	Basic computer skills for biology MS-Word, PowerPoint, Excel, introduction to biological databases. **Field Skills** : Identification, collection, cataloguing and preservation of plant specimens, Herbarium and Museum.	
V*	1. Preparation of solutions- molar, molal, normal, percentage, stock, standard and serial dilution buffers. 2. Determining pH of solutions (pH paper, Universal indicator, pH meter) and preparation of buffers (Phosphate, Tris-Cl buffers) 3. Working of instruments -light microscope, Electrophoresis, autoclave, laminar air flow, spectrophotometer, centrifuge, gel electrophoresis unit (Agarose & Poly acrylamide). 4. Temporary and Permanent slide preparation. 5. Calculate cell size using micrometer. 6. Calculate number of cells (pollen/spores) using haemocytometer. 7. Preparation of LB/PDA/YEB medium, growth and maintenance of cultures (liquid - serial dilution method; and semi-solid cultures - streak, spread and pour plates) 8. Calculation of mean, mode, median. 9. Using software to draw tables, graphs and calculating descriptive statistics (Microsoft Excel) 10. Laboratory safety equipment (Fire extinguisher, Fume hood, safety glasses) 11. Mounting of a properly dried and processed plant specimen with herbarium.	30

Recommended Books/e-resources/LMS:

1. Evert, R. F., Eichhorn, S. E., Perry, J.B. (2012). Laboratory Topics in Botany. W.H. Freeman and Company.
2. Mesh, M.S., Kebede-Westhead, E. (2012). Essential Laboratory Skills for Biosciences. John Wiley & Sons, Ltd.
3. Mu, P., Plummer, D. T. (2001). Introduction to practical biochemistry. Tata McGraw-Hill Education.
4. Mann, S. P. (2016). Introductory Statistics, 9th edition. Hoboken, NJ, John Wiley and Sons Inc.
5. Danniel, W.W. (1987). Biostatistics. New York, NY: John Wiley Sons.
6. Jones, A.M., Reed, R., Weyers, J. (2016). Practical Skills in Biology, 6th Edition, Pearson
7. Bisen, P.S. (2014). Laboratory Protocols in Applied Life Sciences, 1st edition. CRC Press.
8. Zar, Z. H. (2010). Biostatistical Analysis, 5th edition, Pearson Prentice Hall, New Jersey, USA.

Botany 2nd Sem

Botany (Major)
IInd Sem

Session 2025-26			
Part A			
Subject	**Botany**		
Semester	2nd		
Name of the Course	**Plant Anatomy**		
Course Code/ID	250/BOT/CC201		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	CC-A4		
Level of the course(AsperAnnexure-I)			
Pre-requisite for thecourse(if any)			
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to 1. students will be able to gain knowledge of various cells and tissues, meristem, epidermal and vascular tissue system in plants. 2. Students will be able to learn various aspects of growth, development of the tissues and differentiation of various plant organs. 3. Students will be able to gain knowledge of basic structure and organization of plant parts in angiosperms. 4. Students will be able to understand the correlation of structure with morphology and functions.		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
Theory			
Max. Marks: 75 Internal Assessment Marks:25 End Term Exam Marks: 50	Time:2Hours		
Practical			
Max. Marks: 25 Internal Assessment Marks:5 End Term Exam Marks: 20	Time:2Hours		
Part B- Contents of the Course			
Instructions for Paper-Setter Nine questions will be set in all. All questions will carry equal marks. Question No.1 will be short answer type covering the entire syllabus and will be compulsory. The remaining eight questions will be set unit wise selecting two questions from each unit. The candidate will be required to attempt question No. 1 and four more questions selecting one question from each unit.			
Unit	Topic		Contact

19/11/25

		Hours
I	**Tissues**: Classification of tissues; Simple and complex tissues (no phylogeny); Pits and plasmodesmata; Wall ingrowths and transfer cells; Ergastic substances. **Stem and leaf**: Organization of shoot apex (Apical cell theory, Histogen theory, Tunica Corpus theory, cyto-histological zonation); Types of vascular bundles; Structure of dicot and monocot stem; Shoot Chimeras; Structure of dicot and monocot leaf, Kranz anatomy; Development of Leaf.	11
II	Root: Organization of root apex (Apical cell theory, Histogen theory, KorperKappe theory); Quiescent centre; Root cap; Structure of dicot and monocot root; Endodermis, exodermis and origin of lateral root.	12
III	Vascular Cambium: Structure (Axially and radially oriented elements); function and seasonal activity of cambium; Secondary growth in root and stem, Anomalies in secondary growth in stem(*Dracena, Boerhaavia, Achyranthes*). Wood: Types of rays and axial parenchyma; Sapwood and heartwood; Ring and diffuse porous wood; Early and late wood, tyloses; Dendrochronology. Periderm : Development and composition of periderm; rhytidome and lenticels.	11
IV	Adaptive and Protective Systems : Epidermal tissue system; cuticle; epicuticular waxes;trichomes (uni-and multicellular, glandular and non-glandular, two examples of each); stomata (classification); Adcrustation and incrustation; Anatomical adaptations of xerophytes and hydrophytes. Secretory System: Hydathodes, cavities, lithocysts and laticifers. Scope of Plant Anatomy -Applications in systematics, forensics and pharmacognosy	12
V*	Study of anatomical details through permanent slides/temporary stain mounts/ macerations/ museum specimens with the help of suitable examples. 1. Apical meristem of root, shoot and vascular cambium. 2. Distribution and types of parenchyma, collenchyma and sclerenchyma. 3. Xylem: Tracheary elements-tracheids, vessel elements; thickenings; perforation plates; xylem fibres. 4. Wood: ring porous; diffuse porous; tyloses; heartwood and sapwood. 5. Phloem: Sieve tubes-sieve plates; companion cells; phloem fibres. 6. Epidermal system: cell types, stomata types; trichomes: non-glandular and glandular. 7. Root: monocot, dicot, secondary growth. 8. Stem: monocot, dicot - primary and secondary growth; phloem wedges in Bignonia, included phloem in Leptadenia/Salvadora; periderm; lenticels. 9. Leaf: isobilateral, dorsiventral, C4 leaves (Kranz anatomy). 10. Adaptive Anatomy: xerophytes, hydrophytes.	30

	11. Secretory tissues: cavities, lithocysts and laticifers.	

Recommended Books/e-resources/LMS:

1. Dickison, W.C. (2000).Integrative Plant Anatomy. Cambridge, U.K.: Harcourt Academic Press.

2. Esau, K. (1977).Anatomy of Seed Plants. New Delhi, Delhi: John Wiley & Sons, Inc.

3. Evert, R.F., Eichhorn, S. E. (2006). Esau's Plant anatomy: Mersitems, Cells, and tissues of the Plant Body: their structure, function and development. New Jersey, U.S.: Wiley- Liss.

4. Mauseth, J.D. (1988). Plant Anatomy. San Francisco, California: The Benjammin Cummings Publisher.

5. Raven, F.H., Evert, R. F., Eichhorn, S.E. (1992). Biology of Plants. New York, NY: W.H. Freeman and Company.

Botany Major 2nd Sem

Session 2025-26			
Part A			
Subject	**Botany**		
Semester	2nd		
Name of the Course	**Plant Resource Utilization**		
Course Code/ID	250/BOT/CC202		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	CC-A5		
Level of the course(AsperAnnexure-I)			
Pre-requisite for thecourse(if any)			
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to After completing this course, the learner will be able to: 9. Students will gain a foundational understanding of the origins of significant cultivated plants. 10. Students will develop a conceptual understanding of important plants that yield vegetables, fiber, and oil. 11. Students will acquire knowledge about the cultivation techniques of essential plants. 12. Students will gain a conceptual understanding of the processing methods applied to economically significant plants. 5.Students will be able to gain thé knowledge of economic values of cereals, legumes, spices, oil & fibre yielding plants.		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
Theory			
Max. Marks: 75 Internal Assessment Marks:25 End Term Exam Marks: 50	Time: 2Hours		
Practical			
Max. Marks: 25 Internal Assessment Marks:5 End Term Exam Marks: 20	Time: 2Hours		
Part B- Contents of the Course			
Instructions for Paper-Setter Nine questions will be set in all. All questions will carry equal marks. Question No.1 will be short answer type covering the entire syllabus and will be compulsory. The remaining eight questions will be set unit wise selecting two questions from each unit. The candidate will be required to attempt question No. 1 and four more questions selecting one question from each unit.			

19/11/25

Unit	Topic	Contact Hours
I	Origin of Cultivated Plants, Concept of centre of origin, their importance with reference to Vavilov's work; examples of major plant introductions; Crop domestication and loss of genetic diversity; evolution of new crops/varieties, importance of germplasm diversity. **Fruits**- Mango, Citrus and Banana.	11
II	**Cereals**-Wheat, Rice and maize. Role of dwarf varieties in green revolution; brief account of millets and Pseudocereals. **Legumes**- Gram, soyabean and pea, their importance to man and cultivation. **Sugars and starches**- Ratooning and cultivation of sugarcane, products and by products of sugarcane industry. Potato (Tuber anatomy and propagation methods) and comparative account with cassava. **Vegetables**: brief study of tomato and onion.	12
III	**Spices:** family and part used with special reference to fennel, saffron, clove, black pepper, turmeric and common adulterants of spices. **Beverages**: Tea, coffee and cocoa, their processing and some common adulterants. **Oils and Fats**: General description with details of groundnut, coconut, Brassica species and their use related health implications. **Natural Rubber Para Rubber**: tapping, extraction and processing and uses of Para Rubber.	11
IV	**Drug Yielding Plants**- Therapeutic and habit forming drugs: Medicinal properties and uses with special reference to Cinchona, Rauvolfia, Papaver and Cannabis. Masticatories and Fumitories :Tobacco and Bettle leaf - Botany and Health hazards. **Fibre yielding plants**: Cotton and Jute-cultivation and uses.	11
V*	1. Cereals: Wheat (habit sketch, L.S/T.S. grain, starch grains, micro-chemical tests), Rice (habit sketch, study of paddy and grain, starch grains, micro-chemical tests). Millets and Pseudocereals (specimens / photographs and grains) 2. Legumes: Soybean, Groundnut, (habit, fruit, seed structure, micro-chemical tests). 3. Fruits: Mango (habit sketch, L.S. fruit, micro-chemical tests in ripe fruit); Citrus (habit sketch, T.S. hesperidium, W.M. vesicle, micro-chemical tests including test for vitamin C) 4. Sugars and starches: Sugarcane (habit sketch; cane juice-micro-chemical tests); Potato (habit sketch, tuber morphology, T.S. tuber to show localization of starch grains, W.M. starch grains, micro-chemical tests). 5. Spices: Black pepper, Fennel and Clove (habit and sections L.S./T.S.). 6. Beverages: Tea (plant specimen, tea leaves), Coffee (plant	30

	specimen, beans). 7. Oils and fats: Coconut- T.S. nut, Mustard–plant specimen, seeds 8. Essential oil-yielding plants: Habit sketch of Rosa, Vetiveria, Santalum and Eucalyptus (specimens/photographs). 9. Rubber: specimen, photograph/model of tapping, samples of rubber products. 10. Drug-yielding plants: Specimens of Cinchona, Digitalis, Papaver and Cannabis (male & female plant). 11. Tobacco: specimen and products of Tobacco. 12. Fiber-yielding plants: Cotton (specimen, whole mount of seed to show lint and fuzz; whole mount of fiber and test for cellulose), Jute (specimen, transverse section of stem, test for cellulose and lignin on transverse section of stem and fiber). Collection and preparation of reports on various crops and economically important plants being cultivated/wildly available in your area.	

Recommended Books/e-resources/LMS:

13. Kochhar, S.L. (2012). Economic Botany in Tropics. New Delhi, India: MacMillan & Co. 2. Wickens, G.E. (2001). Economic Botany: Principles & Practices.The Netherlands: Kluwer Academic Publishers.
14. Chrispeels, M.J. and Sadava, D.E. (1994) Plants, Genes and Agriculture.Jones & Bartlett - Publishers.
15. Singh,V.,Pande,P.C.,Jain,D.K.2018.EconomicBotany,RastogiPublications.
16. Daubenmire,R.F.Plants&Environment(2nd Edn.)JohnWiley&Sons.,NewYork22
17. S. Sundar Rajan-2007. College Botany Vol V, Part1: Taxonomy and Economic Botany Himalaya Publishing House.
18. SusilKumarMukharjee-2004.CollegeBotanyVol-III.New CentralBookagency, London.

Botany Major
2nd Sem

Session 2025-26			
Part A			
Subject	**Botany**		
Semester	2nd		
Name of the Course	**Plant Molecular Biology**		
Course Code/ID	250/BOT/CC203		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	CC-A6		
Level of the course(AsperAnnexure-I)			
Pre-requisite for thecourse(if any)			
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to- 1. Students will be able to gain understanding of nucleic acid, organization of DNA in prokaryotes and Eukaryotes, DNA replication mechanism, genetic code and transcription process. 2. Students will be able to understand processing and modification of RNA and translation process, function and regulation of expression.		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
Theory			
Max. Marks: 75 Internal Assessment Marks:25 End Term Exam Marks: 50	Time:2Hours		
Practical			
Max. Marks: 25 Internal Assessment Marks:5 End Term Exam Marks: 20	Time:2Hours		
Part B- Contents of the Course			

Instructions for Paper-Setter

Nine questions will be set in all. All questions will carry equal marks.
Question No.1 will be short answer type covering the entire syllabus and will be compulsory. The remaining eight questions will be set unit wise selecting two questions from each unit. The candidate will be required to attempt question No. 1 and four more questions selecting one question from each unit.

Unit	Topic	Contact Hours
I	**Nucleic acids as carriers of genetic information** -Historical perspective; Experiments that established nucleic acids (DNA &	11

19/11/21

	RNA) as the carrier of genetic information: Griffith's,Hershey & Chase, Avery, McLeod & McCarty and FraenkelConrat 's experiment. **Structure and organisation of the genetic material** - DNA Structure: Miescher to Watson and Crick- a historic perspective, DNA structure, salient features of double helix; Types of DNA: A,B & Z conformations. **Genome complexity**: Concept of C-value paradox, denaturation and renaturation, Cot curves; Organization of DNA- in Prokaryotes, Viruses & Eukaryotes. **Organelle DNA** - mitochondria and chloroplast DNA; **Chromatin structure**- Nucleosome, Euchromatin, **Heterochromatin**- Constitutive and Facultative heterochromatin, **RNA** : types of RNA molecules, structure and function of mRNA, tRNA and rRNA.	
II	**Central Dogma, Genetic code** (salient features) **Replication of DNA** -Mechanism - initiation, elongation and termination, Kornberg's discovery; Enzymes and other proteins involved in DNA replication; General principles – bidirectional, semiconservative and semi discontinuous replication (Replisome), RNA priming (primase & Primosome); Various modes of DNA replication, including rolling circle, θ (theta) mode of replication, replication of linear ds-DNA. Replication of the 5'end of linear chromosome (end replication problem & Telomerase).	11
III	**Transcription** - Transcription in prokaryotes and eukaryotes ; Understanding the steps in process of transcription: Initiation, Elongation and Termination. Enzymes and factors involved in transcription. **Processing and modification of RNA** -Split genes-concept of introns and exons, Splicing pathways, group I & group II intron splicing, Spliceosome and assembly of the spliceosome machinery , Alternative splicing, Eukaryotic mRNAprocessing (5' cap, 3' poly A tail) ; Ribozymes, RNA Editing	11
IV	**Translation** – Translation in prokaryotes and eukaryotes; process of translation - Initiation, Elongation and Termination. Enzymes and factors involved in translation. **Ribosome structure and assembly** (in prokaryotes and eukaryotes); charging of tRNA, aminoacyl tRNA synthetases; Fidelity of translation; Inhibitors of protein synthesis; Post-translational modifications of proteins. **Gene Regulation in prokaryotes and eukaryotes**- Basic principles of transcriptional regulation: Positive & negative; Inducible & Repressible; Activators and Repressors; Prokaryotes: Operon concept & regulation of lactose metabolism (positive and Negative) and tryptophan synthesis (Repression-Derepression and Attenuation) in E.coli; Eukaryotes: Gene silencing: Methylation, RNAi, Imprinting.	12
V*	1. Preparation of LB medium and raising E. coli 2. DNA isolation from cauliflower heads	30

	3. Quantification of unknown DNA by diphenylamine reagent. 4. Study of experiments establishing nucleic acid as genetic material (Avery et al, Griffith's, Hershey & Chase's and Fraenkel & Conrat's experiments)through photographs 5. Numericals based on DNA re-association kinetics (melting profiles and Cot curves) 6. Study of DNA replication through photographs: Modes of replication - Rolling circle, Theta and semi-discontinuous ; Semiconservative model of replication (Messelson and Stahl's experiment); Telomerase assisted end-replication of linear DNA 7. Study of structures of : tRNA (2D and 3D); prokaryotic RNA polymerase and eukaryotic RNA polymerase II through photographs 8. Understanding the regulation of lactose (lac) operon (positive & negative regulation) and tryptophan (trp) operon (Repression and De-repression & Attenuation) through photographs.	

Recommended Books/e-resources/LMS:

1. Watson J.D., Baker, T.A., Bell, S.P., Gann, A., Levine, M., Losick, R. (2007). Molecular Biology of the Gene, Pearson Benjamin Cummings, CSHL Press, New York, U.S.A. 6th edition.

2. Snustad, D.P. and Simmons, M.J. (2010). Principles of Genetics. John Wiley and Sons Inc.,U.S.A. 5th edition.

3. Klug, W.S., Cummings, M.R., Spencer, C.A. (2009). Concepts of Genetics. Benjamin Cummings. U.S.A. 9th edition.

4. Russell, P. J. (2010). iGenetics- A Molecular Approach. Benjamin Cummings, U.S.A. 3 rd edition.

5. Griffiths, A.J.F., Wessler, S.R., Carroll, S.B., Doebley, J. (2010). Introduction to Genetic Analysis. W. H. Freeman and Co., U.S.A. 10th edition.

6. Micklos D A., Freyer G.A. (2003) DNA Science: A First Course (2nd Edition), Cold Spring Harbor Laboratory; Greg A.,CSHL Press, USA

Botany Major 3rd Sem

Botany 3rd Sem

Session 2025-26			
Part A			
Subject	Botany		
Semester	3rd		
Name of the Course	Diversity of Algae		
Course Code/ID	250/BOT/CC301		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	CC-A7		
Level of the course(AsperAnnexure-I)			
Pre-requisite for thecourse(if any)			
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to- 3. Students will be able to understand diversity of algae and classification. 4. Students will be able to explore algal groups and recognise the contribution of Phycologists. 5. Students will be able to understand the role and economic importance of Algae. 6. Students will be able to examine the vegetative and reproductive structure		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
Theory			
Max. Marks: 75 Internal Assessment Marks:25 End Term Exam Marks: 50	Time: 2 Hours		
Practical			
Max. Marks: 25 Internal Assessment Marks:5 End Term Exam Marks: 20	Time: 2 Hours		

Part B- Contents of the Course

Instructions for Paper-Setter

Nine questions will be set in all. All questions will carry equal marks.
Question No.1 will be short answer type covering the entire syllabus and will be compulsory.
The remaining eight questions will be set unit wise selecting two questions from each unit.
The candidate will be required to attempt question No. 1 and four more questions selecting one question from each unit.

Unit	Topics	Contact

19/11/25

		Hours
I	**General characteristics-** Ecology and distribution; range of thallus organization; Cell structure and components; cell wall, pigment system, reserve food (of only groups represented in the syllabus), flagella; and methods of reproduction, classification; criteria, system of Fritsch, and evolutionary classification of Lee (only upto groups); significant contributions of important phycologists (F.E. Fritsch, G.M. Smith, R.N. Singh, T.V. Desikachary, H.D. Kumar, M.O.P. Iyengar).	11
II	**Cyanophyta** - Ecology and occurrence, range of thallus organization, cell structure, heterocyst, reproduction, economic importance; role in biotechnology. Morphology and life-cycle of *Nostoc*. **Chlorophyta** -General characteristics, occurrence, range of thallus organization, cell structure and reproduction. Morphology and life-cycles of *Chlamydomonas, Volvox, Oedogonium.* Evolutionary significance of *Prochloron.*	12
III	**Charophyta-** General characteristics; occurrence, morphology, cell structure and life-cycle of *Chara*; evolutionary significance. **Xanthophyta** -General characteristics; range of thallus organization; Occurrence, morphology and life-cycle of *Vaucheria.* **Phaeophyta** - Characteristics, occurrence, range of thallus organization, cell structure and reproduction. Morphology and life-cycles of *Ectocarpus* , *Sargassam* and *Fucus*.	12
IV	**Rhodophyta** -General characteristics, occurrence, range of thallus organization, cell structure and reproduction. Morphology and life-cycle of *Polysiphonia.* **Applied Phycology** - Role of algae in the environment, agriculture, biotechnology and industry.	11
V*	Study of vegetative and reproductive structures of Nostoc, *Chlamydomonas* (electron micrographs), *Volvox, Oedogonium*, *Chara, Vaucheria, Ectocarpus*, *Sargassam, Fucus* and *Polysiphonia*, *Procholoron* through electron micrographs, temporary preparations and permanent slides	30

Recommended Books/e-resources/LMS:

1. Lee, R.E. (2008). Phycology, Cambridge University Press, Cambridge. 4th edition.
2. Prescott, L.M., Harley J.P., Klein D. A. (2005). Microbiology, McGraw Hill, India. 6th edition.
3. Kumar, H.D. (1999). Introductory Phycology. Affiliated East-West Press, Delhi.
4. Sahoo, D. (2000). Farming the ocean: seaweeds cultivation and utilization. Aravali International, New Delhi.
5. Campbell, N.A., Reece J.B., Urry L.A., Cain M.L., Wasserman S.A. Minorsky P.V., Jackson R.B. (2008). Biology, Pearson Benjamin Cummings, USA. 8th edition.
6. Pelczar, M.J. (2001) Microbiology, 5th edition, Tata McGraw-Hill Co, New Delhi.

Session 2025-26
Part A

Subject	**Botany**
Semester	3rd
Name of the Course	Diversity Of Fungi and Phytopathology
Course Code/ID	250/BOT/CC302
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	CC-A8
Level of the course(AsperAnnexure-I)	
Pre-requisite for thecourse(if any)	
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to 7. Understand some of the selected Fungi. Students will be able to understand diversity of Fungi and classification. 8. Students will be able to explore Fungal groups and recognise the contribution of Mycologists. 9. Students will be able to understand the role and economic importance of Fungi. 10. Students will be able to examine the vegetative and reproductive structure of different Fungi and Diseases cause by Microbes and Fungi.

Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5

Theory	
Max. Marks: 75 Internal Assessment Marks:25 End Term Exam Marks: 50	Time: 2Hours

Practical	
Max. Marks: 25 Internal Assessment Marks:5 End Term Exam Marks: 20	Time: 2Hours

Part B- Contents of the Course

Instructions for Paper-Setter

Nine questions will be set in all. All questions will carry equal marks.
Question No.1 will be short answer type covering the entire syllabus and will be compulsory.
The remaining eight questions will be set unit wise selecting two questions from each unit.
The candidate will be required to attempt question No. 1 and four more questions selecting one question from each unit.

Unit	Topic	Contact Hours
I	**Introduction to true fungi** -Definition, General characteristics;	10

	Thallus organization; Cell wall composition; Nutrition; Classification. **Chytridiomycetes** -General account **Oomycota** -General characteristic; Ecology; Life cycle and classification with reference to Phytophthora Albugo. **Zygomycota** - General characteristics; Ecology; Thallus organisation; Life cycle with reference to *Rhizopus*.	
II	**Ascomycota** - General characteristics (asexual and sexual fruiting bodies); Ecology; Life cycle, Heterokaryosis and parasexuality; life cycle and classification with reference to *Saccharomyces*, *Aspergillus, Penicillium*, *Alternaria and Neurospora, Peziza.* **Basidiomycota** -General characteristics; Ecology; Life cycle and Classification with reference to black stem rust on wheat *Puccinia* (Physiological Specialization), loose and covered smut (symptoms only), *Agaricus*; Bioluminescence, Fairy Rings and Mushroom Cultivation.	12
III	**Allied Fungi** - General characterises; Status of Slime molds, Classification; Occurrence; Types of plasmodia; Types of. fruiting bodies. **Deuteromycota** -General characteristic; Ecology; Life cycle and classification with reference to Colletotricum **Symbiotic associations** -Lichen – Occurrence; General characteristics; Growth forms and range of thallus organization; Nature of associations of algal and fungal partners; Reproduction. **Mycorrhiza**-Ectomycorrhiza, Endomycorrhiza and their significance.	12
IV	**Applied Mycology** -Role of fungi in biotechnology, Application of fungi in food industry (Flavour & texture, Fermentation, Baking, Organic acids, Enzymes, Mycoproteins); Secondary metabolites (Pharmaceutical preparations); Agriculture (Biofertilizers); Mycotoxins; Biological control (Mycofungicides, Mycoherbicides, Mycoinsecticides, Myconematicides); Medical mycology. **Phytopathology** -Terms and concepts; General symptoms; Geographical distribution of diseases; etiology; symptomology; Host- Pathogen relationships; disease cycle and environmental relation; prevention and control of plant diseases, and role of quarantine. **Bacterial diseases** – Citrus canker and angular leaf spot disease of Cotton. **Viral diseases** – Tobacco Mosaic viruses, vein clearing. Fungal diseases – Early blight of potato, Black stem rust of wheat, white rust of crucifers.	12
V*	1. Introduction to the world of fungi (Unicellular, coenocytic/septate mycelium, asocarps & basidiocarps). 2. *Rhizopus*: study of asexual stage from temporary mounts and	30

	sexual structures through permanent slides. 3. *Aspergillus* and *Penicillium*: study of asexual stage from temporary mounts. Study of Sexual stage from permanent slides/photographs. 4. *Peziza*: sectioning through ascocarp. 5. *Alternaria*: Specimens/photographs and temporary mounts. 6. *Puccinia*: Herbarium specimens of Black Stem Rust of Wheat and infected Barberry leaves; sections/ mounts of spores on wheat and permanent slides of both the hosts. 7. *Agaricus*: Specimens of button stage and full grown mushroom; sectioning of gills of Agaricus, fairy rings and bioluminescent mushrooms to be shown. 8. Study of phaneroplasmodium from actual specimens and /or photograph. Study of Stemonitis sporangia. 9. *Albugo*: Study of symptoms of plants infected with *Albugo;* asexual phase study throughsection/ temporary mounts and sexual structures through permanent slides. 10. Lichens: Study of growth forms of lichens (crustose, foliose and fruticose) on different substrates. Study of thallus and reproductive structures (soredia and apothecium) through permanent slides. Mycorrhizae: ectomycorrhiza and endo mycorrhiza (Photographs) 11. Phytopathology: Herbarium specimens of bacterial diseases; Citrus Canker; Angular leaf spot of cotton, Viral diseases: TMV, Vein clearing, Fungal diseases: Early blight of potato, Black stem rust of wheat and White rust of crucifers.	

Recommended Books/e-resources/LMS:

1. Agrios, G.N. 1997 Plant Pathology, 4th edition, Academic Press, U.K.

2. Alexopoulos, C.J., Mims, C.W., Blackwell, M. (1996). Introductory Mycology, John Wiley & Sons (Asia) Singapore. 4th edition.

3. Webster, J. and Weber, R. (2007). Introduction to Fungi, Cambridge University Press, Cambridge. 3rd edition.

4. Sethi, I.K. and Walia, S.K. (2011). Text book of Fungi and Their Allies, Macmillan Publishers India Ltd. 5. Sharma, P.D. (2011). Plant Pathology, Rastogi Publication, Meerut, India.

Session 2025-26	
Part A	

Subject	**Botany**		
Name of the Course	Fundamentals of Genetics		
Semester	3rd		
Course Code/ID	250/BOT/CC303		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	CC-A9		
Level of the course(As per Annexure-I)			
Pre-requisite for the course(if any)			
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5

Theory	
Max. Marks: 75 Internal Assessment Marks:25 End Term Exam Marks: 50	Time: 2Hours

PRACTICAL	
Max. Marks: 25 Internal Assessment Marks:5 End Term Exam Marks: 20	Time: 2Hours

Part B- Contents of the Course

Instructions for Paper-Setter

Nine questions will be set in all. All questions will carry equal marks.
Question No.1 will be short answer type covering the entire syllabus and will be compulsory. The remaining eight questions will be set unit wise selecting two questions from each unit. The candidate will be required to attempt question No. 1 and four more questions selecting one question from each unit.

Unit	Topic	Contact Hours
I	**Mendelism**: History; Principles of inheritance; Chromosome theory of inheritance; Autosomes and sex chromosomes; Probability and pedigree analysis; Incomplete dominance and codominance; Multiple alleles, Lethal alleles, Epistasis, Pleiotropy, Recessive and Dominant traits, Penetrance and Expressivity, Polygenic inheritance.	11
II	**Extrachromosomal Inheritance** - Chloroplast mutation: Variegation in Four o'clock plant; Mitochondrial mutations in yeast; Maternal effects-shell coiling in snail; Infective heredity-Kappa particles in Paramecium. **Linkage, crossing over and chromosome mapping**- Linkage and crossing over-Cytological basis of crossing over; Recombination frequency, two factor and three factor crosses; Interference and coincidence; Numericals based on gene mapping; Sex Linkage.	12
III	**Chromosomal Mutations**: Deletion, Duplication, Inversion, Translocation, Aneuploidy and Polyploidy; **Gene mutations**- Types of mutations; Molecular basis of	12

7/2/25

	Mutations; Mutagens – physical and chemical (Base analogs, deaminating, alkylating and intercalating agents); Detection of mutations: ClB method, Attached X method. Role of Transposons in mutation. DNA repair mechanisms, Sex Determination, Environmental factors determining sex determination, Barr bodies, Dosage compensation.	
IV	**Extrachromosomal Inheritance** -Chloroplast mutation: Variegation in Four o'clock plant; Mitochondrial mutations in yeast; Maternal effects-shell coiling in snail; Infective heredity-Kappa particles in Paramecium **Population and Evolutionary Genetics**- Allele frequencies, Genotype frequencies, Hardy-Weinberg Law, role of natural selection mutation, genetic drift. Genetic variation and Speciation.	11
V*	11. Mendel's laws through seed ratios. Laboratory exercises in probability and chi-square analysis. 12. Chromosome mapping using test cross data. 13. Pedigree analysis for dominant and recessive autosomal and sex linked traits. 14. Incomplete dominance and gene interaction through seed ratios (9:7, 9:6:1, 13:3, 15:1, 12:3:1, 9:3:4) 15. Blood Typing: ABO groups & Rh factor. 16. Study of aneuploidy: Down's, Klinefelter's and Turner's syndromes. 17. Photographs/Permanent Slides showing Translocation Ring, Laggards and Inversion Bridge. 18. Study of Human and Phlox/ Allium Karyotype (normal and abnormal).	30

Recommended Books/e-resources/LMS:

1. Gardner, E.J., Simmons, M.J., Snustad, D.P. (2008). VIII ed. Principles of Genetics. Wiley India.

2. Snustad, D.P., Simmons, M.J. (2009). Principles of Genetics.V Edition. John Wiley and Sons Inc.

3. Klug, W.S., Cummings, M.R., Spencer, C.A. (2009). Concepts of Genetics.XI Edition. Benjamin Cummings.

4. Russell, P. J. (2009). iGenetics- A Molecular Approach. III Edition. Benjamin Cummings.

5. Glick, B.R., Pasternak, J.J. (2003). Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington.

6. Pevsner, J. (2009). Bioinformatics and Functional Genomics.II Edition. John Wiley & Sons.

7. Griffiths, A.J.F., Wessler, S.R., Lewontin, R.C. and Carroll, S.B. IX Edition. Introduction to Genetic Analysis.

	Mutations; Mutagens – physical and chemical (Base analogs, deaminating, alkylating and intercalating agents); Detection of mutations: ClB method, Attached X method. Role of Transposons in mutation. DNA repair mechanisms, Sex Determination, Environmental factors determining sex determination, Barr bodies, Dosage compensation.	
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V*	11. Mendel's laws through seed ratios. Laboratory exercises in probability and chi-square analysis. 12. Chromosome mapping using test cross data. 13. Pedigree analysis for dominant and recessive autosomal and sex linked traits. 14. Incomplete dominance and gene interaction through seed ratios (9:7, 9:6:1, 13:3, 15:1, 12:3:1, 9:3:4) 15. Blood Typing: ABO groups & Rh factor. 16. Study of aneuploidy: Down's, Klinefelter's and Turner's syndromes. 17. Photographs/Permanent Slides showing Translocation Ring, Laggards and Inversion Bridge. 18. Study of Human and Phlox/ Allium Karyotype (normal and abnormal).	30

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2. Snustad, D.P., Simmons, M.J. (2009). Principles of Genetics.V Edition. John Wiley and Sons Inc.

3. Klug, W.S., Cummings, M.R., Spencer, C.A. (2009). Concepts of Genetics.XI Edition. Benjamin Cummings.

4. Russell, P. J. (2009). iGenetics- A Molecular Approach. III Edition. Benjamin Cummings.

5. Glick, B.R., Pasternak, J.J. (2003). Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington.

6. Pevsner, J. (2009). Bioinformatics and Functional Genomics.II Edition. John Wiley & Sons.

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2. Snustad, D.P., Simmons, M.J. (2009). Principles of Genetics.V Edition. John Wiley and Sons Inc.

3. Klug, W.S., Cummings, M.R., Spencer, C.A. (2009). Concepts of Genetics.XI Edition. Benjamin Cummings.

4. Russell, P. J. (2009). iGenetics- A Molecular Approach. III Edition. Benjamin Cummings.

5. Glick, B.R., Pasternak, J.J. (2003). Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington.

6. Pevsner, J. (2009). Bioinformatics and Functional Genomics.II Edition. John Wiley & Sons.

7. Griffiths, A.J.F., Wessler, S.R., Lewontin, R.C. and Carroll, S.B. IX Edition. Introduction to Genetic Analysis.

	Mutations; Mutagens – physical and chemical (Base analogs, deaminating, alkylating and intercalating agents); Detection of mutations: ClB method, Attached X method. Role of Transposons in mutation. DNA repair mechanisms, Sex Determination, Environmental factors determining sex determination, Barr bodies, Dosage compensation.	
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2. Snustad, D.P., Simmons, M.J. (2009). Principles of Genetics.V Edition. John Wiley and Sons Inc.

3. Klug, W.S., Cummings, M.R., Spencer, C.A. (2009). Concepts of Genetics.XI Edition. Benjamin Cummings.

4. Russell, P. J. (2009). iGenetics- A Molecular Approach. III Edition. Benjamin Cummings.

5. Glick, B.R., Pasternak, J.J. (2003). Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington.

6. Pevsner, J. (2009). Bioinformatics and Functional Genomics.II Edition. John Wiley & Sons.

7. Griffiths, A.J.F., Wessler, S.R., Lewontin, R.C. and Carroll, S.B. IX Edition. Introduction to Genetic Analysis.

Session 2025-26			
Part A			
Subject	**Botany**		
Semester	4th		
Name of the Course	**Diversity of Bryophytes and Pteridophytes**		
Course Code/ID	250/BOT/CC401		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	CC-A10		
Level of the course(AsperAnnexure-I)			
Pre-requisite for thecourse(if any)			
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to 19. Students will be able to learn classification , Habit, Habitat, lifecycle of Bryophytes and Pteridophytes. 20. Students will be able to learn about the ecological and economic importance of Bryophytes and Pteridophytes. 21. Morphology and reproductive structure of some of the selected bryophytes and pteridophytes will be studied by the students.		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
Theory			
Max. Marks: 75 Internal Assessment Marks:25 End Term Exam Marks: 50	Time: 2Hours		
Practical			
Max. Marks: 25 Internal Assessment Marks:5 End Term Exam Marks: 20	Time: 2 Hours		

Part B- Contents of the Course

Instructions for Paper-Setter

Nine questions will be set in all. All questions will carry equal marks.
Question No.1 will be short answer type covering the entire syllabus and will be compulsory. The remaining eight questions will be set unit wise selecting two questions from each unit. The candidate will be required to attempt question No. 1 and four more questions selecting one question from each unit.

Unit	Topic	Contact

19/14/25

		Hours
I	Characteristic features and life cycle patterns of Bryophytes. Classification; Habit and Habitat; Adaptations to land habit. Evolution of sporophyte. Ecological and Economic importance of Bryophytes.	11
II	Comparative account of Morphology and Anatomy of *Riccia, Marchantia, Pellia, Porella, Anthoceros, Sphagnum* and *Funaria;* Reproduction and evolutionary trends in *Riccia, Marchantia, Anthoceros and Funaria* (developmental stages not included).	12
III	Characteristic features and life cycle patterns of Pteridophytes. Evolutionary concepts in Pteridophytes: Telome theory; Stelar evolution; Heterospory and seed habit Apogamy and Apospory. Ecological and Economic importance of Pteridophytes.	10
IV	Comparative account of Morphology and Anatomy of *Rhynia, Psilotum, Selaginella, Equisetum, Pteris, Marsilea*; Reproduction and evolutionary trends in *Selaginella*; *Equisetum; and Pteris* (developmental details not included).	12
V*	1. *Riccia* – Morphology of thallus (permanent slide). 2. *Marchantia*- Morphology of thallus, whole mount of rhizoids & Scales, vertical section of thallus through Gemma cup, whole mount of Gemmae (all temporary slides), vertical section of Antheridiophore, Archegoniophore, longitudinal section of Sporophyte (all permanent slides). 3. *Anthoceros*- Morphology of thallus, dissection of sporophyte (temporary slide), vertical section of thallus (permanent slide). 4. *Pellia, Porella*- Permanent slides. 5. *Sphagnum*- Morphology of plant, whole mount of leaf (permanent slide only). 6. *Funaria*- Morphology, whole mount of leaf, rhizoids, operculum, peristome, annulus, spores (temporary slides); permanent slides showing capsule section. 7. *Psilotum*- Study of specimen, transverse section of synangium (permanent slide). 8. *Selaginella*- Morphology, whole mount of leaf with ligule, transverse section of stem,whole mount of strobilus, whole mount of microsporophyll and megasporophyll (temporary slides), longitudinal section of strobilus (permanent slide). 9. *Equisetum*- Morphology, transverse section of internode, longitudinal section of strobilus, transverse section of strobilus, whole mount of sporangiophore, whole mount of spores (temporary slide), transverse section of rhizome (permanent slide). 10. *Pteris*- Morphology, transverse section of rachis, vertical section of sporophyll, wholemount of sporangium, whole mount of spores (temporary slides), transverse section of rhizome, whole mount of prothallus with sex organs and young sporophyte (permanent slide). Botanical excursion	30

Recommended Books/e-resources/LMS:

1. Buchanan, B., Gruissem, W. and Jones, R. (2000) Biochemistry and Molecular Biology of Plants. American Society of Plant Biologists.

2. Raven, P.H., Johnson, G.B., Losos, J.B. and Singer, S.R. (2005) Biology. Tata MC Graw Hill.

3. Richardson, D.H.S. (1981) The Biology of Mosses. John Wiley and Sons, New York.

4. Sambamurty (2008) A Textbook of Bryophytes, Pteridophytes, Gymnosperms and Paleobotany. IK International Publishers.

5. Shaw, A.J. and Goffinet, B. (2000) Bryophyte Biology. Cambridge University Press.

6. Vander-Poorteri (2009) Introduction to Bryophytes. COP.

7. Parihar, N.S. 1991. Bryophytes. Central Book Depot, Allahabad. 8. Parihar, N.S. 1996. The Biology and Morphology of Pteridophytes. Central Book Depot, Allahabad

Session 2025-26			
Part A			
Subject	**Botany**		
Semester	4th		
Name of the Course	**Diversity of Gymnosperm and Paleobotany**		
Course Code/ID	250/BOT/CC402		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	CC-A11		
Level of the course(AsperAnnexure-I)			
Pre-requisite for thecourse(if any)			
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to- 22. Students will be able about the evolution of Gymnosperms. 23. Students will gain knowledge about the classification, distribution of the Gymnosperm. 24. Students gain insights on Fossils and their techniques to study them. 25. Students will learn the economic importance of the Gymnosperms.		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
Theory			
Max. Marks: 75 Internal Assessment Marks:25 End Term Exam Marks: 50	Time:2Hours		
Practical			
Max. Marks: 25 Internal Assessment Marks:5 End Term Exam Marks: 20	Time:2Hours		

Part B- Contents of the Course

Instructions for Paper-Setter

Nine questions will be set in all. All questions will carry equal marks.
Question No.1 will be short answer type covering the entire syllabus and will be compulsory. The remaining eight questions will be set unit wise selecting two questions from each unit. The candidate will be required to attempt question No. 1 and four more questions selecting one question from each unit.

Unit	Topic	Contact

19/11/25

		Hours
I	General account of fossils, techniques used to study fossil. Evolution of gymnosperms. Classification and distribution of Gymnosperms in India. Contribution of Prof. Birbal Sahni.	10
II	Characteristic features and life cycle patterns of Gymnosperms. Patterns of variation in morphology of gymnosperms. Ecological and Economic importance of Gymnosperms.	11
III	*Cycas*- Morphology and anatomy of coralloid roots, bulbil, leaf, root, rachis, leaflet, stem, microsporophyll and megasporophyll, reproductive structures (male and female cone), ovule and Seed. *Pinus*- Morphology and anatomy of long and dwarf shoots, root, needle, stem, microsporophyll, megasporophyll male and female cones, Microspores, Megaspore, Ovule and seed. (developmental stages and EM studies not included).	13
IV	*Ephedra*- Morphology, and anatomy of root, stem and leaf. Reproductive structure of male and female strobilus, ovule and seed. Morphology and anatomy of *Gnetum.* (developmental stages and EM studies not included). Modern methods of propagation of gymnosperms: somatic embryogenesis, haploids and protoplast culture.	11
V*	Study of habit, structure and reproductive structures of *Cycas, Pinus, Ephedra, Gnetum** temporary mounts and permanent slides (Fresh material whichever available). *Only through permanent slides *Cycas*- Morphology (coralloid roots, bulbil, leaf), whole mount of microsporophyll, transverse section of coralloid root, transverse section of rachis, vertical section of leaflet, vertical section of microsporophyll, whole mount of spores (temporary slides), longitudinal section of ovule, transverse section of root (permanent slide). *Pinus*- Morphology (long and dwarf shoots, whole mount of dwarf shoot, male and female cones, transverse section of Needle, transverse section of stem, longitudinal/ transverse section of male cone, whole mount of microsporophyll whole mount of Microspores (temporary slides), longitudinal section of female cone, tangential longitudinal section and radial longitudinal sections stem (permanent slide) *Ephedra*- Morphology, transverse section stem, Vertical section leaf. Male and Female cone. *Gnetum*- Morphology (stem, male & female cones), transverse section of stem, vertical section of ovule (permanent slide), Study of fossils through Photographs/Specimens/Herbarium Botanical excursion	30

Recommended Books/e-resources/LMS:

1. Bhatnager, S.P. and Moitra, A. (1996) Gymnospersm. New Age International (P) Ltd. Publishers, New Delhi.

2. Buchanan, B., Gruissem, W. and Jones, R. (2000) Biochemistry and Molecular Biology of Plants. American Society of Plant Biologists.

3. Raven, P.H., Johnson, G.B., Losos, J.B. and Singer, S.R. (2005) Biology. Tata MC Graw Hill.

4. Richardson, D.H.S. (1981) The Biology of Mosses. John Wiley and Sons, New York.
5. Sambamurty (2008) A Textbook of Bryophytes, Pteridophytes, Gymnosperms and Paleobotany.IK International Publishers. 6. Bhatnagar SP and Mohitra A 1996 Gymnosperms. New Age Publishers, New Delhi

Session 2025-26	
Part A	
Subject	**Botany**
Semester	4th
Name of the Course	**Reproductive Biology of Angiosperm**
Course Code/ID	250/BOT/CC403
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	CC-A12
Level of the course(AsperAnnexure-I)	
Pre-requisite for thecourse(if any)	
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to-

	26. Student would have an understanding of - Induction of flowering and molecular and genetic aspects of flower development. 27. Students will gain knowledge on Pollen development, dispersal and pollination. 28. Students will be able to understand Ovule development, fertilization, Endosperm development and its importance 29. Students will be able to learn pathways of reproduction. 30. Student would be able to apply this knowledge for conservation of pollinators and fruit development

Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5

THEORY	
Max. Marks: 75 Internal Assessment Marks:25 End Term Exam Marks: 50	Time: 2Hours

PRACTICAL	
Max. Marks: 25 Internal Assessment Marks:5 End Term Exam Marks: 20	Time: 2Hours

Part B- Contents of the Course

Instructions for Paper-Setter

Nine questions will be set in all. All questions will carry equal marks.
Question No.1 will be short answer type covering the entire syllabus and will be compulsory. The remaining eight questions will be set unit wise selecting two questions from each unit. The candidate will be required to attempt question No. 1 and four more questions selecting one question from each unit.

Unit	Topic	Contact Hours
I	**Introduction**: History and scope, Anther: Structure, ontogeny; tapetum; structure and functions; micro-sporogenesis; callose deposition and its significance, Microgametogenesis, pollen wall development, MGU (male germ unit) structure, NPC system, pollen wall proteins; pollen viability, storage and germination; pollen tube structure.	11
II	**Ovule:** Structure, ontogeny, types; special structures – endothelium, operculum, obturator, aril, arillode, caruncle, hypostase, epistase: female gametophyte –megasporogenesis and megagametogenesis: organization and ultra structure of mature embryo sac.	11
III	**Pollination and Fertilization**: Pollination types and	11

	significance; adaptations; pollination biology; pollen-pistil Interaction; structure of stigma and style; double fertilization. Self Incompatibility: Basic concepts; methods to overcome self incompatibility	
IV	**Endosperm:** Types, development and functions; endosperm haustoria. Embryogenesis: Classification, development, organization and differentiation of crucifer and Najas embryo; embryo– endosperm relationship; physiological and genetical control. **Polyembryony and Apomixes**: Introduction; classification; causes and applications. Development of seed, modes of seed dispersal.	12
V*	1. Photographs of eminent embryologists. 2. Anther: wall and its ontogeny; tapetum; microsporogenesis, stages (slides and fresh material). 3. Pollen grains: fresh and acetolysed, ornamentation and aperture; pollen viability: tetrazolium test. 4. Pollen germination: in different media; calculation of percentage germination; male germ unit (MGU): through photographs. 5. Ovule: types; unitegmic, bitegmic; tenuinucellate and crassinucellate (permanent slides/ specimens/photographs). 6. Female gametophyte through permanent slides/ photographs: types and ultrastructure of mature embryo sac. 7. Style and stigma through suitable preparations: unpollinated and pollinated stigma and style; wet and dry stigma; hollow and solid styles; tracing and path of pollen tube. 8. Intra-ovarian pollination; test tube pollination/ fertilization: through photographs. 9. Endosperm: dissections of developing seeds for free-nuclear endosperm with haustoria; types (permanent slides). 10. Embryogenesis: study of development of dicot embryo through permanent slides; dissection of developing seeds for embryos at various developmental stages; study of suspensor through electron micrographs.	30

Recommended Books/e-resources/LMS:

1. Raghavan, V. (2000) Developmental Biology of Flowering plants, Springer, Netherlands.
2. Raghavan, V. (1997) Molecular embryology of flowering plants. Cambridge, University Press.
3. Shivanna, K.R. (2003) Pollen Biology and Biotechnology, Science Publishers.
4. Bhojwani, S.S. and Bhatnagar SP (2004) The Embryology of Angiosperms, Vikas Publishing House
5. Johri, B.M. (1984), Embryology of Angiosperms, Springer-Verlag, Netherlands.